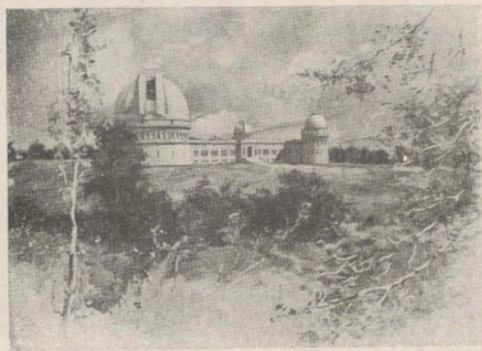


An Illustrated Catalogue
of
Astronomical Photographs

including

Lantern Slides, Transparencies, and Prints
from Negatives Made at the
Yerkes Observatory



Third Edition

April 1923

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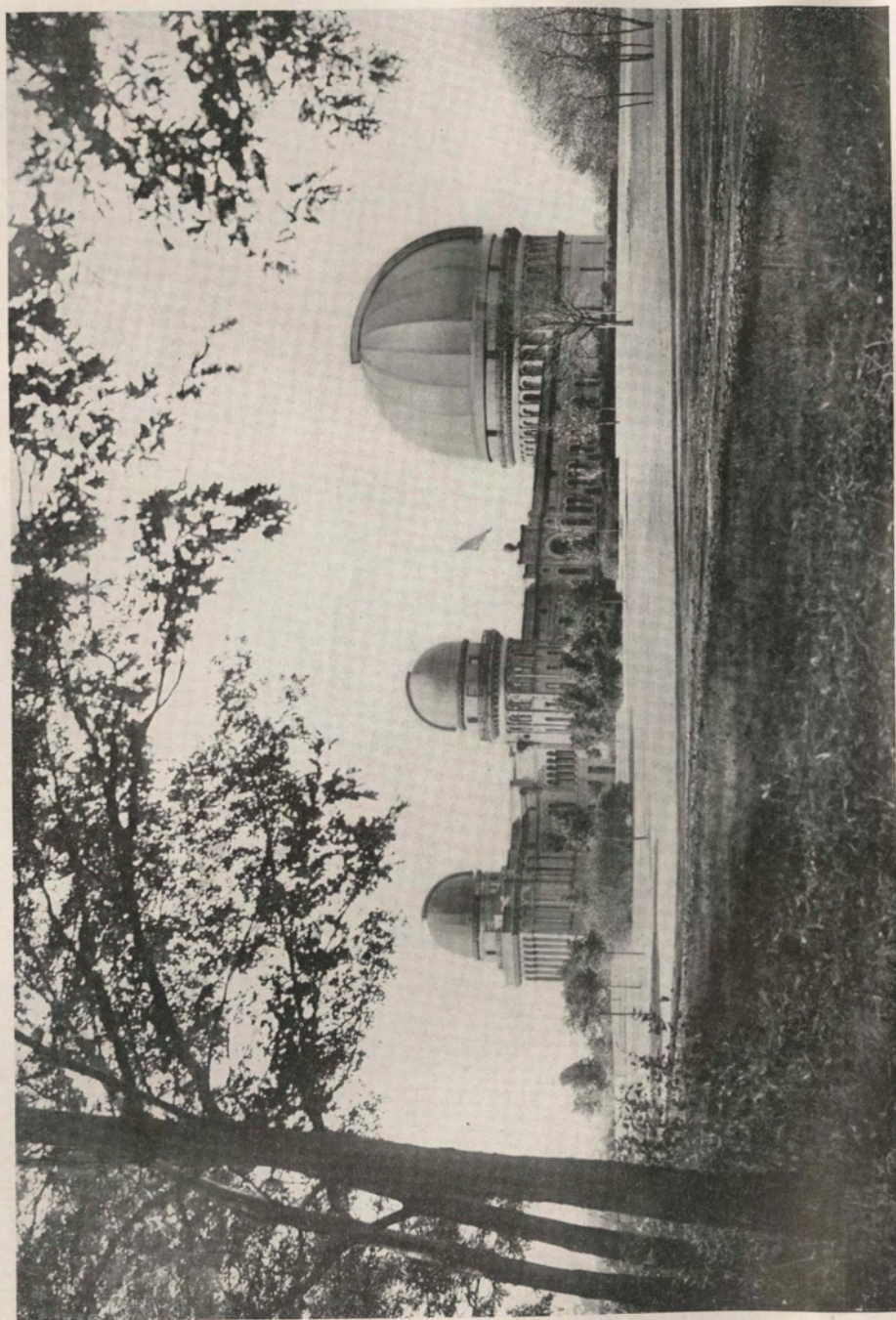


FIG. 1.—The Yerkes Observatory from the Northeast. BI19

Since 1903, the Yerkes Observatory of the University of Chicago has been reproducing in lantern slides, transparencies, and prints the original astronomical photographs made at Williams Bay. In this catalogue these reproductions are listed for the convenience of the general public, and for the scientist, the student, and the lecturer, in whose work these scientifically accurate illustrations are of service. Orders for these photographs will be filled promptly by the University of Chicago Press, to which all communications should be addressed.

LANTERN SLIDES. The lantern slides are uniformly $4 \times 3\frac{1}{4}$ inches in size. In addition to the negatives listed, a large number, suitable for reproduction, are available for those who wish to make an intensive study of some particular subject. All illustrations appearing in the *Astrophysical Journal*, except those supplied by other observatories, can be furnished at regular rates. Illustrations from textbooks can, in many cases, be supplied at prices intended to cover the cost.

The frequent call for small sets of slides for school and lecture purposes has led to the preparation of a selected list of 100 representative slides, an abridged catalogue of which may be obtained upon request to the University of Chicago Press, 5750 Ellis Avenue, Chicago, where this set may be examined. Each slide included in this set is marked in the present listing with an asterisk (*). A short description, consisting of about 200 words, of each title in this selected 100 has been printed on cards for the convenience of lecturers and teachers.

Prices: Lantern slides are 75 cents each. Certain slides may be colored to order, at an extra charge of 75 cents for spectra and buildings, and 50 cents for all others. It has been found impracticable to rent slides. Card descriptions of the 100 list are 5 cents each, or \$2.50 per set.

PRINTS AND TRANSPARENCIES. Prints as well as slides can be furnished, and for many subjects window transparencies are also supplied. The approximate sizes of the prints are given in inches for each number, the width being given first. Prints of other sizes can be supplied only at an increase in price.

Prices: Unmounted prints, matt or glossy, are 50 cents each. Bromide enlargements can be made of many subjects at prices which will be given on application.

Transparencies are made to order as follows: 8×10 , \$2; 10×12 , \$3; 11×14 , \$4; 14×17 , \$6; 18×22 , \$10. An extra charge of 20 per cent is made if furnished with ground-glass back, bound by passepartout strips.

Please order by number. For the convenience of previous purchasers, former numbers are inclosed in brackets. The following abbreviations used throughout the catalogue designate references to articles in which the photographs have been published with a description:

Ap.J. = *Astrophysical Journal*.

A.N. = *Astronomische Nachrichten*.

Mem. Spett. Ital. = *Memorie della Società degli Spettroscopisti italiani*.

M.N. = *Monthly Notices of the Royal Astronomical Society*.

Pop. Astron. = *Popular Astronomy*.

Proc. Amer. Phil. Soc. = *Proceedings of the American Philosophical Society* (Philadelphia).

Pub. Y.O. = *Publications of the Yerkes Observatory*.

Carriage on all orders is charged to the purchaser.

THE SUN

(Direct photographs taken by Fox, with the 40-inch refractor, unless otherwise specified)

- S₁ [342]. Entire disk showing spots and granulation. July 30, 1906. 8×10.
 S₃ [305]. Great spot of February, 1907. Taken with the Easton photoheliograph. 7×3.
 *S₄ [327]. Great spot of July, 1905. 8×10.
 *S₅ [306]. Sun's disk. Double slide giving comparison of high-level spectroheliogram with direct photograph. February 12 and 13, 1907. 9×4.
 S₇. Entire disk with huge spot, February 9, 1917. Taken by Miss Calvert with 12-inch refractor. 7×7.
 *S₉. Entire disk with large spot and many smaller spots, August 7, 1917. Taken by Miss Calvert with 12-inch refractor. 7×7.
 S₁₄. Copies on glass from negatives of the sun made with the 12-inch telescope. Diameter 2 inches. These have been prepared for the use of students for determining heliographic position of spots and for measuring the rotation of the sun. 4×5.
 S₁₆. Rotation of sun shown by four exposures of disk. Photographed by Miss Calvert with 12-inch telescope on March 2, 3, 4, and 5, 1922. 10×8.

SPECTROHELIOGRAMS OF THE DISK

(Taken with the Rumford Spectroheliograph attached to the 40-inch refractor, by Hale and Ellerman, Fox, Slocum, Lee, and Pettit)

- S₅ [306]. Comparison of high-level spectroheliogram with direct photograph of entire disk, February 12 and 13, 1907. 9×4.
 S₇₈. Spectroheliograms of the sun's disk with brilliant flocculi on eight successive days to illustrate solar rotation. (*Pub. Y.O.*, 3, Pl. XXV.) 10×6.
 *S₆ [21]. Entire disk, showing brilliant calcium flocculi, August 12, 1903. 8×10.
 S₇₉. Entire disk with large spots and large areas of flocculi, August 31, 1908. 8×10.
 S₃₇ [27]. Minute structure of calcium flocculi, similar to granulation of the photosphere, August 6, 1903, low level. 7×4.
 S₃₈ [648]. Minute structure of calcium flocculi, similar to granulation of the photosphere, September 22, 1903, high level. (*Ap.J.*, 19, Pl. II.) 6×3.
 S₆₆ [31]. Spot of April 29, 1903, showing faculae photographed with light of continuous spectrum. (*Ap.J.*, 19, Pl. VI.) 5×4.
 S₄₂ [32]. The same, showing low-level calcium vapor in flocculi. (*Ap.J.*, 19, Pl. VI.) 7×5.
 S₄₃ [33]. The same, showing calcium vapor at higher level, partially covering the spot. (*Ap.J.*, 19, Pl. VII.) 7×5.
 S₄₄ [34]. The same, high-level calcium vapor, with slit at center of K line. (*Ap.J.*, 19, Pl. VII.) 7×5.
 S₄₉ [39]. Spot of July 7, 1903, showing low-level calcium vapor. 5×7.
 S₅₀ [40]. The same, showing high-level calcium vapor. (*Ap.J.*, 19, Pl. X, Fig. 1.) 6×4.
 S₅₁ [41]. The same, showing dark hydrogen flocculi photographed with H β line. 5×4.

- S52 [42]. The same, showing dark and bright hydrogen flocculi photographed with $H\gamma$ line. (*Ap. J.*, 19, Pl. X, Fig. 2.) 5×4 .
- S53 [43]. Combination showing very dark hydrogen flocculus and dark calcium flocculus at same point on the photosphere, June 17, 1903. (*Ap. J.*, 19, Pl. XIII.) 5×3 .
- S54 [44]. Combination showing spot surrounded by dark hydrogen flocculus and bright calcium flocculus, July 2, 1903. 6×4 .

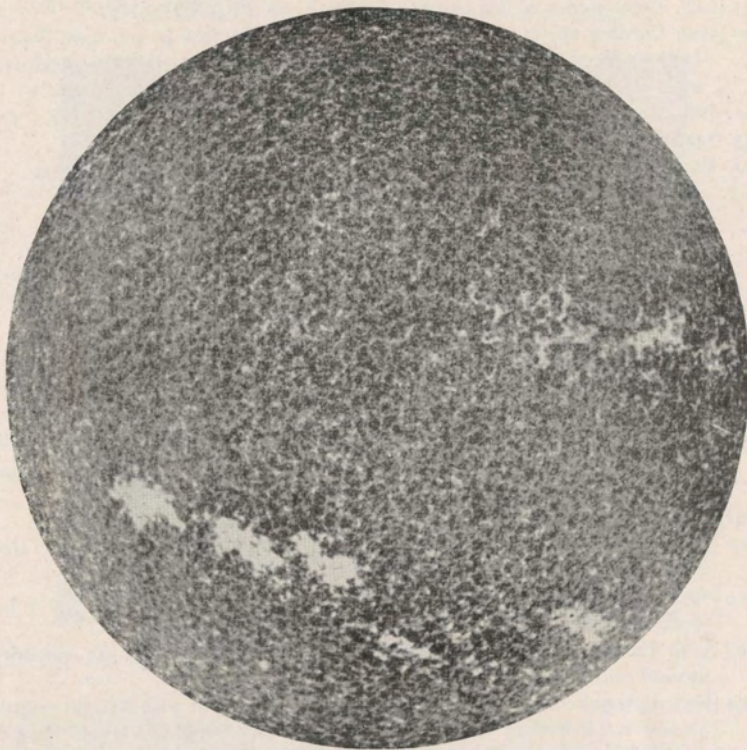


FIG. 2.—Disk, Showing Brilliant Calcium Flocculi. No. S6

- S55 [45]. Combination showing rapid development of spot group with brilliant flocculi, July 23, 24, and 25, 1903. 9×3 .
- S56 [609]. Great spot group of October, 1903. High level. (*Pub. Y.O.*, 3, Pt. 1, Pl. XIV.) 10×8 .
- S57 [610]. The same, low level. (*Pub. Y.O.*, 3, Pl. XII, Fig. 1.) 10×8 .
- S59 [325]. Sun-spot and flocculi. Five views at different levels. Taken with the slit at various distances from center of H line, August 25, 1904. (*Ap. J.*, 21, 351.) 6×9 .
- S58. A similar series, taken August 22, 1919, at four levels. 7×10 .

- S60 [415]. Spectroheliograms illustrating development of spot and rotation of sun, May 6-13, 1907. (*Ap. J.*, 29, Pl. I.) 8×6.
- S61 [527]. Growth and subsidence of eruption 140,000 miles long connecting two sun-spots. (*Ap. J.*, 29, Pls. II and III.) 8×6.
- S64 [560]. Hydrogen spectroheliogram showing oppositely directed vortices in the two hemispheres, August 31, 1908. (*Ap. J.*, 28, Pl. XX, Fig. 5.) 4×5.
- S65 [561]. Calcium spectroheliogram covering the same region as No. S64. (*Ap. J.*, 28, Pl. XX, Fig. 6.) 4×5.
- *S41 [608]. Combination of S64 and S65. (*Ap. J.*, 28, Pl. XX.) 9×7.
- S67 [562]. Calcium spectroheliogram showing spiral structure in sun-spot, September 24, 1909. This spot was contemporaneous with the great terrestrial magnetic storm of September 25. (*Ap. J.*, 31, 26.) 4×5.
- S71. Enlargement of large spot, August 8, 1917. 86,000 miles in diameter. 3×3.
- S73. Large spots overlaid with calcium vapor, August 10, 1917. 8×10.
- S77. Enormous spot of August 20, 1919 (spectroheliogram enlarged). 3×3.

SPECTROHELIOGRAMS OF PROMINENCES

(Taken with Rumford spectroheliograph in the light of the H line of calcium, unless otherwise specified. By Fox, Slocum, Lee, and Pettit)

- S90 [591]. Solar prominences around entire disk, August 13, 1908. 8×10.
- S116. The same, April 1, 1916. 8×10.
- S93 [418]. Eruptive prominence showing great changes. Four views. May 21, 1907. (*Ap. J.*, 26, 155.) 7×8.
- *S95 [428]. Combination of eruptive prominence and spectroheliogram of the disk showing relation between the prominence and the spots and flocculi. August 14, 1907. (*Ap. J.*, 28, Pl. XVIII, Fig. 1.) 6×5.
- S102 [598]. Enlargement of large prominence of July 27, 1908. 3×2.
- S100 [530]. Combination of nine views of the prominence of July 25-29, 1908. (*Mem. Spett. Ital.*, 37, 184.) 6×9.
- *S99 [593]. Arc of prominences, showing current in opposite directions from center outward. (*Ap. J.*, 33, Pl. VIII, No. 7; a detail of S123.) 4×2.
- S103 [594]. Prominences. Fine detail, showing currents in opposite directions toward center, July 22, 1908. 4×1.
- S104 [595]. Low quiescent prominence, showing strong current with straight eruptive prominence in background, August 22, 1907. A detail of No. S122. (*Ap. J.*, 33, Pl. VII, No. 5.) 3×1.
- S122 [649]. Combination of six prominences indicating horizontal currents in the solar atmosphere. (*Ap. J.*, 33, Pl. VII.) 7×5.
- S123 [650]. The same. Second series. (*Ibid.*, Pl. VIII.) 7×5.
- S130. "Banyan" prominence of March 17-April 28, 1910. Five views. 5×7.
- S134. The same, showing rapid changes on March 17 and 18, 1910. 6×8.
- S131. Eruptive prominence which disappeared within three hours, March 25, 1910. (*Ap. J.*, 32, 127.) 5×9.
- S120 [611]. Large prominence with very fine detail, October 10, 1910, showing changes in ten minutes. (*Ap. J.*, 34, 296.) 4×5.
- S133. Prominence of June 19-20, 1911, 2^h 18^m to 5^h 35^m, G.M.T. Nine views. (*Ap. J.*, 35, Pl. XV.) 10×6.

