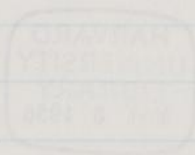


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1. Plotting primary & secondary

1900-1901

1902-1903

1904-1905

1906-1907 (part) 1908-1909 (part)

1910-1911 (part) 1912-1913

1914-1915 (part) 1916-1917 (part)

1918-1919 (part) 1920-1921 (part)

1. Photometer for measuring star distribution



A, Negative.

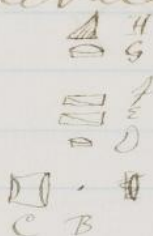
B camera lens at focal plane forming image of A at D.

E eyepiece for viewing D

All the light falling in field B is thus uniformly distributed in the circular disk seen through E. We have then instead of measuring points to measure a circular disk of uniform

April 30, 1878

2. Nebula Photometer.



- A. Object glass.
 B. Opener disk of ground-glass.
 C. Eyepiece.
 H. Prism reflecting comparison star.
 G. Objective of auxiliary telescope.
 F. E. Double image scales receiving light.
 G. D. Convex lens at focus of G forming image of letter on B.

April 30th '76

3. Naked-eye Photometer.

 $\triangle F$ $\bigcirc F$

$\bigcirc G$ H, I
 $\square \nabla 10' \square$
 $D C B$

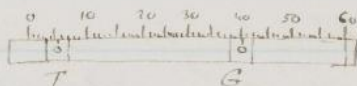
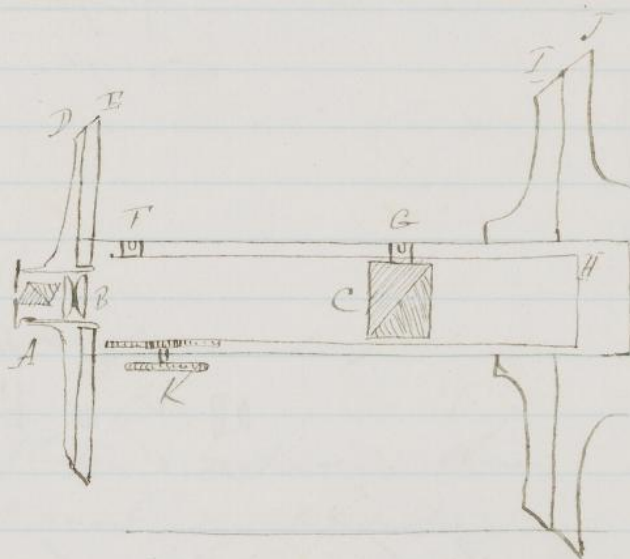
 $\bigcirc A$

- A. F two similar object glasses
 F. Prism reflecting one star into F.
 G, B two convex lenses forming images of A and F.
 C. Prism reflecting image of F.
 D Eyepiece showing two images of A and F.
 H, I Prisms for reducing light of A.

April 30. 78

I had better be to front of A
 and carry a large graduated
 circle which may be used at
 a considerable distance. It may be
 removed when the star is to be
 found. (May 10. 78)

2, Micrometer and Photometer combined.

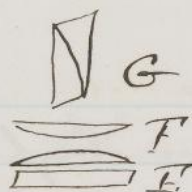


- B Eyepiece with cross A.
- F Position circle for cross A with index D.
- C Double image prism in tube H moved by rack and pinion K.
- G Index for mirror C.
- F Index showing position of tube.
- I Position circle with index I.

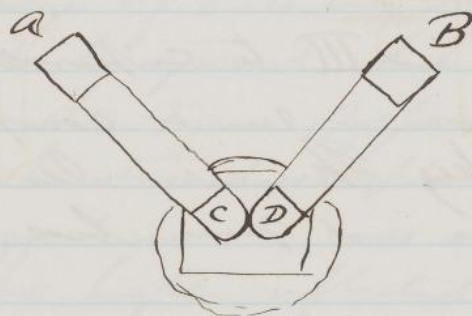
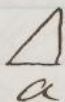
(A series of large pitch would seem a desirable substitute for the interior motor and rack and pinion $M_{10.157}$)

April 30, 1878

5. Companion of Star
distant 2' - 30'



Section
parallel
to axis of
telescope



Section at
right-angles to
axis of telescope.

A, B. two right-angled prism reflecting images of stars to C, D.

C, D. two similar prisms bring images of stars back by side into field.

E. plate of Iceland spar bring two images together.

F. eyepiece

G. thick prism with circle and index for varying brightness of two images at will.

By turning AC and BD the distance AB may be varied.

Application.
I. ~~Measurement~~ Ellipticity of disk of sun or moon along polar or equatorial axis. Remove piece G and plate F by two limbs in contact. Revolve whole instrument and see if images still touch.

II. Relative brightness of any stars within 30'.
Bring the two images back by side and compare at will.

III. Relative brightness of two adjacent bright stars. Place convex lenses against - screens A and B and thus bring two images of illuminated object - glass side by side. Interpose diaphragm with two rectangular holes and thus bring them in contact. $\square \square$

IV, V. Apply II and III to comparison of different portions of the moon or sun or compare latter with adjacent sky. Measure also brightness of bright spots, fringes and penumbrae.

VI. Brightness of various portions of a nebula. The third G may be interposed between A and C and a saving in the light of one image be thus attained.