- SI35. The same. $5^h 58^m$ to $9^h 10^m$, G.M.T. Nine views. (*Ap. J.*, 35, Pl. XVI.) 10×6 .
- SI36. The same. June 19, $9^h 45^m$ to June 20, $4^h 58^m$ G.M.T. Nine views. (*Ap. J.*, 35, Pl. XVII.) 10×6 .
- SI37. Prominence of October 8, 1910. Six views showing attraction of sun-spots for prominences. (*Ap. J.*, 36, Pl. XI.) 9×6 .
- SI24. Prominences of October 22, 1910, showing attraction of sun-spot for prominences with inrush of calcium vapor at velocity of 100 km per second. (*Ap. J.*, 36, Pl. XIII.) 4×6 .



FIG. 3.—Eruptive Prominence and Disk. No. S95

- SI41. Massive prominence, July 6, 1915. 5×4 .
- SI38. Unusual jetlike prominence, 200,000 km in height, April 19, 1916. 4×5 .
- SI39. Striking prominence of massive and jetlike types, June 28, 1916. Combination of two photographs showing marked changes in 35 minutes. 10×8 .
- SI40. A quadrant nearly covered with prominences of varying types, November 2, 1916. 10×8 .
- SI27. Prominence, August 1, 1917. 5×4 .
- SI29. Prominence, August 10, 1917. 5×4 .
- S231. Prominences around the sun, eclipse of June 8, 1918. 8×10 .
- *S214. "Heliosaurus" prominence at eclipse of June 8, 1918. 10×6 .
- *SI51. Extraordinary prominence of May 29, 1919. Five views, showing great changes. (*Ap. J.*, 50, 206.) 8×10 .
- SI48. The same, first three views only. (*Ap. J.*, 50, Pl. IV.) 4×9 .

S149. The same, last two views only. The enlargement of S148 and S149 is no greater than that of S151. (*Aph. J.*, 50, Pl. V.) 4×9.

S157. Prominence of July 15, 1919. Three views showing increase in height of 200,000 km in one hour. (*Aph. J.*, 50, Pl. VI.) 6×10.

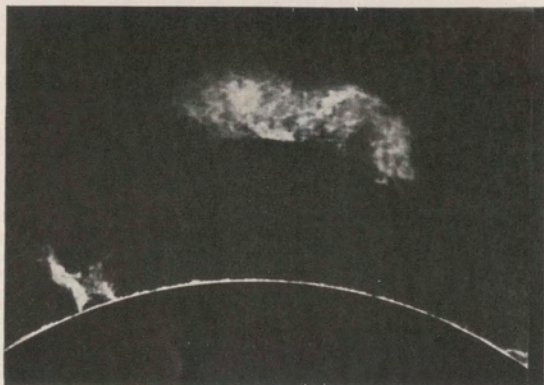


FIG. 4.—Solar Prominence of May 29, 1919. From S151

S160. Prominence of October 6 and 7, 1920, over spot group, which is also shown as photographed October 2. 8×4.

S161. Extraordinary prominence of October 8, 1920, showing rapid increase in height to 286,000 miles. Forty minutes later it reached 517,000 miles, the greatest height ever recorded. 10×8.

SOLAR SPECTRUM

S172 [664]. H and K region, showing bright reversals combined with high-level spectroheliogram of flocculi, showing location of the slit. Photographed September 28, 1910, by Slocum with the Rumford spectroheliograph. 4×5.

S173 [430]. Spot spectrum, with spectrum of the photosphere for comparison, showing altered lines. Region of wave-lengths 5040 to 5150. Taken with horizontal spectrograph in Snow building by Fox. (Other regions furnished if desired.) 9×2.

*S175. Visual solar spectrum, after G. Müller. (If colored, 75 cents extra.) 9×2.

S176. Infra-red and visual solar spectrum, after Langley. (The short visual region may be colored, if desired, for 50 cents extra.) 9×3.

S177. Selected sections from Rowland's great photographic map of the solar spectrum. Violet and ultra-violet region. 8×7.

S178. The same. Upper strip, the B group in the red, due to oxygen in our atmosphere. Lower strip, region of sodium lines in yellow; center strip, the same greatly enlarged. 8×7.

S179. The same. Region covering orange to deep red. 8×7.

ECLIPSES

- S211. Diagram of tracks of all solar eclipses from 1900 to 1919 (Oppolzer). 8×10 .
 S222. The same, for the years 1919 to 1940. 8×10 .
 S212. Variation of solar corona with sun-spot period (Hansky). 10×8 .
 *S200 [46]. The corona, taken by Barnard and Ritchey, May 28, 1900. 10×8 .
 *S202 [49]. Spectrum of "flash" taken by Frost with concave grating, May 28, 1900.
 (*Ap. J.*, 12, 307.) 3×1 .
 S203 [50]. Spectrum of cusp, taken by Frost with objective-prism ten seconds after third contact, showing the dark lines reversed at the tips of the crescents.
 May 28, 1900. 3×1 .
 S204. Solar corona of 1905. Composite drawing by Captain H. W. Carpenter.
 (*Ap. J.*, 23, 130.) 8×6 .
 S210. Path of total eclipse of June 8, 1918, across the United States. 10×8 .
 S213. The corona of the total solar eclipse of June 8, 1918. Taken through clouds at Green River, Wyoming, by Barnard and Miss Calvert with coelostat and 6-inch lens of $61\frac{1}{2}$ feet focal length. 7×7 .
 *S221. Corona, June 8, 1918, photographed by Edison Pettit at Matheson, Colorado.
 (*Pop. Astron.*, 26, Pl. XVIII.) 10×8 .
 S232. Objective-prism spectrum of corona and prominences, eclipse of June 8, 1918.
 Taken by Parkhurst with 6-inch reflector. 10×8 .
 S233. Spectrum of prominences at eclipse of June 8, 1918, showing ultra-violet lines.
 Enlarged from S232. 10×4 .

See also under Prominences

THE MOON

(Photographed through color-filter with the 40-inch refractor by Ritchey or Slocum)

No.	Moon's Age in Days		No.	Moon's Age in Days	
M1 [52]	7	8×10	*M3 [666]	16	8×10
M4 [53]	$8\frac{1}{2}$	8×10	M5 [667]	$16\frac{3}{4}$	8×8
*M2 [524]	$9\frac{3}{4}$	8×10	M6 [56]	18	8×10
M9 [54]	$11\frac{1}{2}$	8×10	M7 [525]	$20\frac{1}{2}$	8×10
M10	$15\frac{1}{2}$	8×10	M8 [307]	$22\frac{1}{2}$	8×10

(Enlarged details from photographs by Ritchey)

M15 [57]	Mare Imbrium	8×8	*M20 [63]	Tycho, showing ray	
M16 [58]	Mare Nubium	8×10		system	10×8
*M17 [59]	Mare Serenitatis and		M21 [64]	Clavius	8×10
	Mare Tranquillitatis	8×10	M23 [341]	Caucasus and Apen-	
*M18 [61]	Theophilus	7×9		nine mountains	8×8
*M19 [62]	Copernicus	7×9			

(Photographed through color-filter with the 12-inch refractor by Wallace)

No.	Moon's Age in Days		No.	Moon's Age in Days	
*M30 [65]	2	8×10	M35 [74]	$14\frac{1}{2}$	6×6
*M31 [66]	5	8×10	M36 [75]	24	8×10
M32 [67]	6	6×9	M37 [76]	25	4×7
M33 [69]	$7\frac{1}{2}$	7×9	*M38 [77]	27	8×10
*M34 [73]	$12\frac{1}{2}$	7×9			

(Photographed with the 10-inch Bruce telescope by Barnard)

*M45 [438]. Earth-lit new moon ("old moon in the new moon's arms"). February 14, 1907. Shows a slender crescent embracing the earth-lit night portion of the moon. (*Proc. Amer. Phil. Soc.*, 46.) 2×3 .

M47 [565]. The earth-lit, the full, and the totally eclipsed moon, showing the moon as illuminated by reflected, direct, and refracted sunlight. 2×4 .

See also p. [29] for stereoscopic views of the moon

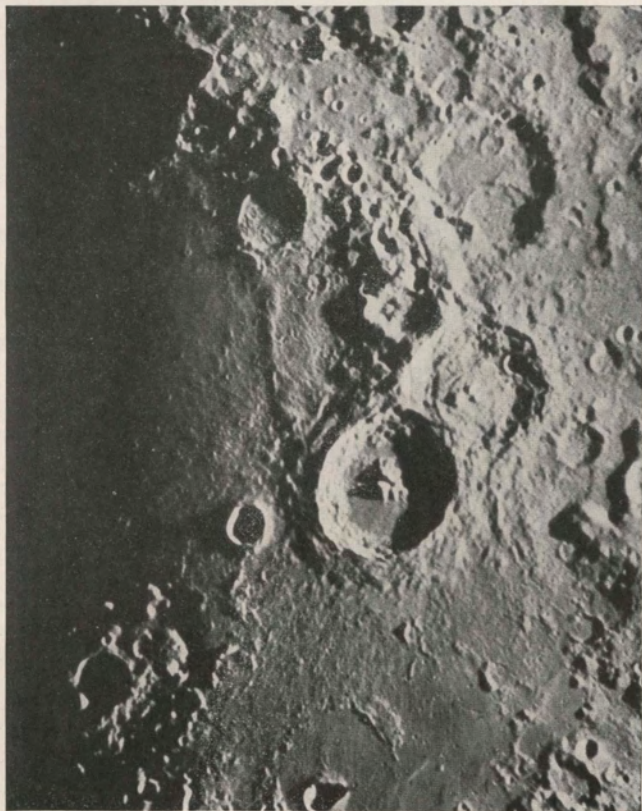


FIG. 5.—Crater Theophilus. No. M18

M49. Three partial phases of the eclipse of May 2, 1920, to indicate sphericity of earth by its curved shadow. 5×2 .

*M50. Total eclipse of the moon with star trails in background. 10×8 .

P25. Conjunction of *Saturn* and the new moon. 3×3 . See also Stereo 23.

P26. Conjunction of the moon, *Mars*, and *Saturn*, April 16, 1911. Photographed with 6-inch Bruce telescope. 6×5 .

- *M60 [284]. Occultation of *Aldebaran* by the moon, March 22, 1904. Shows *Aldebaran* just before immersion, immediately after reappearance, and $1^m 40^s$ later. Wallace. 9×4 .
- P63. Occultation of *Venus* by the moon. Photographed just after emergence by Van Biesbroeck with 24-inch reflector, January 13, 1923. 8×8 .
- M61. Moon as it would appear if its whole disk could be simultaneously illuminated from a source at the same altitude. Drawn by Russell W. Porter. 7×7 .
- M62. Libration in longitude as shown by two photographs of the full moon (one of which is No. M10), taken by Slocum with the 40-inch refractor. 10×8 .
- M63. A similar slide to show libration in latitude. 10×8 .

PLANETS

(Photographed by Barnard through color-filter with the 40-inch refractor and enlarging lens, unless otherwise specified)

- *P1 [323]. Transit of *Mercury*, November 14, 1907. Photographed by Fox with 12-inch refractor. 2×2 .
- P60. *Mercury*. Bruce 10-inch telescope. The image is very small. 4×4 .
- *P2 [654]. *Venus*, showing crescent phase. 2×2 .
- P63. Occultation of *Venus* by the moon. Photographed just after emergence by Van Biesbroeck with 24-inch reflector, January 13, 1923. 8×8 .
- P3 [526]. *Mars*, showing the region of Mare Sirenum, September 5, 1909. 3×4 .
- P4 [637]. *Mars*, showing the region of the origin of longitudes—the Fastigium Aryn or Dawes Forked Bay, and the Sinus Margaritifer, September 24, 1909. 4×5 .
- *P5 [638]. *Mars*, region of Syrtis Major. Photographs taken September 28, 1909, at $15^h 24^m$, $16^h 24^m$, and $16^h 46^m$, G.M.T., showing change due to rotation. (*M.N.*, 71, 471.) 5×4 .
- P6 [633]. *Mars*. Enlargement to a 4-inch diameter from best exposure of September 28, 1909. 8×8 .
- P7 [563]. *Mars* near the moon, showing the planet just after emergence from occultation, September 1, 1909. The image of *Mars* is star-like in this photograph. Photographed with the 10-inch Bruce lens. 3×3 .
- P51 [288]. Trail of the asteroid (13) *Egeria*. Photographed November 15, 1904, by Mr. Parkhurst, with the 2-foot reflector. 3×4 .
- *P52 [564]. Two asteroid trails. Photographed December 28, 1908, with the 10-inch Bruce lens. The brighter trail is that of (28) *Bellona*. Exposure, 1 hour. 4×5 .
- *P8 [350]. *Jupiter*, October 2, 1906. 3×3 .
- P9 [351]. *Jupiter*, December 5, 1905. This is less sharp than No. P8, but shows change in appearance of the belts. 3×3 .



FIG. 6.—The Planet Mars. No. P5.

- P12. *Jupiter*. Six drawings by Barnard. September 28–November 22, 1880. See also No. P15. (*Pub. Astron. Soc. Pacific*, 1, 89.) 5×4.
- P13. The same. October 10–November 7, 1880. 4×3. See also No. P15.
- P15 [385]. *Jupiter*. Twelve drawings by Barnard, nearly all identical with those of Nos. P12 and P13, but on a smaller scale. 5×6.
- P14. *Jupiter*. Drawing by Barnard. May 26, 1908. (*A.N.*, 178, 390.) 4×3.
- P16. *Jupiter* and *Venus* in conjunction, February 13, 1916. The images are small. Photographed with 10-inch Bruce refractor. 3×3.
- P61. Conjunction of *Moon*, *Venus*, and *Jupiter*, August 25, 1922. 10-inch refractor. 5×4.
- *P38. *Jupiter*. Three exposures showing changes in positions of the four bright satellites. 8×10.
- P19 [357]. *Saturn*, as seen through the 40-inch refractor. Shows the rings opened to their fullest extent, July 7, 1898. Drawn by Barnard. 3×2.
- P20 [440]. The same. Rings on edge showing condensations, December 12, 1907. (*Ap. J.*, 27, 35.) 3×2.
- P21 [441]. The same, showing very oblique dark side of ring and condensations, July 2, 1907. 3×2.
- P22 [442]. Diagram showing cause of disappearances and reappearances of *Saturn's* ring in 1907–8. Drawn by Barnard. (*Ap. J.*, 27, 35.) 3×3.
- P23 [531]. Diagram of ball and ring system of *Saturn*, showing the relation of the bright condensations seen on the dark side of the rings to Cassini's division, etc. Drawn by Barnard. (*Ap. J.*, 27, Pl. V.) 3×5.
- P24. Diagram by Keeler to prove the rotation of *Saturn's* rings spectroscopically. (*Ap. J.*, 1, 416.) 5×4.
- P25. Conjunction of *Saturn* and the earth-lit crescent moon, August 24, 1916. 3×3. See also Stereo 23.
- P26. Conjunction of *Saturn*, *Mars*, and the *Moon*, April 16, 1911. Photographed with 6-inch Bruce telescope. 6×5.
- P30. *Saturn*. Six exposures from negatives made by Barnard with 60-inch reflector of the Mount Wilson Observatory, November 19, 1911. 4×3.
- *P28. *Saturn*, enlargement of the best exposure on No. P30. 4×3.
- P32. Drawings of *Saturn* 1610–1650, after Huyghens. 7×5.
- *P41. *Uranus* and two of its satellites. Photographed by Hubble with 24-inch reflector. 3×3.
- P42. Conjunction of *Venus*, *Mars*, and *Uranus*, January 8, 1921, 10-inch Bruce telescope, January 8, 1921. 5×4.
- *P45 [519]. *Neptune* and its satellite, October 10, 1900. 4×3.

COMETS

(Selections from photographs taken by Barnard with the Bruce telescope, using the 10-inch lens, unless otherwise specified)

GIACOBINI'S COMET, 1906 I

- C9 [329]. December 29. Unique, sharply defined tail with convex edges. (*Ap. J.*, 24, 255.) 5×6.
- C10 [330]. December 30. Fan-shaped tail, very broad and diffuse, showing great contrast with that of December 29. 5×6.

C12 [332]. January 5. Long tail with central brightness and condensation. (*Proc. Amer. Phil. Soc.*, 46, 417.) 5×6.

C13 [333]. January 7. Very small head and neck with widely diverging tail which separates into a number of strands. (*Ap. J.*, 24, 255.) 5×6.

DANIEL'S COMET, 1907 IV

*C18 [448]. July 17. Beautiful fan-shaped tail separated into six or eight rays. (*Proc. Amer. Phil. Soc.*, 49, 417.) 8×10.

C22 [452]. August 6. Shows full length of tail about 12°. Taken with the 3.4-inch lens. 6×10.



FIG. 7.—Comet Morehouse. No. C32

C29 [458]. August 21. Tail broad with two diverging bright rays in the middle. 6×8.

C30 [459]. September 2. Tail separated into two main parts with little structure. 8×10.

C31 [460]. September 8. Shows the comet among the clouds. It has more pictorial effect than scientific value. Taken with 6-inch lens. 7×6.

MOREHOUSE'S COMET, 1908 III

- *C49 [542]. September 30, 1908. Two exposures, 3 hours apart, showing tail separating from head. Taken with 6-inch Bruce lens. (*M.N.*, 69, p. 52.) 8×6.
- C50. September 30, October 1, and October 2. Three exposures showing the rejection and drifting away of tail. 10×7.
- C54. October 1, 1908. Two exposures, 3 hours apart, showing tail drifting away. 8×6.
- C53. October 2, 1908. Two exposures, 3 hours apart, showing threadlike system of new tails. 8×6.
- C51. September 30, showing beginning of separation of tail from the head. A part of No. C49. 5×8.
- C52. Nine exposures on October 15, showing drifting away of tail from comet. Photographs by Morris, Pidoux, Quenisset, Miller, and Barnard. 7×5.
- C33 [543]. October 1. Tail widely separated from the head. 5×6.
- C34 [544]. October 2. Remarkable effect of broad, fan-shaped streamers. 6×8.
- C36 [546]. October 15. Showing rejected tail and a slender new tail. 7×9.
- C43 [553]. November 15. Showing tail made up of many streamers. (*Ap. J.*, 29, Pl. VII.) 5×6.
- *C32 [554]. November 16. Showing tail made up of sheetlike masses. (*Ap. J.*, 29, Pl. VIII.) 6×8.
- *C44 [559]. December 11. Showing distorted and twisted tail. (*Ap. J.*, 29, p. 71.) 6×8.
- C55 [521]. Spectra photographed with the slit-spectrograph and with the objective-prism, by Frost and Parkhurst. (*Ap. J.*, 29, Pl. IV.) 4×6.
- *C56 [522]. Comparison of direct photograph with objective-prism spectral images, by Frost and Parkhurst. (*Ap. J.*, 29, Pl. V.) 5×7.

See also stereograms, Nos. Stereo 3, 4, and 5, p. 29.

HALLEY'S COMET, 1909-1910

- *C57 [539]. Four very early photographs on one slide showing change in position, but no detail. Taken on September 16, 17, 24, and 26, 1909, by Lee with the 24-inch reflector. (*Ap. J.*, 30, Pl. VIII.) 5×6.
- C81. May 3, 1910. 3.4-inch lens. Showing division in end of tail. 6×8.
- *C64 [619]. May 4. Tail 7°-8° long. 6×8.
- C66 [651]. Tail as drawn by Barnard on the morning of May 18. 4×2.
- C67 [652]. Tail as drawn by Barnard on the morning of May 19. 4×2.
- C72 [625]. May 27. Tail for 5° or 6°. 8×10.
- *C73 [626]. May 29. Tail for 8°. 7×8.
- C74 [627]. May 30. Tail faintly shown for 6° or 8°. 7×8.
- *C77 [630]. June 6. Shows the discarded portion of the tail drifting away from the comet. 7×9.
- C79 [568]. Diagram showing passage of the earth through the tail of the comet on May 18. Drawing by Barnard. 3×3.
- C80 [600]. The comet as photographed at Yerkes Observatory, Honolulu, and Beirut (Syria), June 6. 5×9.
- C82 [567]. Spectrum of Halley's comet, January 14, taken with the prismatic camera. Comparison star (λ Tauri) is of the first type. Photographed by Frost and Parkhurst. 3×4.

C83 [578]. The same, on morning of May 5, showing absence of cyanogen from the tail. 3×3 .

C84 [579]. Four drawings made in 1836: January 28, 31; February 11; May 3. 2×3 .

C114. Drawing of Halley's comet in 684 from the Nuremberg Chronicle. 5×4 .

C115. Halley's comet in 1066, as depicted on the Bayeux tapestry. 5×4 .



FIG. 8.—Comet Morehouse. No. C104

BROOKS'S COMET, 1911 V

C102. September 22. Slender tail. (*Aph. J.*, 36, Pl. I.) 8×10 .

*C103. October 19. Tail formed of sheetlike streams. (*Aph. J.*, 36, Pl. II.) 8×10 .

*C104. October 23. Very beautiful. Tail consists of a great number of delicate streams. (*Aph. J.*, 36, Pl. IV.) 8×10 .

C105. The foregoing three, and an exposure on July 26 when the comet was tailless. 10×8 .

OTHER COMETS

(Photographed by Barnard)

- C85. Comet 1889 V (Brooks) and companion comets. Drawn by Barnard. 7×6 . (*A.N.*, 122, 267.)
- C89. Comet 1893 IV (Brooks). Exposures of October 21, 22, and 23, showing probable encounter with some medium which shattered the tail. Taken at Lick Observatory. 7×5 .
- C90 [535]. The same. Composite photograph from exposures on November 2 and 3, showing retardation of tail. (*Ap. J.*, 22, 249.) Taken at Lick Observatory. 7×9 .
- C91 [121]. Great comet of 1901 I, May 11. Photographed in Sumatra. 3×3 .
- C5 [112]. Comet 1903 IV (Borrelly), July 24. Transverse division of tail (*Ap. J.*, 18, 210.) 7×5 .
- C94 [569]. Comet 1910 I. January 21. Curved tail for about 4° . Taken with 6-inch lens. 4×5 .
- C111. Comet 1911 IV (Beljowsky), October 3, 1911. Showing long tail with short, widely diverging tails near head. 7×9 .
- C112. Comet 1914 V (Delavan), September 28, 1914. Two tails, one very straight and one strongly curved. Taken with 6-inch lens. (*Pop. Astron.*, 22, 535.) 7×9 .
- C86. Encke's periodic comet. October 29, 1914. Showing rapid motion, but no tail. 4×5 .
- C87. Finlay's periodic comet, November 14, 1919. Period is 6.69 years. Tailless. 4×5 .
- C88. Pons-Winnecke periodic comet, June 5, 1921. Very rapid motion, no tail. 4×5 .

METEORS

- C155. Meteorite Me 371, from Toluca, Mexico. Etched section showing Widmannstättian figures. From the Yerkes Observatory collection. 10×8 .
- C156. Meteorite ME 141. Complete individual from the Canyon Diablo "crater," Arizona. From the Yerkes Observatory collection. 10×8 .

METEOR TRAILS

(Photographed by Barnard with the Bruce telescope, unless otherwise specified)

- C150 [119]. Meteor trail showing sudden increase of brightness. 6-inch lens. (*Proc. Amer. Phil. Soc.*, 46, 417.) 7×9 .
- C151 [120]. Meteor trail and the *Pleiades*. 3.4-inch lens. 2×2 .
- *C152 [286]. Meteor trail with the great *Orion* nebula in the field. 6-inch lens. 8×10 .
- Stereo 31 [287]. A stereoscopic print of No. 286, showing the meteor in strong relief. Negatives by Barnard and Sullivan. 5×3 .
- C154 [285]. Two meteor trails with star-cloud in *Scutum Sobieski*. 6-inch lens. (*Proc. Amer. Phil. Soc.*, 46, 417.) 8×10 .
- *N16 [601]. Large meteor trail in same field with the fine nebulae *N.G.C.* 6960 and 6992 in *Cygnus*. 10-inch lens. 8×9 .

THE STARS

- SC1-SC140 [517]. Photographs of 140 Hagen Fields, Series I, II, III, and VI, around faint telescopic variables; $\frac{1}{2}^\circ$ square, scale $1^{\text{mm}} = 10''$, showing stars to fifteenth or sixteenth magnitude. Taken by Parkhurst and Jordan with the 24-inch reflector and enlarged on 8×10 double weight paper.
- SC154. Winter constellations. November-February. Diagram by Pettit. 5×6.
- SC157. Spring constellations. February-May. Diagram by Pettit. 5×6.
- SC158. Early summer constellations. May-July. Diagram by Pettit. 5×6.
- SC159. Late summer and fall constellations. August-November. Diagram by Pettit. 5×6.
- SC168. Constellation *Auriga*. Extra-focal images (telescope put slightly out of focus in order to enlarge the images of the stars to disks and eliminate the fainter stars). 6×6.
- SC172. The same, but contains many more stars than does No. SC168. 6×8
- *SC161. The stars of the "Big Dipper" in *Ursa Major*. Extra-focal. 9×5.
- SC164. Constellation *Canis Major*. Extra-focal. 5×7.
- SC165. Constellation *Cassiopeia*. Extra-focal. 6×6.
- SC166. Constellation *Coma Berenices*. Extra-focal. 5×6.
- SC155 [655]. Constellation *Coma Berenices*. Focal images. 6×7.
- SC169. Constellation *Corona Borealis*. Extra-focal. 6×6.
- SC160. Constellation *Corvus*. Extra-focal. 6×8.
- SC156 [656]. Constellation *Delphinus*. Focal images. 5×4.
- SC171. Constellation *Leo Major* with *Mars*. Extra-focal. 8×8.
- SC151 [282]. Constellation *Orion*. Field about 16° . Exposures of 30 and 150 minutes showing cumulative effect of light on a photographic plate. 6×9.
- *SC152. Constellation *Orion*. Extra-focal images of about ten of the brightest stars. 7×9.
- SC174. The same. Shows stars to sixth magnitude. 6×7.
- *SC162. *The Pleiades*. Extra-focal. 6×6.
- SC177. Constellation *Sagitta*, showing a peculiar grouping of stars. 8×10.
- *SC163. Constellation *Scorpius*. Extra-focal. 8×10.
- SC175. The same, but with longer exposure and showing many stars. 8×10.
- SC176. Constellation *Taurus*. Extra-focal. See also SC162 for *Pleiades* alone. 6×6.
- SC195. Star trails around the north pole. Exposure 1 hour. 4×5.
- *SC197. Star trails around the pole and at the equator. 7×4.
- *SC201. Combination of three photographs of the double star *Krueger 60*, showing conspicuous orbital motion (1908, 1915, 1920). Barnard. 4×2.
- SC226 [491]. *U Cygni* (with white comparison stars). Double slide showing effect of intensely red star on color-corrected plate for exact photometric photometry. Photographed by Jordan. (*Ap. J.*, 24, 268.) 6×3.
- *SC230 [421]. Variable star *RZ Cassiopeiae* of the Algol type. Minimum as photographed by Parkhurst with extra-focal camera, August 3, 1907. (*Ap. J.*, 26, 253, Fig. 8.) 6×4.
- SC232 [426]. Variable star *U Ophiuchi* of the Algol type. Minimum as photographed by Parkhurst with extra-focal camera, June 13, 1907. 5×4.
- *SC235. Variable stars *R* and *S Scorpii*, double slide showing notable changes in brightness. Photographed by Barnard with 10-inch Bruce lens. 7×5.

- *SC251. Barnard's star in *Ophiuchus*, having greatest known proper motion. Double slide showing marked change in position in 22 years. 5×7 .
- SC266. Variability of *Nova Persei*. Diagrams by Barnard showing magnitudes from 1916 to 1922. 5×9 .
- SC271 [635]. *Nova Lacertae* of 1910. Triple slide showing the nova as it appeared August 7, 1907, before the outburst as a 14th-magnitude star; on December 31, 1910, when it was of about the 7th magnitude; and on February 2, 1911, when it had faded to the 11th magnitude. Photographed by Barnard with the 10-inch Bruce lens. 4×3 .
- *SC281. *Nova Aquilae* of 1918 before and after outburst. (*Pop. Astron.*, 26, p. 558.) 6×3 .
- *SC351. Diagram of orbit of 70 Ophiuchi. Period is 87 years. Van Biesbroeck. 10×8 .
- SC352. Table of effective temperatures of stars of different classes. 4×3 .
- SC353. Plate of 61 Cygni, taken with the 40-inch refractor, with comparison stars, as used for determining stellar parallax. 5×4 .
- SC354. Orbit of *Sirius*. (Burnham's *General Catalogue of Double Stars*, 2, 468.) 5×4 .

STAR CLUSTERS

(Photographed by Ritchey through color-filter with the 40-inch refractor)

- SC301 [78]. M_2 in *Aquarius*. 8×10 .
- *SC302 [79]. M_{11} in *Aquila*. 7×8 .
- SC303 [80]. M_3 in *Canes Venatici*. 8×10 .
- *SC304 [81]. M_{13} in *Hercules*. (*Pub. Y.O.*, 2, Pl. XIX.) 8×10 .
- *SC305 [82]. M_5 in *Libra*. 7×8 .
- SC306 [83]. M_{15} in *Pegasus*. (*Pub. Y.O.*, 2, Pl. XX.) 8×8 .
- (Photographed by Jordan with the 24-inch reflector, unless otherwise specified)
- SC321 [489]. M_46 (N.G.C. 2437) in *Argus*. Involves a planetary nebula. 8×10 .
- SC322 [488]. M_37 (N.G.C. 2099) in *Auriga*. 8×10 .
- SC323 [487]. N.G.C. 7789 in *Cassiopeia*. 8×10 .
- SC324 [662]. M_{13} in *Hercules*. By Ritchey. (See also No. SC304 above.) 6×6 .
- *MW32 [271]. The double cluster in *Perseus*. (*Proc. Amer. Phil. Soc.*, 46, 417.) Photographed by Barnard with 10-inch Bruce lens. 8×10 .
- SC340 [84]. *Pleiades* region, showing about 30° of sky with stars down to thirteenth magnitude, photographed by Wallace with Clark lens. 8×6 . (See also Nebulae, Nos. N71 and N72.)
- SC341 [639]. *Praesepe* in *Cancer*. Shows the remarkable groupings of the stars in the cluster. By Barnard with the 10-inch Bruce lens. 8×10 .

NEBULAE

(Photographs taken by Ritchey with 24-inch reflector, unless otherwise specified. Exposures range from 1 to 6 hours)

AMORPHOUS GASEOUS NEBULAE

- N1 [87]. Great nebula in *Orion*, the central part only. 40-inch refractor. (*Pub. Y.O.* 2, Part 6.) 8×10 .
- N4 [91]. Great nebula in *Orion*. (*Pub. Y.O.*, 2, Part 6.) 8×10 .

*N5 [348]. The same. On a somewhat smaller scale, to show adjacent nebula and stars. 8×10 .

N10 [311]. *N.G.C.* 1977 in *Orion*. By Cogshall. 7×7 .

N11 [403]. Great curved nebula in *Orion*. Drawing from photographs by Barnard. (*Ap. J.*, 17, 77.) 4×5 .

N14 [100]. *N.G.C.* 6960 in *Cygnus*. (*Pub. Y.O.*, 2, Part 6.) 7×8 and 10×12 .

N15 [99]. *N.G.C.* 6992 in *Cygnus*. (*Pub. Y.O.*, 2; *Ap. J.*, 14, Pl. XI.) 8×10 .



FIG. 9.—The Great Nebula in Orion. No. N4

*N16 [601]. Includes both No. N14 and No. N15 on smaller scale, with a large meteor trail. Photographed by Barnard with 10-inch Bruce lens. 7×8 .

N17. Nebula *N.G.C.* 6992 with meteor trail, enlarged from No. N16.

*N21 [468]. The "North America" nebula. By Barnard with 10-inch Bruce lens. (*Proc. Amer. Phil. Soc.*, 46, Pl. I.) 8×10 .

N25 [481]. Omega nebula in *Scutum*. 7×7 .

N26 [485]. *M* 1 in *Taurus*, the "Crab" nebula. 3×3 .

*N27 [482]. Trifid nebula. 6×7 .

- *N₂₉ [94]. *M* 8 in *Sagittarius*. 7×8.
 N₃₁ [98]. Dumbbell nebula in *Vulpecula*. 4×5.
 N₃₃ [422]. Nebulae near *Gamma Cassiopeiae*. By Jordan. 4×5.

PLANETARY NEBULAE

- *N₄₁ [86]. Ring nebula in *Lyra*. Photographed by Sullivan with 40 inch refractor. 3×3.
 *N₆₁ [646]. Objective-prism spectrum of the same. Without comparison. Photographed by Parkhurst. 3×2.
 N₄₃ [88]. Planetary nebula, *N.G.C.* 3242 in *Hydra*. Photographed by Barnard with 40-inch refractor. 3×3.
 N₆₃ [644]. Spectrum of the same. Photographed by Frost and Parkhurst with prismatic camera, with stellar spectrum for comparison. 3×2.
 N₄₆. Planetary nebula, *N.G.C.* 7662. Photographed by Barnard with 60-inch reflector at Mount Wilson Observatory. 3×3.
 N₄₉ [486]. The same. Drawing by Barnard, showing remarkable detail and central variable star as seen through the 40-inch refractor. (*M.N.*, 68, 465.) 3×4.
 N₄₈. Planetary nebula, *N.G.C.* 6543. Photographed by Barnard with 60-inch reflector at Mount Wilson Observatory. 3×3.
 *N₅₁. Planetary nebula *N.G.C.* 2392 in *Gemini*. Photographed by Barnard with both 25-foot and 100-foot focus of the 60-inch telescope at Mount Wilson Observatory. 4×3.
 N₅₂. Variable nebula, *N.G.C.* 2261, in *Monoceros* as photographed in 1908 by Jordan; in 1913 by Curtis at the Lick Observatory; and by Hubble in 1916. (*Ap. J.*, 44, Pl. V.) 9×5.
 N₅₃. The same, photographed by Hubble in February, 1916, and March, 1917. (*Ap. J.*, 45, Pl. IX.) 7×4.

EXTENDED NEBULAE WITH CONTINUOUS SPECTRUM

- N₇₁ [101]. Nebulosity in the *Pleiades*. (*Pub. Y.O.*, 2, Pl. XXVI.) 8×10.
 *N₇₂ [634]. The same but includes about 4° of sky around the cluster. Photographed by Barnard with 10-inch lens. 8×10.
 N₇₃. Exterior nebulosities of the *Pleiades*. Drawn by E. Calvert from photographs. (E. E. Barnard in *M.N.*, 60, Pl. X.) 5×6.
 *N₇₅ [661]. Great nebula of *Nu Scorpii* which apparently obscures the light of the stars. Photographed by Barnard with 10-inch lens. (*Ap. J.*, 31, Pl. I.) 5×6. See also No. MW83.
 N₇₆. Great nebula in *Cepheus*. Photographed by Barnard with 10-inch lens. 8×10.
 N₇₇ [400]. Great nebula near *Pi* and *Delta Scorpii*. Photographed by Barnard with 10-inch lens. (*Ap. J.*, 23, 144.) 7×8.
 N₇₉ [663]. Nebulous region of *Virgo*. α 12^h 25^m, δ +13°. Shows a large number of nebulae and nebulous stars and gives good idea of the various kinds of nebulae that are clustered in this region. Photographed by Barnard with 10-inch lens. 7×8.
 N₈₁ [484]. *N.G.C.* 1499 in *Perseus*. 7×7.
 N₉₆ [107]. Expansion of nebulosity around *Nova Persei*. Photographed on September 20 and November 13, 1901. (*Ap. J.*, 14, 293.) 3×7.

SPIRAL NEBULAE

- *N101 [92]. Great nebula in *Andromeda*. (*Pub. Y.O.*, 2, Pl. XXIV.) 8×10 .
 N102 [93]. The same, central part, enlarged. (*Ap. J.*, 14, Pl. VIII.) 7×8 .
 N103. The same, with surrounding region. Photographed by Barnard with 10-inch lens. 8×10 .
 *N105 [96]. *M* 51 in *Canes Venatici*, the "Whirlpool." (*Pub. Y.O.*, 2, Pl. XXIX.) 7×7 .



FIG. 10.—Great Nebula in Andromeda. No. N101

- *N107 [95]. *M* 33 in *Triangulum*. (*Pub. Y.O.*, 2, Pl. XXV.) 7×8 .
 *N109 [97]. *M* 101 in *Ursa Major*. 8×10 .
 N111 [483]. *N.G.C.* 7331 in *Pegasus*. 7×7 .

THE MILKY WAY

(Photographed by Barnard with the Bruce telescope unless otherwise specified. The field is approximately 8 degrees in diameter, except for those taken with the 3.4-inch and 1-inch lenses, which cover respectively about 16° and 22° . Many of them were taken while the Bruce telescope was temporarily set up on Mount Wilson, California).

STAR CLOUDS

- MW1 [475]. Cloud forms in *Sagittarius*. α $18^h 0^m$, $\delta - 30^\circ$. 1-inch lantern lens. 4×4 .
 *MW2 [409]. Great star-cloud in *Sagittarius*. α $17^h 56^m$, $\delta - 28^\circ$. 8×9 .

- MW₃. Star-cloud in region of *Nova Aquilae*. α $18^h 52^m$, $\delta - 1^\circ$. 8×10 .
 MW₄ [473]. Great star-clouds of the Milky Way. α $17^h 56^m$, $\delta - 28^\circ$. 3.4-inch lens. 7×8 .
 *MW₆ [410]. Star-cloud and black spots in *Sagittarius*. α $18^h 7^m$, $\delta - 18^\circ 20'$. (*Pop. Astron.*, 14, Pl. XII.) 8×10 .
 MW₇ [474]. Great star-clouds and black spots in *Sagittarius*. α $18^h 7^m$, $\delta - 18^\circ 10'$. 3.4-inch lens. 5×6 .
 MW₉ [477]. Cloud-forms in *Sagittarius*. α $18^h 50^m$, $\delta - 23^\circ$. 1-inch lantern lens. 4×4 .
 MW₁₁ [469]. Star-clouds and vacancies in *Sagittarius*. α $18^h 30^m$, $\delta - 11^\circ$. 3.4-inch lens. 3×4 .
 MW₁₃ [472]. Cluster of stars and star-clouds in *Scorpio*. α $17^h 30^m$, $\delta - 32^\circ$. 3.4-inch lens. 5×6 .
 MW₁₄ [408]. Cluster and star-cloud in *Scorpio*. α $17^h 45^m$, $\delta - 35^\circ$. 8×10 .
 MW₁₅ [507]. West of great star-clouds in *Scorpio*. α $17^h 30^m$, $\delta - 32^\circ$. 8×10 .
 MW₁₆ [411]. Region near *M* 8. α 18^h , $\delta - 26^\circ$. 8×10 .
 *MW₁₇ [412]. Star-cloud in *Scutum Sobieski*. α $18^h 45^m$, $\delta - 6^\circ$. Contains the cluster *Messier* 11. 7×8 .
 MW₁₈ [478]. Cloud-forms in *Sagittarius*. α $19^h 0^m$, $\delta 0^\circ$. Shows trail of a meteor. 1-inch lantern lens. 3×3 .
 MW₁₉ [479]. The same. α $19^h 0^m$, $\delta - 20^\circ$. 1-inch lantern lens. 4×4 .
 *N₂₁ [468]. Region of the "North America" nebula. α $20^h 55^m$, $\delta + 45^\circ$. (*Proc. Amer. Phil. Soc.*, 46, 417.) 8×10 .
 *MW₂₁ [508]. Region of 58 *Ophiuchi*. α $17^h 35^m$, $\delta - 22^\circ$. 8×8 .

FIELDS OF UNIFORM DISTRIBUTION

- MW₃₁ [273]. The Milky Way near *Kappa Cassiopeiae*. α $0^h 30^m$, $\delta + 61^\circ$. 8×10 .
 *MW₃₂ [271]. Region of the double cluster in *Perseus*. α $2^h 20^m$, $\delta + 57^\circ$. (*Proc. Amer. Phil. Soc.*, 46, 417.) 8×10 .
 MW₃₃ [464]. Region of *M* 35. α $6^h 0^m$, $\delta + 24^\circ 30'$. 8×10 .
 MW₃₅ [541]. Near the *Omega* Nebula. α $18^h 20^m$, $\delta - 15^\circ$. 8×10 .
 MW₃₇ [466]. Region of *Chi Cygni*. α $19^h 45^m$, $\delta + 35^\circ$. 7×7 .

DARK AREAS

(For Barnard's catalogue of 182 such areas, see *Astrophysical Journal*, 49, 14, 1919)

- *MW₅₁ [406]. Vacancy in the Milky Way near the star *Theta Ophiuchi*. α $17^h 4^m$, $\delta - 27^\circ 3'$. (*Pop. Astron.*, 14, 579.) 8×10 .
 *MW₅₂ [632]. Region north of *Theta Ophiuchi*, rich in dark areas and including Nos. MW₆₃, 64, on a small scale. (*Ap. J.*, 49, Pl. I.) 10×8 and 3×3 .
 MW₅₄ [404]. Region of *Theta Ophiuchi*. α $17^h 20^m$, $\delta - 24^\circ$. Includes both Nos. MW₅₁ and MW₅₅. 8×10 .
 MW₅₅ [465]. Vacancy in the Milky Way near the star *Theta Ophiuchi*. α $17^h 24^m$, $\delta - 25^\circ 30'$. (*Pop. Astron.*, 14, 579.) 8×8 .
 MW₅₇ [599]. Enlarged view of the largest black spot appearing in No. MW₆. This shows in a striking manner the abrupt and sharply defined edge of the spot. 4×5



FIG. 11.—The "North America" Nebula. No. N₂₁

MW58 [470]. Vacant lanes running east from *Rho Ophiuchi*. α 16^h 50^m , δ -25° . 10-inch lens. 8×6 .

MW59 [471]. Great vacant region east of *Theta Ophiuchi*. α 17^h 24^m , δ -25° . 10-inch lens. 5×6 .

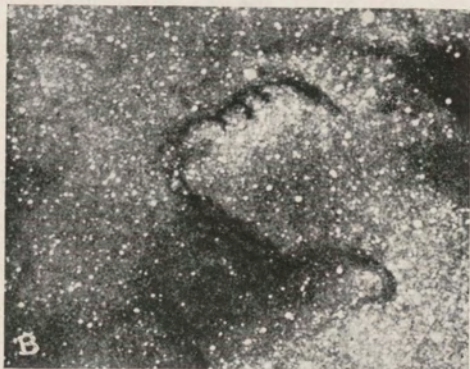


FIG. 12.—Dark Markings on the Milky Way

*MW61. Comparison of dark area and bright nebula *N.G.C.* 6992, similar in shape. (*Ap. J.*, **43**, Pl. I.) 3×2 .

MW60. Barnard's No. 33, dark object in nebulous region of *Zeta Orionis*. 5×4 .

MW62. Barnard's No. 9, in *Camelopardalis*. 10×7 .

*MW63. Barnard's Nos. 63 and 72, in *Ophiuchus*. (*Ap. J.*, **49**, Pl. III.) 3×5 .

*MW64. Barnard's Nos. 75 and 84, in *Ophiuchus*. (*Ap. J.*, **49**, Pl. II.) 3×5 .

MW65. Barnard's Nos. 64, 98, 127, 129, and 133. (*Ap. J.*, **49**, Pl. IV.) 4×5 .

MW66. Barnard's No. 11, in *Camelopardalis*. 5×4 .

REGIONS WITH LUMINOUS NEBULAE

MW81 [401]. Nebulous groundwork in *Taurus*. α 4^h 12^m , δ $+28^\circ$. (*Ap. J.*, **25**, 218.) 8×10 .

*MW82 [402]. The same, but taken simultaneously with the 6-inch lens, and showing a wider field of view. (*Ap. J.*, **25**, 218.) 8×10 .

MW83 [509]. Region of *Nu Scorpii*. α 16^h 5^m , δ -19° . 8×10 . For the nebula only, see No. N75.

*MW84 [405]. Region of the great nebula of *Rho Ophiuchi*. α 16^h 20^m , δ -23° . (*Ap. J.*, **31**, Pl. IIA.) 8×10 .

*MW87 [467]. Nebulous region of *Gamma Cygni*. α 20^h 20^m , δ $+40^\circ$. (*Proc. Amer. Phil. Soc.*, **46**, 417.) 8×10 .

MW90 [269]. Great nebulous region in *Cepheus*. α 21^h 35^m , δ $+57^\circ$. (*Ap. J.*, **21**, Pl. III.) 6×8 .

MW20 [270]. Nebulous Region in *Cygnus*. α 21^h 30^m , δ $+49^\circ$. 6-inch lens. (*Ap. J.*, **21**, Pl. IV.) 8×10 .

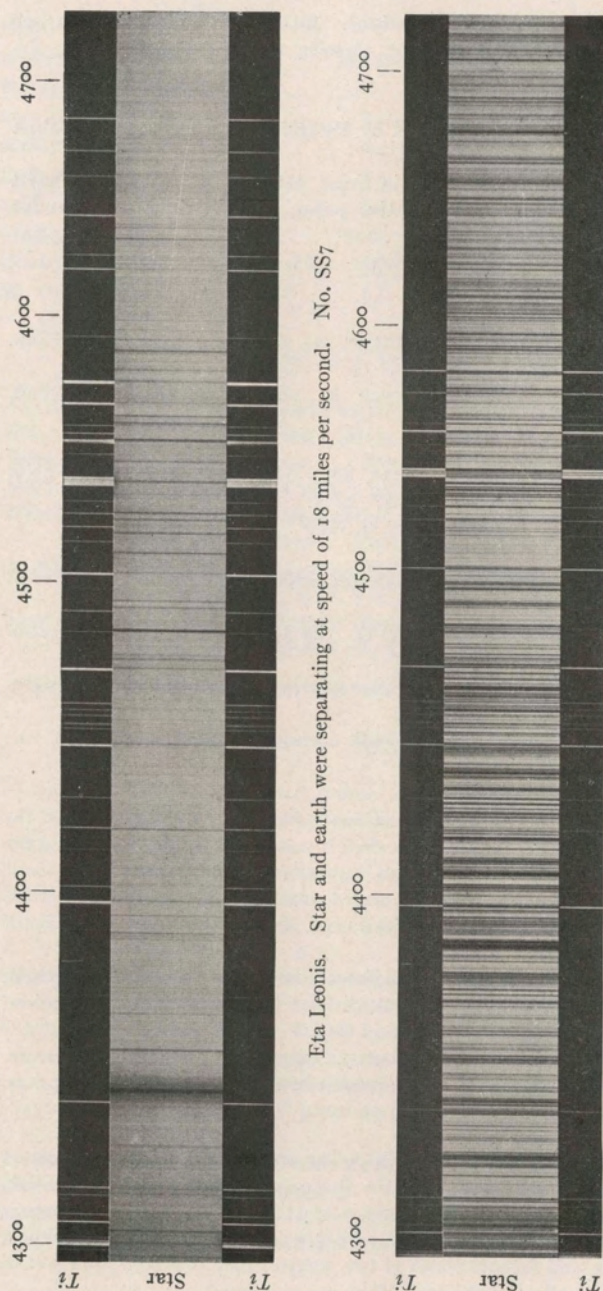
STELLAR SPECTRA

Photographs of stellar spectra, vertically enlarged, with titanium comparison spectrum; taken with the Bruce spectrograph attached to the 40-inch refractor, by Frost, Adams, Barrett and Lee, unless otherwise specified. The letters, A, B, K, etc., refer to the Harvard classification).

TYPICAL SPECTRA

*SS29. Spectra of four stellar types, from drawing by J. E. Keeler. 9×7 and 4×3 . (If colored, \$1.50.)

SS4. Typical spectra, vertically enlarged, with titanium comparison. Blue region. B1, B8p, A, F5, G0, K, K5, M. Nos. SS2, 5, 6, 10, Sun, 14, 21, 25 combined. 8×8 .



Alpha Boötis (Arcturus). Star and earth were approaching at speed of 11 miles per second. No. SS14 in part

FIG. 13.—STELLAR SPECTRA PHOTOGRAPHED WITH THE BRUCE SPECTROGRAPH (Frost and Adams)

The white lines are due to titanium vaporized by an electric spark in front of the spectrograph. They furnish reference points on every plate. The dark lines on a light background are in the spectrum of the star. From the lack of perfect coincidence of the titanium lines in spark and star, the velocity of the star may be inferred after positions of lines have been measured to one twenty-five-thousandth of an inch. After correcting for the earth's velocity (in its orbit around the sun), the above stars are found to have speeds of 2 miles per sec. (recession) and 3 miles per sec. (approach), respectively.

- SS28. Classes of spectra (U.-V. objective-prism). Blue region, without comparison spectrum. *Algol*, B8; *a Persei*, F5; *Capella*, G0; *Saturn*; *Aldebaran*, K5. 3×2 .
- N64. The *Orion* nebula. 3×1 .
- *N61. Ring nebula in *Lyra*. Photographed by Parkhurst with ultra-violet doublet and objective prism. 3×2 .
- N62 [645]. Planetary nebula N.G.C. 6543 in *Draco*, taken by Frost and Parkhurst with ultra-violet doublet and objective prism, with a stellar spectrum for comparison. 3×2 .
- N63 [644]. The same for N.G.C. 3242 in *Hydra*. 3×2 .
- SS17. 10 *Lacertae*. Oe5. 8×2 .
- SS18. *Zeta Puppis*. Oe5-Bo. 8×2 .
- SS1 [137]. *Epsilon Canis Majoris*. Helium type, B1, showing oxygen lines. (Pub. *Y.O.*, 2, Pl. III.) 9×2 .
- SS2 [138]. *Beta Canis Majoris*. Helium type, B1, showing oxygen lines. (Pub. *Y.O.*, 2, Pl. III.) 8×2 .
- SS3 [152]. *Gamma Pegasi*. B2. 9×2 .
- SS5 [136]. *Beta Orionis (Rigel)*. Helium type, B8p. (Pub. *Y.O.*, 2, Pl. III.) 9×2 .
- SS6 [135]. *Alpha Canis Majoris (Sirius)*. A. 9×2 .
- SS7 [139]. *Eta Leonis*. Ap. (Pub. *Y.O.*, 2, Pl. III.) 8×2 .
- SS8. *Alpha Cygni (Deneb)*. A2. 10×3 .
- SS10 [144]. *Alpha Persei*. F5. Shows small displacement due to motion in line of sight. 9×2 .
- SS11. *Alpha Aurigae (Capella)*. Solar type, G. See also No. SS179 under Spectroscopic Binaries. 9×2 .
- SS13 [151]. *Jupiter*, showing identity with solar spectrum and motion in line of sight. 8×4 .
- *SS14 [141]. *Alpha Boötis (Arcturus)*, with both narrow and widened spectrum. K. (*Ap. J.*, 18, Pl. VIII.) 8×3 .
- SS15 [143]. *Beta Geminorum (Pollux)*. K0. 9×2 .
- SS16 [148]. Combination of two spectra of *Gamma Piscium*. K. Taken when the earth was approaching the star and when it was receding, thus indicating the revolution of the earth around the sun. 4×5 .
- SS21 [145]. *Alpha Tauri (Aldebaran)*. Advanced solar type, K5. 9×2 .
- SS25 [146]. *Alpha Orionis (Betelgeuse)*. Third type, Mo. 8×2 .
- SS39. 152. *Schjellerup*. Nb. 8×2 .
- *SS40. The *Pleiades*, spectra of the six brightest stars. No comparison spectrum. Photographed by Parkhurst with ultra-violet doublet and objective-prism. Also extra focal images of same stars. 8×4 .
- SS42 [503]. The *Coma* group, spectra of fourteen stars. No comparison spectrum. Photographed by Parkhurst with ultra-violet doublet and objective-prism. 4×3 .

A set of twenty-four negative copies of stellar spectrograms, with comparison spectrum of titanium and iron, made with the Bruce spectrograph, is in preparation. These are for use in institutions wishing to give instruction in methods of measurement and reduction. They include spectra of different types taken with dispersions of one, two, and three prisms, and include plates of two spectroscopic binaries. The cost of these is 60 cents each, or \$12 for the set. They are as follows:

One Prism		Two Prism	
Orion Nebula.....	P	Zeta Ursae Majoris (2).....	A2p
10 Lacertae.....	Oe5		
Epsilon Canis Majoris.....	cB5	Three Prism	
Gamma Canis Majoris.....	B5	Beta Canis Majoris.....	B1
Alpha Lyrae.....	Ao	Alpha Canis Majoris.....	Ao
Delta Canis Minoris.....	A5	Alpha Canis Minoris.....	dF5
13 Ceti.....	Go	Epsilon Aurigae.....	cF5p
Omicron Ceti.....	M6e	Jupiter.....	Go
Nova Aquilae No. 3 (2).....	Qb	Alpha Boötis.....	Ko
Mu Orionis (4).....	A2	Alpha Tauri.....	gK5
		Alpha Scorpii.....	cMo

PECULIAR AND VARIABLE SPECTRA

- SS51 [153]. *Beta Lyrae*. B2p, showing strongly displaced dark and bright lines. 9×2 .
 SS52. *Omicron Ceti (Mira)*. M6e (Mvep! at min.). 8×2 .
 SS65. *R Leonis*. M8e. Region of $\lambda 4078$ - $\lambda 4481$. 10×3 .
 SS66. The same. Region of $\lambda 4395$ - $\lambda 5000$. 10×3 .
 SS75 [125]. Comparison of yellow carbon bands in electric arc with spectra of red stars. Hale and Ellerman. (*Pub. Y.O.*, 2, Pl. VII, Fig. 3.) 2×1 .
 SS78 [128]. Seven red stars, showing progressive changes; blue region. Hale and Ellerman. (*Pub. Y.O.*, 2, Pl. VIII.) 3×3 .
 SS79 [129]. Nine red stars, showing progressive changes; yellow and green region. Hale and Ellerman. (*Pub. Y.O.*, 2, Pl. IX.) 2×3 .

For spectra of sun and comets see under Sun and Comets

NOVAE

- SS101 [536]. *P Cygni* (temporary star of 1600), showing broad bright lines and the narrow edges of underlying dark lines, giving a spurious large displacement of the dark lines. 9×2 .
 SS106 [642]. *Nova Lacertae*, January 30, 1911. 3×1 .
 SS107 [643]. The same, February 22, 1911. 3×1 .
 SS118. *Nova Geminorum No. 2*. Combination of seven vertically enlarged plates, March 15 to 19, 1912. 9×7 .
 SS119. *Nova Geminorum No. 2*. Combination of seven vertically enlarged plates, March 19 to November 1, 1912. 9×7 .
 *SS125. *Nova Aquilae No. 3*. Taken by Parkhurst with 30° objective-prism over U.-V. doublet, June 8, 9, and 10, 1918; without comparison spectrum. Shows sudden appearance of bright lines. 4×3 .
 SS131. The same, but with 15° prism on 6-inch reflector, and shows several spectra for each date. 5×9 .
 SS135. *Nova Aquilae No. 3*. Seven spectra from June 10 to July 1. 10×8 .
 SS136. The same, July 5 to August 12. 10×8 .
 SS137. The same. August 26 to November 11, 1918. 10×8 .
 SS138. The same. June 18 and June 22, 1918, covering green and yellow region. 10×5 .

- SS139. *Nova Aquilae* and neighboring stars. Photographed with sky patrol, November 24. Without comparison spectrum. 4×5 .
- SS141. *Nova Cygni* No. 3. On eleven dates from August 23 to September 3, 1920. Photographed by Parkhurst with 15° objective-prism over U.-V. camera and over 6-inch reflector. Without comparison spectrum. 6×8 .
- SS142. The same, September 3 to September 24. 6×8 .
- SS143. The same, on twelve dates from September 27 to December 8. 6×8 .
- SS144. The same, on twelve dates from August 23 to December 8. 6×8 .
- SS145. Comparison of *Nova Cygni* and *Nova Aquilae*. Parkhurst. First pair show absorption lines at beginning of apparition; second pair taken as emission spectrum begins. 7×7 .
- SS146. The same, after nebular stage had been reached. 7×7 .
- SS147. Seven spectra of *Nova Cygni*, with comparison spectrum. August 23 to August 27, 1920. Vertically enlarged. 10×8 .
- SS148. The same. August 28 to September 1, 1920. 10×8 .
- SS149. The same. September 2 to September 17, 1920. 10×8 .

SPECTROSCOPIC BINARIES

(Double slides, showing change in radial velocity of spectroscopic binary stars. Titanium comparison spectrum)

- SS171 [492]. *Beta Cephei*. B1. Period, $4^h 34^m$. (*Ap. J.*, 24, 259.) 5×2 .
- SS172 [606]. *Kappa Cancr.* B8. Period, 6.4 days. (*Ap. J.*, 19, 350; 25, 315.) 4×2 .
- SS173 [607]. *Mu Sagittarii*. B8p. Period, 180.2 days. (*Ap. J.*, 19, 351; 26, 157.) 5×5 .
- SS174 [149]. *Eta Virginis*. A. Period, 71.9 days. (*Ap. J.*, 17, 152; 26, 282.) 8×6 .
- SS175 [337]. *Alpha Draconis*. A. Period, 51.4 days. (*Ap. J.*, 18, 307; 23, 267.) 8×4 .
- *SS177 [657]. *Mu Orionis*. A2. Period, 4.45 days. (*Ap. J.*, 23, 266.) A large displacement is very well shown. 7×3 .
- SS178. *Gamma Ursae Minoris*. A2. Period, $2^h 36^m 9^s$, the shortest yet known. 5×4 .
- SS179. *Alpha Aurigae (Capella)*. G and F. Period 104.0 days. Discovered by W. W. Campbell and H. F. Newall. The two components, of different type, are shown on one of the plates. 8×4 .
- *SS191 [335]. *Zeta Ursae Majoris (Mizar)*. Ap. Period, 20.5 days. Lines are double on one plate and single on the other. This was the first spectroscopic binary discovered, by E. C. Pickering in 1888. 7×4 .

VELOCITY CURVES OF SPECTROSCOPIC BINARIES

- | | |
|---|--|
| SS205. <i>Tau Cygni</i> . 8×7 . | SS213 [514]. <i>Mu Orionis</i> . 10×8 . |
| SS207 [511]. <i>Beta Cephei</i> . 9×4 . | SS214 [515]. <i>Zeta Tauri</i> . 6×4 . |
| SS208 [512]. <i>13 Ceti</i> . 4×3 . | SS215 [516]. <i>Eta Virginis</i> . 4×3 . |
| SS212 [513]. <i>Eta Orionis</i> . 3×3 . | SS216. <i>Gamma Ursae Minoris</i> . 10×8 . |

MISCELLANEOUS SPECTRA

- MS₃ [523]. Arc and spark spectrum of iron compared. Region of λ 4250 to λ 4415. 10×1.
- MS₄. Table of wave-lengths and number of waves per second of visual rays. 4×3.
- MS₅. Diagram showing range of ether waves from the extremely short X-rays through the visual and wireless wave-lengths to those of the alternating current. 6×2.
- MS₂₁. Spectrum of hydrogen with that of titanium at center for comparison. (Can also be furnished in colors for \$1.50.) 9×2.
- MS₂₅. The spectrum of helium with that of titanium at center for comparison. (Can also be furnished in colors for \$1.50.) 9×2.
- MS₃₁. The spark spectrum of titanium (λ 4300– λ 4700). 9×2.
- MS₂₂. Spectrum showing Zeeman effect on certain mercury and iron lines. (Zeeman's *Researches in Magneto-optics*, Pl. I.) 5×4.
- MS₂₃. Spectrum showing Stark effect on certain hydrogen and helium series lines. (Stark's *Elektrische Spektralanalyse*, Table II.) 5×4.
- MS₅₁ [156]. Spectrum of lightning, showing coincidence with spectrum of spark in air. Photographed by Fox. (*Ap. J.*, 18, Pl. IX.) 6×4.

STEREOGRAMS (*not suitable for slides*)

(These are recommended as interesting and instructive. Stereograms of comets show the comet in high relief between the observer and the stars. Those of the moon give it a decidedly spherical appearance. The price is fifty cents each, mounted. 5×3)

- Stereo 1 [115]. Borrelly's comet. July 22, 1903. Photographed by Barnard and Wallace. (*Ap. J.*, 18, Pl. VII.)
- Stereo 2 [117]. The same, July 24, 1903. (*Pop. Astron.*, 12, Pl. I; *Ap. J.*, 18, Pl. VI.)
- Stereo 3 [532]. Comet 1908 III (Morehouse) combined from two photographs one hour apart, made October 15, by Barnard with 10-inch Bruce telescope. This shows the cork-screw form of the rejected tail near the head. (*Pop. Astron.*, 17, Pl. IX; *M.N.*, 69, 624.)
- Stereo 6. The same, three hours later. Shows great changes in the form of the rejected tail.
- Stereo 4 [533]. The same, November 16, 1908. Shows some of the short streamers near the head directed away from the earth.
- Stereo 5 [534]. The same, November 19, 1908. Shows a dark rift in the tail.
- Stereo 16. Sun and spot. Photographed by Miss Calvert with 12-inch telescope, February 14, 1917.
- Stereo 21 [320]. Moon's disk at 14 days. Photographed by Wallace.
- Stereo 22 [321]. The same at 17 days.
- Stereo 23. *Saturn* and the earth-lit crescent moon, August 24, 1916. Photographed by Barnard with 10-inch Bruce telescope.
- Stereo 31 [287]. Meteor trail, showing the *Orion* nebula in the field and the meteor trail in strong relief. Negatives by Barnard and Sullivan.
- Stereo 32. *Mars*. Photographed by Barnard with 40-inch refractor.
- Stereo 33. *Uranus*, with two of its moons. Photographed by Hubble with 24-inch reflector.
- Stereo 41. *61 Cygni*. Photographed by Barnard with 10-inch Bruce telescope.

- Stereo 42. "Star cluster in the Constellation of Nod." A model by W. D. Macmillan in which laws of cluster density and magnitudes are observed and by which the stars are shown in relief.
- Stereo 52 [201]. Equatorial head of 40-inch refractor, showing right ascension and declination circles with portion of main tube.
- Stereo 53 [203]. Micrometer eyepiece on the 40-inch refractor.
- Stereo 54 [205]. Rumford spectroheliograph attached to the 40-inch refractor.
- Stereo 56 [210]. Photometer on the 40-inch refractor.
- Stereo 57 [322]. Bruce photographic telescope. Shows three objectives.
- Stereo 58 [349]. The same. Shows eye-end, with plate holders.
- Stereo 71 [214]. Yerkes Observatory, from northeast.
- Stereo 72 [215]. Yerkes Observatory, south entrance.
- Stereo 73 [216]. Yerkes Observatory, southeast wing from the balcony of great dome, showing location with reference to Geneva Lake.
- Stereo 74 [217]. Yerkes Observatory, great dome from balcony of northeast wing.

VIEWS OF YERKES OBSERVATORY

- BI1 [191]. Iron skeleton of great dome, with wood sheathing just begun. 8×10 .
- BI2 [192]. South front, showing great dome with shutter open and telescope visible. 8×10 .
- BI3 [193]. The Observatory in winter, from the northeast. 7×5 .
- BI7. The Observatory from the northwest, October 1916. 10×8 .
- BI15. The Observatory. A nearby view from the northeast. 10×8 .
- BI16. The Observatory. A nearby view from the northwest. 10×8 .
- BI17. The Observatory from the southwest, June 21, 1919. (College men from the Y.M.C.A. Conference in foreground.) 10×7 .
- *BI19. The Observatory from the northeast, 1919. (If colored, 75 cents extra.) 10×6 .
- BI20. The Observatory and grounds, from an airplane. 10×8 .
- BI30 [196]. Central rotunda, main hall. (*Ap. J.*, 5, Pl. XII.) 10×8 .
- BI34. Dome on Snow Building covering the U.-V. doublet telescope. 8×10 .
- BI37. Bruce Building from the northwest. 10×8 .

INSTRUMENTS

- *BI51 [157]. The 40-inch Yerkes telescope, rising-floor at lowest position. 8×10 .
- BI52 [158]. The 40-inch Yerkes telescope, rising-floor at highest position. 10×8 .
- BI55 [161]. Equatorial head of 40-inch telescope, showing axes, circles, etc. 8×10 .
- BI56 [417]. Driving clock of the 40-inch refractor. 7×10 .
- BI57 [314]. The 40-inch objective ready for mounting. The photograph shows Alvan Clark and Carl Lundin sitting beside the lens. (*Ap. J.*, 6, Pl. XVI.) 10×8 .
- BI58 [162]. The 40-inch object glass, mounted. 10×8 .
- BI59 [163]. Eye-end of 40-inch telescope with micrometer. 10×8 .
- BI60 [164]. Eye-end of 40-inch telescope, showing the Bruce spectrograph and accessories for stellar and spectrographic work. (*Pub. Y.O.*, 2, Pl. I.) 10×8 .
- BI71 [165]. The 12-inch Kenwood refractor. (*Ap. J.*, 5, Pl. XIV.) 8×10 .

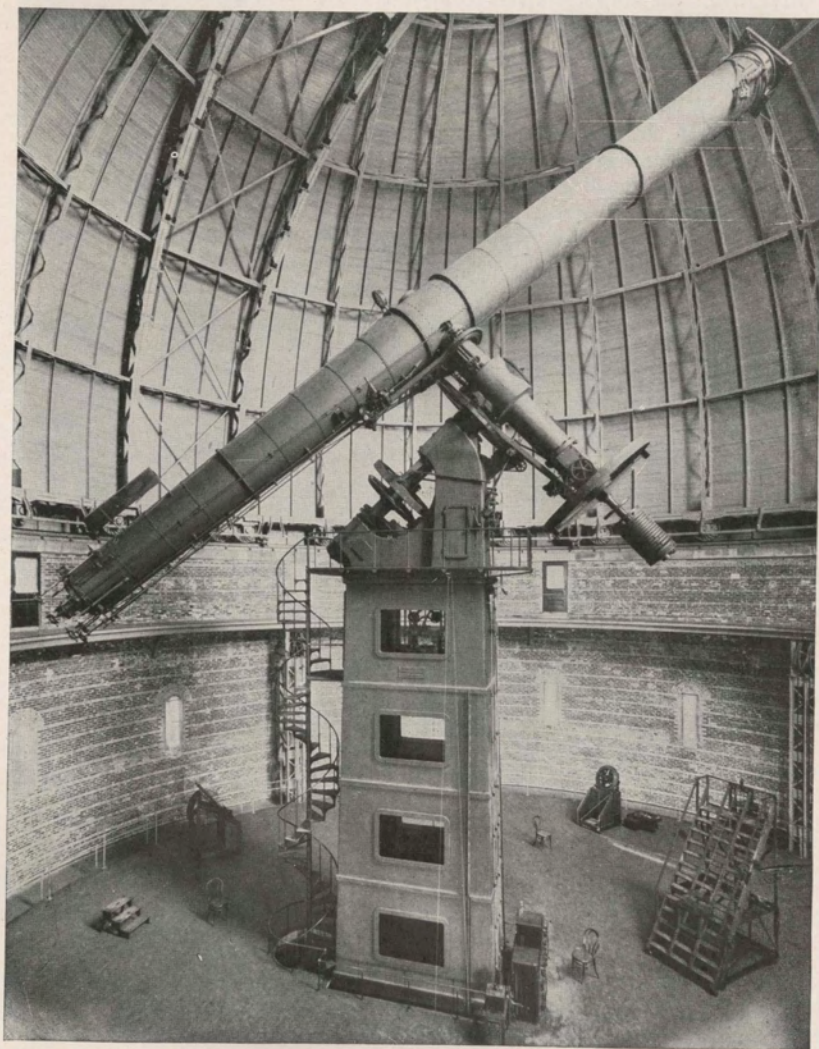


FIG. 14.—40-Inch Yerkes Telescope. B151

- *BI75 [166]. The 24-inch reflector. (*Ap. J.*, 14, Pl. X; *Pub. Y.O.*, 2, Pl. XXII.) 8×10.
 *BI81 [498]. Bruce telescope, which has three objectives by which different-sized photographs of the same region may be photographed simultaneously. 8×10.
 BI83. Bruce telescope, showing three plateholders. 8×10.
 BI84. Bruce telescope as temporarily set up in the corridor of the Yerkes Observatory. (*Ap. J.*, 21, 37.) 8×10.
 BI92. Zeiss Ultra-violet Camera. 814 mm focal length, 145 mm aperture. 15° and 30° prisms of same glass. Brashear mounting with driving clock. (*Ap. J.*, 36, 172.) 5×7.
 BI95 [171]. The horizontal coelostat telescope of 61½ feet focal length, as used at Wadesboro, N.C., for the eclipse of May 28, 1900. 10×8.

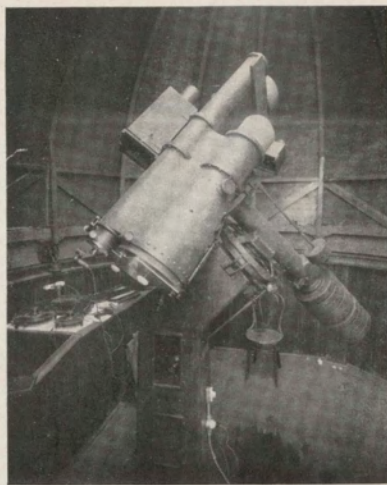


FIG. 15.—Bruce Telescope

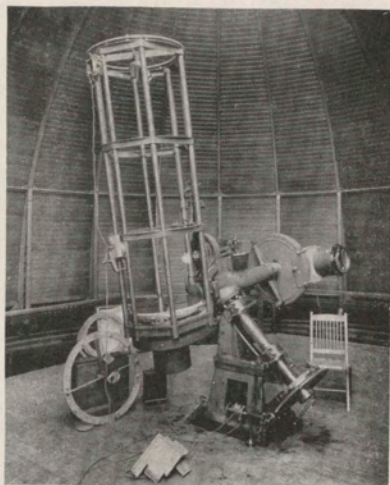


FIG. 16.—24-Inch Reflector

- BI98. The same, as used at the eclipse of June 8, 1918, at Green River, Wyoming. 10×8.
 BI97. Eclipse station of Yerkes Observatory, "Camp C. A. Young," Green River, Wyoming, June 8, 1918. 10×8.
 BI101 [640]. The comet seeker. 9×7.
 BI102. Sky patrol. A twin photographic camera, equatorially mounted. 10×8.
 *BI105 [177]. Rumford spectroheliograph attached to the 40-inch telescope. (*Pub. Y.O.*, 3, Pl. I.) 8×10.
 BI107 [179]. The same, showing prisms in prism box. 8×10.
 BI109 [180]. Solar spectrograph attached to 40-inch telescope. 10×8.
 *BI115 [183]. Bruce spectrograph attached to 40-inch telescope. (*Ap. J.*, 15, Pl. I.) 10×8.
 BI116 [184]. Bruce spectrograph, without case, showing three prisms and internal structure. (*Ap. J.*, 15, Pl. II.) 10×8.

- BI118 [186]. Concave grating spectroscope. 10×8 .
 BI119 [187]. Wedge photometer attached to 40-inch telescope. 5×8 .
 BI120 [188]. Double-slide plate-holder on 40-inch telescope. (*Pub. Y.O.*, 2, Pl. XII.)
 10×8 .
 BI131. Fuess spectrometer. 5×4 .
 BI132. Gaertner machine for measuring parallax plates. (*Pub. Y.O.*, 4, Pl. II.)
 10×8 .
 BI135 [296]. Zeiss stereocomparator. 10×8 .
 BI136 [297]. Zeiss stereocomparator with "Blink" microscope. 10×8 .
 BI137 [298]. Hartmann spectrocomparator, made by Zeiss. 10×8 .
 BI138 [495]. Hartmann microphotometer for exact measurements of photographic densities. (*Ap. J.*, 10, 321; 26, 246.) 5×7 .
 BI140. Graduated globe for measuring position of points on spectroheliograms. (*Pub. Y.O.*, 3, Pl. XXVI.) 7×5 .
 BI141. Diffraction grating of wooden bars placed over objective of 40-inch telescope for photometric purposes. 5×4 .

For many descriptions and reproductions of instruments of the Yerkes Observatory, see the *Astrophysical Journal*, Vols. V and VI, and "The Study of Stellar Evolution," by George E. Hale.

PORTRAITS

- | | |
|---|----------------------------|
| F1. J. C. Adams. | F26. B. A. Gould. |
| F2. G. B. Airy. | F27. Asaph Hall. |
| F3. F. W. A. Argelander. | F28. Edmund Halley. |
| F4. E. E. Barnard. | F29. Caroline Herschel. |
| F5. F. W. Bessel. | F30. John Herschel. |
| F6. Lewis Boss. | F31. William Herschel. |
| F7. James Bradley. | F32. Hipparchus. |
| F8. Tycho Brahe. | F33. Margaret Huggins. |
| F9. S. W. Burnham. | F34. William Huggins. |
| F10. G. D. Cassini. | F35. C. Huyghens. |
| F11. Alvan Clark. | F36. P. J. C. Janssen. |
| F12. Agnes Clerke. | F37. J. C. Kapteyn. |
| F13. Copernicus. | F38. James E. Keeler. |
| F14. Henry Draper. | F39. Kepler. |
| F15. F. W. Dyson. | F40. G. R. Kirchhoff. |
| F16. A. S. Eddington. | F41. S. P. Langley. |
| F17. Albert Einstein. | F42. Laplace. |
| F18. J. F. Encke. | F43. Le Verrier. |
| F19. J. Flamsteed. | F44. J. Norman Lockyer. |
| F20. J. B. L. Foucault. | F45. Charles Messier. |
| F21. J. Fraunhofer. | F46. A. A. Michelson. |
| F22. Fraunhofer demonstrating the spectroscope. | F47. Maria Mitchell. |
| F23. Galileo. | F48. G. Müller. |
| F24. K. F. Gauss. | F49. Simon Newcomb. |
| F25. David Gill. | F50. Isaac Newton. |
| | F51. Theodor von Oppolzer. |

F52. Edward C. Pickering.	F60. Otto Struve.
F53. Henri Poincaré.	F61. Wilhelm Struve.
F54. Ole Roemer.	F62. François Tisserand.
F55. Henry A. Rowland.	F63. H. H. Turner.
F56. J. Scheiner.	F64. H. C. Vogel.
F57. G. V. Schiaparelli.	F65. Max Wolf.
F58. K. Schwarzschild.	F66. C. A. Young.
F59. A. Secchi.	

Portraits of some of the members, past and present, of the staff of the Yerkes Observatory, can also be supplied. Also many groups of astronomers gathered at the Observatory on different occasions, such as the dedication in 1897 and the meeting of the American Astronomical Society in 1922.

MISCELLANEOUS

- Misc. 1. Specimen measurement by two observers at the Yerkes Observatory of the lines in the spectrum of *Beta Geminorum* for determining its radial velocity. (*Ap. J.*, 18, 258.) 5×4.
- Misc. 2. A table summarizing the measures of radial velocities of four standard stars as determined by two observers at Yerkes Observatory. (*Ap. J.*, 18, 273.) 5×4.
- Misc. 3. Brief table, giving colors, wave-lengths, and frequencies of rays of light. 5×4.
- Misc. 4. Wave-lengths of hydrogen lines as observed by Evershed in the solar chromosphere and as computed by Balmer's formula. (Baly's *Spectroscopy*, p. 560.) 4×5.
- Misc. 5. Table of positions and radial velocities of 25 spiral nebulae. (*Ap. J.*, 50, 125.) 3×4.
- Misc. 6. Diagrams of varieties of spectroscopes. (Young's *Manual of Astronomy*, § 244.) 5×4.
- Misc. 7. Diagram of optical path of pencils in the Michelson interferometer as used to determine diameters of stars. (*Ap. J.*, 53, 249.) 5×4.
- Misc. 8. Table of velocity of light in several media in miles per second. 5×3.
- Misc. 9. Curve showing relation between color-index and spectral class on plates taken with the U-V. doublet. Parkhurst. 5×4.
- Misc. 10. Table of radial velocities of globular clusters, according to Slipher. 5×3.

FACSIMILE OF CARD DESCRIPTION

PREPARED FOR EACH TITLE IN

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5 CENTS EACH; \$2.50 PER SET

BI 105. THE RUMFORD SPECTROHELIOGRAPH, ATTACHED TO THE 40-INCH REFRACTOR

The spectroheliograph was devised and named by Professor George E. Hale. It records photographically the areas of brilliant vapors over the sun's disk, and the eruptions of similar gases at the sun's edge. The latter are visible only in a spectroscope or at total solar eclipse. The high dispersion produced by prisms or a diffraction grating greatly weakens the continuous spectrum of sunlight in our atmosphere, while it does not weaken the monochromatic light of the gaseous prominences.

The spectroheliograph is a spectroscope which gives in the focal plane of its camera lens a sharp spectrum of the dark lines. A second slit in this focal plane, as long as the diameter of the sun's image (7 inches), is adjusted to admit the light from a single selected line of the spectrum and to exclude all other light, so that we are dealing only with a single ray. The central parts of the calcium lines H and K are reversed, or bright, at points on the sun's surface where the calcium vapor is especially brilliant.

A motor moves the solar image across the first slit and simultaneously moves the photographic plate across the second slit at the same speed, thus producing a photograph of the solar disk and any eruptions at its edge, in the light of the particular ray chosen.

See *Astrophysical Journal*, **16**, 211, 1902, and **19**, 41, 1904; also *Publications of Yerkes Observatory*, **3**, Part I.

Yerkes Observatory. 100 selected slides. Issued by the University of Chicago Press

Clerk of the Circuit and District Courts of the United States,

NORTHERN DISTRICT OF ILLINOIS.

S. W. BURNHAM,
Clerk.CHICAGO, ~~Nov 20~~ 1893

Burnham

Dear Dr. Ranper,

I am sure you will be glad to know that Prof. Barnard has been awarded by the French Academy the great Arago gold medal for his astronomical discoveries. As this medal, which is worth 1000 francs, has never been awarded but once before, the honor conferred is of the highest order. Barnard deserves it and has earned it and I am more pleased than ^{I should have been} if they had made a mistake and given it to me.

Sincerely yours

S. W. Burnham

London

CLERK OF THE CIRCUIT AND DISTRICT COURTS OF THE UNITED STATES
NORTHERN DISTRICT OF ILLINOIS

CHICAGO, ILL. 28-28-28

S. W. BURHAM, JR.
CLERK

(71)

Dear Sir,

I am sure you will be glad to know that Prof. Barnard has been awarded by the British Academy the great Darwin Medal for his extraordinary discovery. The medal, which is worth 1000 francs, has never been awarded but once before, the honor conferred is of the highest order. Barnard received it and the amount of it and I am more pleased than if they had made a mistake and given it to me.

Sincerely yours
S. W. Burham, Jr.

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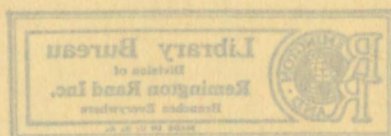
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Northwestern Christian Advocate,
Official Organ Methodist Episcopal Church,

Arthur Edwards, D.D. Editor.
Chas. M. Lumsden, B.D.
David D. Thompson.

57 Washington St. Chicago,

January 24. 1893.

189

Dear Dr. Harper:

Three or four of us want to catch you down town some day and take you to a brief lunch in some quiet restaurant.

Mr. Burnham the double star of observer and recently at Lick Observatory, Mr. Doulass the Photographer, and I want to talk to you about bringing Mr. Barnard who is now at Lick to Chicago for service with the Yerkes Telescope. Mr. B. is the one who recently discovered the fifth moon of Jupiter, as you remember. Can you name a day and let me gather in the other conspirators.

Please reply to 2816 Indiana Ave.

With high regard,

Your friend,

Arthur Edwards.

Edwards

Northwestern Christian Advocate
Official Organ, Methodist Episcopal Church

January 24, 1903
189

Chicago

Editor, Northwestern Christian Advocate
Chicago, Ill.

Dear Dr. Harper:

Three or four of us want to catch you down town some day and take you to a brief lunch in some quiet restaurant. Mr. Barnard the double star of observer and recently at the observatory, Mr. DeLass the photographer, and I want to talk to you about bringing Mr. Barnard who is now at Hick to Chicago for service with the Yerkes Telescope. Mr. E. is the one who recently discovered the fifth moon of Jupiter, as you remember. Can you name a day and let me gather in the other conspirators.

Please reply to 2878 Indiana Ave.

With high regards,

Your friend,

Arthur C. Edwards

OFFICE OF
W. E. HALE,
126 STATE STREET.

*Students
Observatory*

Hale

June 30 1894.

CHICAGO, 189.....

President. W. R. Harper.

University of Chicago. City.

Dear Sir:-

It gives me pleasure to offer to give to the University of Chicago, the astronomical, physical, photographic, and mechanical equipment of the Kenwood Observatory, to be taken by you where it is now located on 46th Street, at such time as your Observatory buildings are prepared to receive it.

This equipment consists of a 12 inch equatorial telescope, with visual lens, and 12 inch lens for photographic work, including its pier and dome. Also a spectro-heliograph and other attachments for solar and stellar observations and photography. Also other physical, electrical, photographic, and astronomical apparatus and fixtures, together with a machine shop for fine mechanical work, all of which I value at \$30,000.

You are at liberty to use the above apparatus and the building in which it stands, until such time as your new Observatory is ready to receive it.

Yours Very Truly,

W. E. Hale

W. E. HALE,
122 STATE STREET
CHICAGO, ILL.

June 30 1894.

CHICAGO, ILL.

President W. R. Harper.

University of Chicago. City.

Dear Sir:-

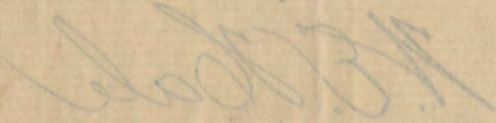
It gives me pleasure to offer to give to the University

of Chicago, the astronomical, physical, photographic, and
mechanical equipment of the Kenwood Observatory, to be taken by
you where it is now located on 48th Street, at such time as
your Observatory buildings are prepared to receive it.

This equipment consists of a 12 inch equatorial telescope,
with visual lens, and 12 inch lens for photographic work, in-
cluding its pier and dome. Also a spectro-heliograph and
other attachments for solar and stellar observations and photo-
graphy. Also other physical, electrical, photographic, and
astronomical apparatus and fixtures, together with a machine
shop for fine mechanical work, all of which I value at \$20,000.
You are at liberty to use the above apparatus and the

building in which it stands, until such time as your new Obser-
vatory is ready to receive it.

Yours Very Truly,



OFFICE OF
ASTRONOMY AND ASTRO-PHYSICS.
DEPARTMENT OF ASTRO-PHYSICS.
GEORGE E. HALE, - EDITOR.

University of Chicago,
Kenwood Observatory.

Chicago, Oct. 24, 1894 189

Budget
file
President Wm. R. Harper

University of Chicago

My dear Sir:-

I enclose herewith a statement of the estimated annual expenses of operating the Yerkes Observatory, together with comparative statements giving the actual expenses of other observatories among which the Yerkes Observatory must maintain a standing. The estimate of expenses other than the salaries of astronomers will be seen to differ from an estimate given you over a year ago. At that time I guaranteed that the expenses of the Observatory, other than salaries, should not exceed six thousand dollars during the first year. This guarantee was made with the hope of inducing the Board of Trustees to proceed at once with the construction of the Observatory. I felt that it would be better to operate the Observatory at this low figure rather than to further delay its construction. The estimate made no provision for Observatory publications nor for minor apparatus and materials, though it was well known that every observatory, however small, issues an annual volume containing the results of its work for the year. We are receiving such volumes, presented by other observatories to the Yerkes Observatory, almost daily, and it is imperative that we make some return before long. The estimate now presented covers expenses which will of necessity be incurred in case the Observatory is to stand among other institutions of the same class. With an adequate staff of

University of Chicago
Department of Astronomy

ASTRONOMY
DEPARTMENT
UNIVERSITY OF CHICAGO

Chicago, Oct. 24, 1904

President Wm. R. Harper

University of Chicago

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(2)

Chicago, 189

astronomers godd work might ^{be done} even if the expenses other than salaries were kept down to \$6000, during the first year, but later the expenses would have to be increased to about the amount indicated in the enclosed estimate.

You will notice that the total expenditure contemplated is little more than one-third that of the Harvard Observatory, about one-half that of the Paris and Pulkowa Observatories, and about equal to that of the Lick Observatory. It should be mentioned, that the expense of publishing the quarto volumes issued by the Lick Observatory is not included in the statement given. The same institution also provides each married member of its staff with a comfortable house, and good lodgings for all other employes. Many other observatories-e.g. the Pulkowa, Nice, Potsdam, Vienna, Berlin, etc.-do likewise.

In connection with the list of salaries, I have named the astronomers we ought to secure to fill these important positions. Professor Burnham, as you know, can be at Lake Geneva but a small part of the time, on account of his business in Chicago. Professor Keeler, formerly of the Lick Observatory and now Director of the Allegheny Observatory, is the ablest stellar spectroscopist in this country. A strong effort is being made to secure for him a large telescope, but if this does not succeed I think we could induce him to come to the Yerkes Observatory. Professor Barnard, of

(2)

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(3)

Chicago, 189

the Lick Observatory, is also without an equal in his line of work, and he should be secured if possible. Dr. Schumann, of Leipzig, would be an almost equally important acquisition, and he should be engaged soon, as efforts are being made to induce him to go elsewhere. He ~~had~~ would probably bring with ^{him} the apparatus of his private laboratory, which is worth several thousand dollars. It is barely possible that he would come for \$1500, but Keeler and Barnard could not be secured for less than \$3000 each. With these men and a single computer, the Observatory would soon make a name for itself and for the University.

Very respectfully yours

George E. Hale

(3)

Chicago, Illinois

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Very respectfully yours

George E. Hale

Chicago,.....189.....

Annual Expenses of other Observatories of the Same Class

Paris Observatory(from Annual Report of the Director,1893)

Staff

Director

9 Astronomers

14 Assistant Astronomers

Chief of Computers

Large number of Computers

Chief of Photographic Reduction Bureau

5 Assistants in " " "

Librarian

Assistants,mechanicians,etc.

Annual Expenses-\$48000

Pulkowa Observatory (Mem.della Soc.deg.Spettro.Ital.,1875)

Staff

Director

4 Astronomers

7Assistant Astronomers

10 Assistants

Secretary

Mechanician

4 Machinists

Annual Expenses-\$44000

Annual Expenses of other Observatories of the same Class

Park Observatory (from Annual Report of the Director, 1893)

Staff

Director

9 Astronomers

14 Assistant Astronomers

Chief of Computers

Large number of Computers

Chief of Photographic Reduction Bureau

5 Assistants in " " "

Librarian

Assistants, mechanicals, etc.

Annual Expenses-\$48000

Pulkova Observatory (Mon. delia Soc. del. Spectro. Ital., 1875)

Staff

Director

4 Astronomers

Assistant Astronomers

10 Assistants

Secretary

Mechanician

2 Miscellaneous

Annual Expenses-\$44000

Chicago, 189.....

Greenwich Observatory (from Annual Report of the Director, '94)

Staff

Director

Chief Astronomer

5 Astronomers (First Class)

3 Astronomers (Second Class)

23 Computers

Foreman of Works

Mechanician

Assistants and others, making a total of 47.

Harvard University Observatory

(Staff of about 40)

Annual Expenses-\$65000.

Lick Observatory

Staff

Director(Holden)-----\$5000.(and house)

Astronomer(Schaeberle)-----2400. " "

Astronomer(Barnard)-----2400. " "

Astronomer(Campbell)-----2000. " "

Astronomer(Tucker)-----2000. " "

Assistant Astronomer(Colton)-----1500. " "

Secretary(Perrine)-----1000. " "

2 Mechanics-----2000.

Total Expenses-\$25000.

Greenwich Observatory (from Annual Report of the Director, '94)

Staff

Director

Chief Astronomer

8 Astronomers (First Class)

8 Astronomers (Second Class)

22 Computers

Foreman of Works

Mechanician

Assistants and others, making a total of 47.

Harvard University Observatory

(Staff of about 40) Annual Expenses-\$65000.

Lick Observatory

Staff

Director (Holden)-----\$5000 (and house)

" " Astronomer (Schlesinger)-----\$400

" " Astronomer (Burns)-----\$400

" " Astronomer (Campbell)-----\$2000

" " Astronomer (Thacker)-----\$2000

" " Assistant Astronomer (Colton)-----\$500

" " Secretary (Pattino)-----\$1000

2 Mechanicians-----\$800

Total Expenses-\$27000.

Hale
Geo. E.

CHICAGO, June 15 1895

My dear Dr. Harper,

I am very glad to hear that you have received Professor Barnard's letter of acceptance. I quite agree with you in thinking that he should be handsomely treated here. If he is to be given an opportunity to work with the great telescope next autumn something should be done at once to provide for houses. I would also suggest that the Board of Trustees might advantageously do what they can to induce the contractors to push forward their work on the Observatory. I was at Lake Geneva yesterday, and found that ~~now~~ brick has been laid, and the foundations are not yet completed.

My Father is out of town, and will not return before July 1. I shall be glad to talk with you at any time.

Yours very truly
George E. Hale

Chicago June 17 1897

My dear Dr. Harker,

I am very glad
to hear that your letter
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I quite agree with you in thinking that
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Yours very truly
George F. Harker

Hale

CHICAGO, March 14th 1896. 189__

President W.R. Harper,

University of Chicago, Chicago.

My dear Dr. Harper,

It has been recognized from the outset that the work of the Astronomical Department should be emphasized under three heads, viz. - (1) Astronomy, which deals with the masses, positions and motions of the heavenly bodies; (2) Astrophysics, which deals with their chemical constitution, temperature, pressure and other physical characteristics, determination of relative motions, solar and stellar radiation, etc.; and (3) Geophysics, which deals particularly with the physical phenomena of the Earth and its atmosphere, considered as one of the members of the solar system. Save for the appointment of a professor in charge of the astronomical work at the University, the organization of the first two divisions may be regarded as fairly satisfactory at the present time. It remains to inaugurate the work of the third division, for which an exceptional opportunity now presents itself. The intimate connection existing between some of the most important problems of Astrophysics and Geophysics is evidenced by the maintainance in such observatories as those of Paris, Greenwich, Nice, Potsdam, Catania etc., of complete equipments for magnetic and meteorological observations, under the control of a special staff of observers. The Earth, as one of the members of the solar system, presents for investigation many problems of the highest cosmical significance. For example, the

CHICAGO, MARCH 14, 1908.

President W. R. Harper,

University of Chicago, Chicago.

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CHICAGO, _____ 189__

relation long known to exist between solar disturbances and the variations of terrestrial magnetism can only be elucidated by a careful study of the records of automatic magnetic instruments, such as those asked for in my first communication to Mr. Yerkes on the subject of minor equipment. Such delicate recording instruments can be used only in situations far removed from earth tremors and disturbances of any kind. As the grounds of the Yerkes Observatory offer nearly perfect conditions for such work we greatly hope that it may soon be established there.

With the needs of this division of our department in view we heartily endorse Dr. Bauer's plan of organizing geophysical investigations at Lake Geneva, and in the event of his appointment we shall be glad to do everything in our power to aid him in his undertaking. His long experience in the Coast Survey, and the international reputation to which the marked scientific success of his new Journal is largely due, eminently fits Dr. Bauer for the important work which we believe should be entrusted him.

Very truly yours,

George E. Hale
G. L. O. Hadsworth

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should be entrusted him.

Very truly yours,

George E. Hale
James E. Keller

The University of Chicago

FOUNDED BY JOHN D. ROCKEFELLER

Depew

CHICAGO, Dec. 22d, 1896.

Yerkes

Mr. Chauncey Depew,

I take the liberty of writing you in reference to the glass of the Yerkes Astronomical Observatory. This glass is now in Cambridge, Mass. and is finished ready for shipment. The transportation of such a glass is, from the point of view of science, one of the most delicate operations. We shall be able to succeed in transporting it safely only with the co-operation of the railroad authorities.

When the great Lick glass, 36 inches in diameter, was taken from Cambridge to California, it was placed in the middle of a sleeping car and made the trip with perfect safety. The case is so

peculiar, so important and so exceptional that I venture, in the interests of science, to ask ~~through you the railroad authorities~~ *your kind assistance assistance of the* interested, namely, Boston & Albany, ~~N. Y. Central~~ *Lake Shore* and the Northwestern railroad, and likewise the Wagner Sleeping Car

Co. for your kind assistance. Would it be too much to ask ~~the use of~~ *for transportation*

over your line a Wagner sleeping car and the transportation of ~~one or~~ two attendants.

We are very anxious not to have the glass moved from the time it leaves Cambridge until it reaches Lake Geneva. I am sure that you will appreciate the fact that in locating the observatory ~~on~~ the line of the North Western R.R., a step was taken which will ultimately be of financial interest to those interested in that railroad. I am sure also that for any courtesy extended to the University in this matter, Mr. Yerkes and Mr. Rockefeller will be particularly appreciative.

Mr. Depew of the N.Y. C.R.R. has already consented to furnish the transportation asked of the car over the N.Y. C.R.R.

Sincerely hoping that it may seem wise to you to assist us in this very delicate and difficult matter, and thanking you in advance

The University of Chicago

FOUNDED BY JOHN D. ROCKEFELLER

for any courtesy which you may extend to us, I remain, with pleasant
recollections of past meetings,

Yours very sincerely,

W. R. Harper

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to the matter of the Yerkes Astronomical Observatory. This glass is

now in Cambridge, Mass. and is finished ready for shipment. The

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interested, namely, Boston & Albany, N. Y. Central, Michigan Central

and the Northwestern railroad, and likewise the Western Sleeping Car

Co. for your kind assistance. Would it be too much to ask you to

have a Warner sleeping car and the necessary equipment sent to

We are very anxious not to have the glass covered from the time it

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Sincerely hoping that it may seem wise to you to assist us in

this very delicate and difficult matter, and thanking you in advance

Astronomy

G

Hale

YERKES OBSERVATORY, UNIVERSITY OF CHICAGO
WILLIAMS BAY, WISCONSIN

CABLE ADDRESS
ARCTURUS, CHICAGO

Oct. 2, 1897.

President W. R. Harper,
University of Chicago,
Chicago.

33

Dear Dr. Harper,-

I take the liberty of introducing to you Dr. E. J. Wilczynski, who has recently taken his degree at the University of Berlin. Dr. Wilczynski showed his first interest in astronomy when a student at the North Division High School, and as I found him to be particularly gifted in this direction, I recommended to his parents that he be given an opportunity to pursue his studies further. Four years ago he went to the University of Berlin, and now, at the age of twenty-one years, has received his degree. He is anxious to obtain some work in connection with the University, and as I know his means to be very limited, I hope it will be possible to give him some position. If he cannot obtain any work in teaching, he will probably have to go into some line of business, which would be likely to take him away from astronomy altogether. This I should regard as a real misfortune, as his talents seem to me exceptional.

Very truly yours,

George E. Hale

*He is equally strong
in theoretical physics.*

YERKES OBSERVATORY, UNIVERSITY OF CHICAGO
WILLIAMS BAY, WISCONSIN

CABLE ADDRESS
ARCTURUS, CHICAGO

Oct. 2, 1887.

President W. R. Harper,
University of Chicago,
Chicago.

Dear Dr. Harper:-

I take the liberty of introducing to you Dr. E. E. Wilczynski, who has recently taken his degree at the University of Berlin. Dr. Wilczynski showed his first interest in astronomy when a student at the North Division High School, and as I found him to be particularly gifted in this direction, I recommended to his parents that he be given an opportunity to pursue his studies further. Four years ago he went to the University of Berlin, and now, at the age of twenty-one years, has received his degree. He is anxious to obtain some work in connection with the University, and as I know his means to be very limited, I hope it will be possible to give him some position. If he cannot obtain any work in teaching, he will probably have to go into some line of business, which would be likely to take him away from astronomy altogether. This I should regard as a real misfortune, as his talents seem to be exceptional.

Very truly yours,

George E. Hale

He is especially strong
in theoretical physics

374 Grand Ave. ^{Flax}
Brooklyn, Jan. 22, 1900.

Dear Dr. Harper,

(101)

Permit me
to urge upon you the importance
of advancing both Dr. Laves
and Dr. Moulton this year.
I wish to renew the recommend-
ations made in my letter
of a few weeks since on
the Budget, and to further
emphasize the desirability
of giving to these men only
what is fairly due them.

It must not be supposed
that the work of Dr. Laves and
Dr. Moulton is in any way in-
ferior to that done by the
members of the Observatory staff.

As a matter of fact they are offering the only comprehensive courses in astronomy given in any American university. Special attention ^{is called} to the excellence of these courses in a recent report on instruction in astronomy in the United States included with the report of Commissioner Harris.

I know that Professor Young has talked of Dr. Loomis as his possible successor at Princeton, and good authorities have considered Dr. Moulton competent to fill the position of Superintendent of the Nautical Almanac. Therefore, in view of (1) their ability, (2) the importance and variety of the courses they offer, (3) the advancement

accorded to other men of certainly
not superior ability in other
departments of the University,
and (4) the great difficulty of
securing other men to fill
such positions, even at far
higher salaries, I strongly
recommend that they be given
the fullest possible consideration.
Both rank and salary are
of great importance to them.
As far as the former goes I hope
Dr. Laves will certainly be made
an Assistant Professor and
Dr. Moulton ^{an Instructor} in my opinion
they are respectively entirely com-
petent to occupy the next higher
ranks, i.e., Associate Professor
and Assistant Professor. Again,
in the matter of salaries I hope
their needs and deserts will

accorded to other men of certain
vast superior ability in other
departments of the University.
and (4) the great difficulty of
securing others even to fill
such positions, even at far
higher salaries, I strongly
recommend that they begin
the fullest possible consultation
with each other and ask any one
of great importance to them.
As far as the former good life
but I am well certainly be well
on Assistant Professor and
Dr. Houghton, in my opinion
they are respectfully entreated
to select to occupy the next higher
rank, i.e. Assistant Professor
and Assistant Professor.
in the matter of salaries I hope
there will be some

not be overlooked. Dr. Laves
should in no event be given
less than \$1600, and Dr. Moul-
ton should receive \$1200. at
the very lowest.

My belief in the importance
of these advancements is
indicated by the fact that
in my letter regarding the
budget I gave them precedence
over the ~~other~~ requests
made for the very urgent
needs of the Observatory, which
I must consider of secondary
importance when compared
with these pressing claims.

Trusting that you will do
everything in your power for
Dr. Laves and Dr. Moulton, I am
Yours very truly
George E. Hale

not be overlooked. Dr. Jones
should in no event be given
less than \$1000, and Dr. H.
ten should receive \$1000. at
the very least.
My belief in the importance
of these elements is
indicated by the fact that
in my letter regarding the
budget I gave them precedence
over the ~~other~~ requests
made for the very urgent
needs of the Government, which
I must consider of secondary
importance when compared
with these pressing claims.
Trusting that you will be
sufficiently impressed in your favor for
Dr. Jones and Dr. H. and
I am very truly
Yours
J. B. Jones

P.S.

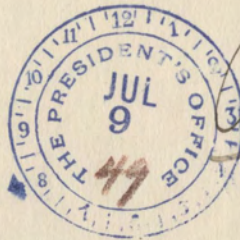
I see in the papers that Mr. Yerkes and a member of the University faculty are to speak before some Club in Chicago on municipal ownership. If, as is not improbable, the position to be taken by the University man is likely to be in opposition to that of Mr. Yerkes, it might perhaps be as well to see him before this occasion, if possible. Of course I know nothing of the actual facts of the case, which in no event would really involve the University, but Mr. Y's previous expressions of feeling regarding statements by University men have been such as to raise in my mind a fear which has perhaps already presented itself to you.

I am in the future
 that Mr. Verbeke and a number
 of the University faculty
 are to speak before some
 Club in Chicago on municipal
 ownership. If, as is most
 probable, the position to be
 taken by the University
 is likely to be in opposition
 to that of Mr. Verbeke, it might
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 him before this occasion, if
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 which in no event would really
 involve the University, but through
 previous expressions of feeling regarding
 statements by University men
 there must be some in-
 vention of fact which has perhaps
 already furnished the basis for

THE UNIVERSITY OF CHICAGO
FOUNDED BY JOHN D. ROCKEFELLER

YERKES OBSERVATORY
WILLIAMS BAY, WISCONSIN

CABLE ADDRESS
ARCTURUS CHICAGO



WILLIAMS BAY, WISCONSIN.

July 7, 1900.

President W. R. Harper,
The University of Chicago,
Chicago, Ill.

Dear Dr. Harper:-

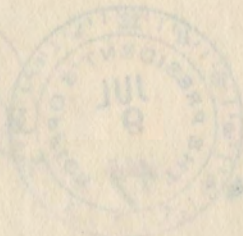
I am sorry to say that there is some danger that Dr. Laves will leave his position at the University, as he is seriously considered for the position of Professor of Astronomy and Director of the Observatory at the University of Missouri. Dr. H. S. Pritchett, Superintendent of the U. S. Coast and Geodetic Survey and President elect of the Massachusetts Institute of Technology, in writing to me regarding this matter, says "I consider him (Dr. Laves) an uncommonly good man in mathematical astronomy and I think Chicago University would make a mistake to let him go." I have long believed, as I have frequently told you, that Dr. Laves should be given an assistant professorship with an advance in salary. Is it not possible to do something in order to retain him at the University?

Very sincerely yours,

George F. Hale

THE UNIVERSITY OF CHICAGO

FOUNDED BY JOHN D. ROCKEFELLER



YERKES OBSERVATORY
WILLIAM DAVENPORT

CHICAGO, ILL.

WILLIAM DAVENPORT

July 7, 1900.

President W. H. Harper,

The University of Chicago,

Chicago, Ill.

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I am sorry to say that there is some danger that Dr. Laves will leave his position at the University, as he is seriously considered for the position of Professor of Astronomy and Director of the Observatory at the University of Missouri. Dr. H. E. Pittchett, Superintendent of the U. S. Coast and Geodetic Survey and President of the Massachusetts Institute of Technology, in writing to me regarding this matter, says "I consider him (Dr. Laves) an uncommonly good man in mathematical astronomy and I think Chicago University would make a mistake to let him go." I have long believed, as I have frequently told you, that Dr. Laves should be given an assistant professorship with an advance in salary. Is it not possible to do something in order to retain him at the University?

Very sincerely yours,

W. H. Harper

Astoria
Astoria, July 16, 1900.

My Dear Professor Hale:-

I have your note of July 7th in reference to Laves. I am sorry to say that the university never takes action in reference to any man at a time when he is considering a position in another University.

Yours very truly,

W. R. Harper

July 16, 1900.

My Dear Professor Halsey:-

I have your note of July 7th in reference to Hayes. I am sorry to say that the University never takes action in reference to any man at a time when he is considering a position in another University.

Yours very truly,

W. R. Harper

Astronomy

THE UNIVERSITY OF CHICAGO
FOUNDED BY JOHN D. ROCKEFELLER

YERKES OBSERVATORY
WILLIAMS BAY, WISCONSIN

May 19, 1902

President W. R. Harper

The University of Chicago

Dear Dr. Harper:

I urgently request that permission be given by the Trustees to expend \$300.00, from the appropriation ^{which} becomes available on July 1, for the immediate improvement of the Students' Observatory. It should be possible for this sum to provide a new building (preferably of wood) for the meridian instrument, and to effect some very necessary repairs on the small dome which covers the equatorial telescope. If permission cannot be obtained to erect a wooden building, it might become necessary to use the entire sum for a sheet-iron building for the meridian instrument. In the absence of any accurate estimate from an architect (which I asked permission for Professor Laves to obtain some time ago) it is impossible to tell just what the building would cost. But at present I desire only to ask permission to expend \$300.00 at once.

As you are aware, the present buildings of the Students' Observatory, originally constructed only for temporary use for the U. S. Naval Exhibit at the World's Fair, are in so deplorable a condition that all of the delicate (essential) parts of the instruments have had to be removed to protect them from the weather. As a consequence, courses announced in practical astronomy have had to be abandoned. More must be done for the Students' Observatory in the near future, but the appropriation asked would do a great deal of good at the present time.

Very truly yours

Lyons E. Hall

May 19, 1903

President W. R. Harper

The University of Chicago

Dear Dr. Harper:

I respectfully request that permission be given by the Trustees to expend \$500.00 from the appropriation, now available on July 1 for the immediate improvement of the Yerkes Observatory. It should be possible for this sum to provide a new building (probably of wood) for the meridian instrument, and to effect some very necessary repairs on the small dome which covers the equatorial telescope. It is estimated that to obtain or erect a wooden building, it might become necessary to use the entire site for a short-lived building for the meridian instrument. In the absence of any accurate estimate from an architect, I have asked permission for Professor Hayes to obtain some time ago) it is impossible to tell just what the building would cost. But at present I desire only to ask permission to expend \$500.00 at once.

As you are aware, the present building of the Yerkes Observatory, originally constructed only for temporary use for the U. S. Naval Exhibit at the World's Fair, and in so desirable a position that all of the delicate (essential) parts of the instrument have had to be removed to protect them from the weather. As a consequence, devices mounted in practical telescope have had to be abandoned. More must be done for the Yerkes Observatory in the near future, but the expenditure asked would do a great deal of good at the present time.

Very truly yours

W. H. Hay

December 19, 1902.

Ashtons
My dear Mr. Hale:-

I am wondering whether it is not possible for the
Department of Astronomy to turn out some Doctors. Isn't there any
way of arranging our work so that this would be possible?

Yours very truly,

W. R. Harper

Mr. George E. Hale.

December 19, 1902.

My dear Mr. Hale:-

I am wondering whether it is not possible for the

Department of Astronomy to turn out some Doctors. I don't there any

way of arranging our work so that this would be possible?

Yours very truly,

W. R. Harper

Mr. George E. Hale.

YERKES OBSERVATORY
WILLIAMS BAY, WIS.

5754 Woodlawn Ave.
OFFICE OF THE DIRECTOR

December 20th, 1902.

✓
President W. R. Harper,

The University of Chicago.

Dear Dr. Harper:

In reply to your letter of December 19th, I beg to say that Mr. Hamilton, recently appointed to the chair of astronomy at Beloit College, will take his examination for the Doctor's degree in our department within a few weeks. We cannot expect, however, to turn out many Doctors until a suitable students' observatory has been provided. Indeed, I doubt whether any other institution in the country has done so well in this regard with an equipment for instruction so meagre as ours.

I am hoping to obtain an appointment with you not later than Monday, as a very important question connected with the future plans of the Carnegie Institution, and requiring immediate consideration on my part, has just arisen. I expect to go to Williams Bay on Tuesday, and after spending some days there I shall go to Washington on Saturday. For this reason I am anxious to see you not later than Monday.

Very truly yours,

George E. Hale

VERKES OBSERVATORY
5754 Woodlawn Ave.
OFFICE OF THE DIRECTOR

VERKES OBSERVATORY
WILLIAMS BAY, WIS.

CARL K. KOSCH
ASTROPHYSICAL OBSERVATORY
CHICAGO

December 30th, 1902.

President W. R. Harper,

The University of Chicago.

Dear Dr. Harper:

In reply to your letter of December 18th, I beg to say that Mr. Hamilton, recently appointed to the chair of astronomy at Beloit College, will take his examination for the Doctor's degree in our department within a few weeks. We cannot expect, however, to turn out many Doctors until a suitable students' observatory has been provided. Indeed, I doubt whether any other institution in the country has done so well in this regard with an equipment for instruction so meagre as ours.

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Very truly yours,

George F. Johnson

January 11th, 1907.

Professor E. B. Frost,
Williams Bay, Wis.

My dear Mr. Frost:-

Your favor of the 9th inst. is at hand. I shall be able in a few days now to send you a full statement. We tried to provide so that you would not have to pass the hat around the Lake next year, and I think that this is accomplished.

So far as the temporary student observatory is concerned, we have not yet heard from the east from our request for funds for that purpose. Several of the requests which we made were held under further advisement and this is one.

The question of the Botanical department garden is ~~not~~ in shape just now so that we can build on it at all. If we could get the money for the temporary observatory then it will be better for us to go ahead with that at once.

With sincere regards,

Yours,

H. P. Judson.

January 11th, 1907.

Professor W. B. Frost,

Williams Bay, Wis.

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at hand. I shall be able in a few days now to send

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The question of the Botanical department garden

is not in shape just now so that we can build on it

at all. If we could get the money for the temporary

observatory then it will be better for us to go ahead

with that at once.

With sincere regards,

Yours,

H. P. Judson

January 31st, 1907.

Astronomy

My dear Mr. Frost:-

I think Mr. Moore has written you about the questions involved in the plans for the final location of the Mathematical and Astronomical buildings in the quadrangles. Before proceeding with the question of the temporary student observatory we ought to be quite clear as to what we intend finally to do for a permanent structure for that purpose. I understand that the possibility of providing a dome on the roof of one of the high buildings you regard as doubtful. Of course I can see that to extend solid piers that height would be difficult and expensive. That failing the question of location on the Midway front naturally comes up. Of course that would insure a southern horizon, but other buildings would be likely to cut off the horizon on other sides. The question of a botanical garden is at present too indefinite to be very sure about. If we are able to locate those gardens within the quadrangles that might solve your question. If circumstances, however, should take such a turn that we should want to put that garden at some distance away, it would

January 21st, 1907.

Dear Mr. Moore

My dear Mr. Frost:-

I think Mr. Moore has written you about the questions involved in the plans for the final location of the Mathematical and Astronomical buildings in the quadrangles. Before proceeding with the question of the temporary student observatory we ought to be quite clear as to what we intend finally to do for a permanent structure for that purpose. I understand that the possibility of providing a dome on the roof of one of the high buildings you regard as doubtful. Of course I can see that to extend solid piers that height would be difficult and expensive. That failing the question of location on the Midway front naturally comes up. Of course that would involve a southern horizon, but other buildings would be likely to cut off the horizon on other sides. The question of a botanical garden is at present too indefinite to be very sure about. If we are able to locate these gardens within the quadrangles that might solve your question. If circumstances, however, should take such a turn that we should want to put that garden at some distance away, it would

not quite fill the bill for you. I should be glad to have your judgment on this matter. While there is no immediate prospect of erecting these buildings which we have in mind, we do want to decide as to what is to be done when the time comes so as to waste no time in preliminary planning later.

Very truly yours,

H. P. Judson

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have your judgment on this matter. While there is no
immediate prospect of erecting these buildings which we
have in mind, we do want to decide as to what is to be
done when the time comes so as to waste no time in
preliminary planning later.

Very truly yours,

H. P. Judson

7 1/68 ~~1/68~~

Chicago, October 8, 1921

Harry Pratt Judson, Esq.,
President, University of Chicago,
Chicago.

Dear Sir:

I am agitating for a Free Public Astronomical Observatory in or near Chicago, patterned somewhat on the order of those in many German cities. I plan to have it open to the public every night. The stars and planets would be shown every clear evening through telescopes, and on cloudy or rainy evenings there would be illustrated lectures and demonstrations of astronomical and kindred subjects.

A Free Astronomical Observatory is a great asset to any city. Des Moines, Iowa, possesses one; but Chicago, a much larger city, does not. I have received considerable offer of support from people interested in the cultural and educational value of astronomy, as well as enough equipment to start going. The Chicago Tribune, of which I am the astronomical editor, has lent its pages to the project, as an interested party. What is needed for a start is an open space that will hold 500 or more people, and a hall of equal capacity for the lectures. What facilities and advantages would the University of Chicago offer the Tribune to have this proposed institution locate with you?

I am Thanking you for your consideration and reply,

Yours very truly,

S. F. Maxwell

Astronomer, Chicago Tribune.

}

Dear Sir:

MS I

Yfntv yrev axuoY

October 10, 1921.

My dear Mr. Maxwell:-

Your favor of the 8th instant is received. I will confer with our Department of Astronomy and with others, and will let you know as soon as possible what can be done.

With best wishes, I am

Very truly yours,

Mr. S. F. Maxwell,
Astronomer, Chicago Tribune,
Chicago, Ill.

HPJ:CB

October 10, 1931.

My dear Mr. Maxwell:-

Your favor of the 8th instant is received. I will confer with our Department of Astronomy and with others, and will let you know as soon as possible what can be done.

With best wishes, I am

Very truly yours,

Mr. S. F. Maxwell,
Astronomer, Chicago Tribune,
Chicago, Ill.

H2:CB

168

The University of Chicago

October 18, 1921.

President Harry Pratt Judson,
University of Chicago,
Chicago, Illinois.

My dear Mr. Judson:

Mr. Maxwell has been writing short articles on Astronomy for the Sunday Tribune for several years. He is personally much interested in the subject, and there are evidences that the Tribune managers are also interested. It might be that they could stir up enough interest to lead the way to securing money for an observatory.

It is difficult to answer specifically the question which he asks regarding the "facilities and advantages" which the University would care to offer. We have at present no place having a capacity of 500 people which could be devoted to this purpose every night, or even a considerable fraction of the nights. Consequently the University could not cooperate until a building is provided. It seems to me that it would be safe to state that the University looks upon the project with favor and would be glad to consider having the proposed observatory located on some of its ground in the vicinity of the Midway. It does not seem to me safe to go much further on present information.

Very truly yours,

DR Moulton

FRM/g

The University of Chicago

October 18, 1921.

President Harry Pratt Judson,
University of Chicago,
Chicago, Illinois.

My dear Mr. Judson:

Mr. Maxwell has been writing short articles on
Astronomy for the Sunday Tribune for several years. He
is personally much interested in the subject, and there
are evidences that the Tribune managers are also interested.
It might be that they could stir up enough interest to lead
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which he asks regarding the "facilities and advantages" which
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space having a capacity of 500 people which could be devoted
to this purpose every night, or even a considerable fraction
of the night. Consequently the University could not
cooperate with a building is provided. It seems to me that
it would be safe to state that the University looks upon the
project with favor and would be glad to consider having the
proposed observatory located on some of its ground in the
vicinity of the library. It does not seem to me safe to go
much further on present information.

Very truly yours,

Dr. Maxwell

RM's

October 29, 1921.

My dear Mr. Maxwell:-

With reference to your questions of the 8th instant I may say that I have conferred with some of our staff. Of course, our main Observatory is at Williams Bay, Wisconsin. We have here only a small telescope used by the undergraduate classes. We have an open space on our grounds that will hold 500 or more people. We have a hall of that capacity or larger where lectures could be given. We have, however, no such telescope as ought to be used for the purpose you indicate. If any provision could be made for such a telescope with the proper mounting and housing, the University would be greatly gratified, and our staff in Astronomy would be interested in putting it at the disposal of the public.

Very truly yours,

Mr. S. F. Maxwell,
Astronomer,
The Chicago Tribune.

HPJ:CB

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Very truly yours,

Mr. E. F. Maxwell,
Astronomer,
The Chicago Tribune.

HPJ:CB

Astronomy Mr. F. R. Moulton
3
H.P.J.

Chicago, November 1, 1921

Mr. Harry Pratt Judson,
President,
University of Chicago,
Chicago, Illinois.

Dear Sir: -

I wish to convey to you my great appreciation for the offer which you have made me in behalf of your institution, and I will lay the same before the owners of the Chicago Tribune.

The purpose of a Free Public Observatory in Chicago, is, of course, to reach the everyday people. It has been my policy while Astronomy Editor of the Tribune to recommend nothing for view which an ordinary person could not avail himself of with a little effort. The people for the most part do not know or understand large telescopes, or even those of moderate power, because hardly one in ten thousand has ever even seen one, to say nothing of looking through it. But they do understand small glasses, for these lie within their power.

My proposed program for the Observatory calls for a number of small, portable glasses, as the principal equipment. Enough friends of astronomy have come forward with loans and gifts of this sort to rid me of all worry for instruments at the start.

I well realize how utterly foreign it may seem to you at the University, who have the finest refractor in the world, to look on us with our spy glasses, and how you may pause to wonder what good we can do with such means. But I can assure you that a view of Saturn through a three inch glass is far better than no view at all, and to clinch the matter in our favor, we have the three inch glass.

I know the advantages of a big glass, and unquestionably I will be able to find one some day once my project

Chicago, November 1, 1921

Mr. Harry Pratt Judson,
President,
University of Chicago,
Chicago, Illinois.

Dear Sir: -

I wish to convey to you my great appreciation for the offer which you have made me in behalf of your institution, and I will lay the same before the owners of the Chicago Tribune.

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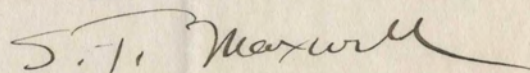
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tionably I will be able to find one some day once my project

#2

takes life. But for the present friendliness and toleration of our scheme is more important than lenses, and it is for this that I give you my utmost thanks.

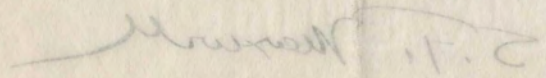
Yours sincerely,

A handwritten signature in dark ink, appearing to read "S. J. Maxwell". The signature is fluid and cursive, with a long, sweeping underline that extends to the right.

Astronomy Editor.

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ation of our scheme is more important than losses, and it
is for this that I give you my utmost thanks.

Yours sincerely,



Astronomy Editor.