B. Photometer.

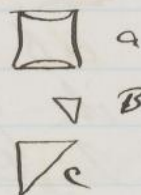
To secure delivery in a photometer for comparing two surfaces they should be perfectly smooth and the line of separation should be as slightly marked as possible. These conditions are

well fulfilled by two R.A. plates ^{B.C.}

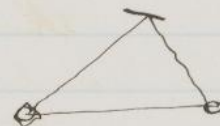
in front of a lamp A, provided the edge of B is very sharp. It should be ground while cemented

on another piece of glass. As C

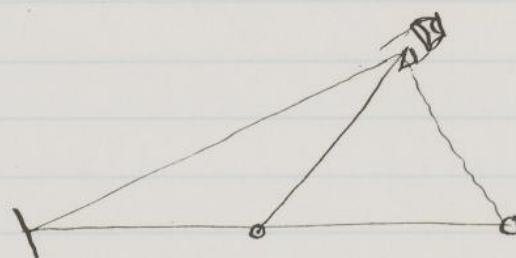
may be turned, lights at any angle may be compared.



The light reflected by a mirror may thus be measured at different angles.



Another arrangement depending with one piece is below:-

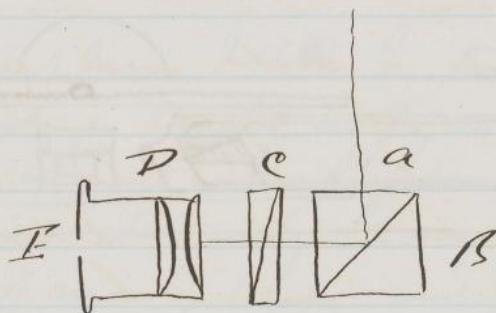


Aug. 23d, 1878.

7. Microtota.

Prisms arranged as in 5, two emergent pencils formed side by side and with a pressure used that both together will not fill the retina. This only requires about 10 diameters per inch. ∞ . The distance between the prisms AB could be determined by a glass scale at the focus which could be measured with a higher power showing in an illumination. Detail later.

8. Solar Eysopium.



AB prisms of glass cemented together.

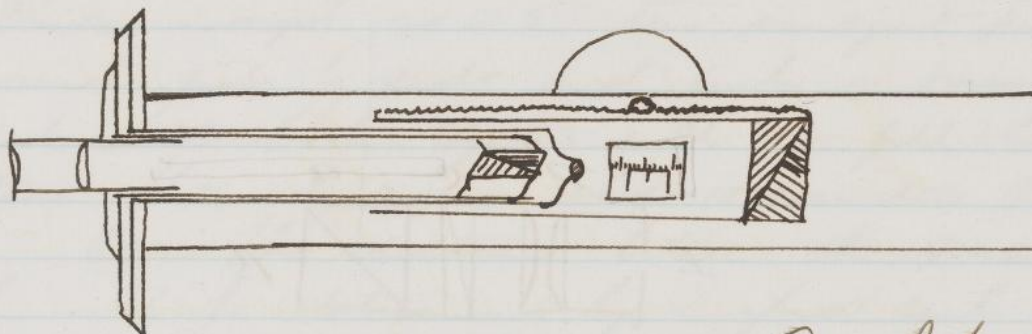
C double image micrometer of rotating.

D Eyepiece.

E eyepiece cutting off extraordinary image
of object glass.

July 7th 1878

9. Improved Micrometer & Photometer (4)



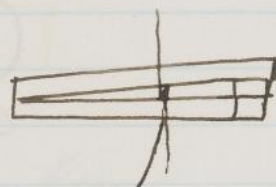
Aug July 31st '78

Wm. L. L. L., Photo-micrometer Aug 2d.
 The distance or angle of the two components can
 perhaps be measured more accurately by setting at
 an even division and measuring the angle by turning
 the wire in the eyepiece. Thus
 a distant companion may be
 measured as accurately ^{in distance} as
 one which is close to angle.

Aug 2d 1878.

10 Substitude for 9 and 5

In 9 replace mica by two plates of glass inclined at a small angle at 1° thus save almost all light reduce faint star only .2 magnitude instead of nearly 1 mag. and avoid color of secondary spectrum.



Plates 1 inch diam angle 1° . Distance at outer edge $\frac{1}{8}$ " changes focus $\frac{1}{30}$ ". If moved to such a distance as to see that cone will fill glass or 17 inches the angular ^{linear} separation of the images will be .6 in. = 15.2 mm = 7'. This device is especially designed for measuring ^{faint} companions to bright stars.

By putting a circle in the field an image of Mars or Saturn might be compared with its satellites. The faint image will be about 7 m fainter than the bright. (I believe)

Aug 2d 1878.

12. Measure distances of Planet from star.
Form two images of planet by double image
prism and measure from overlapping part.

..

.

Distances

Obs. Angle

Applications.

Orbital of Mars, Venus.

Position Satellites of Jupiter, Saturn(?) Mars?

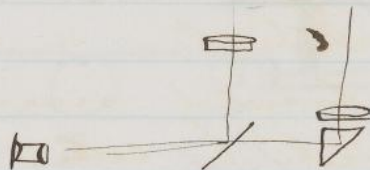
Aug. 7th 1878.

Apply same method to stars and
thus dispense with ~~line~~ illumination in
field. Inset plate of
glass forming two images ..
of brighter star and
place faint star between them.

Nov. 18, 1878

13 Meridian Photometry. I

Observe polestar
and any star during
transit simultaneously



and reduce eye by
cat's-eye. Recorder

just observe and set a star by circle
and chronometer. Also needs setting which
is made as star passes pole-star.

Some culminations give correction for
absorption.

Nov 18. 1878.

14. Meridian Photometry II.

Diagram showing a lens (A) with light rays (AB, AN) passing through it.

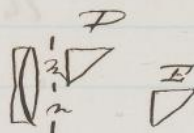
Diagram showing a lens (A) with light rays (AB, AN) passing through it.

Collects and then during transit received in two objectives placed side by side. A lens forms two images of them as adjacent circular disks which are compared by a direct and double-image prism.

Mar 18, 1878

15. *Prisidina* *Stomatia*

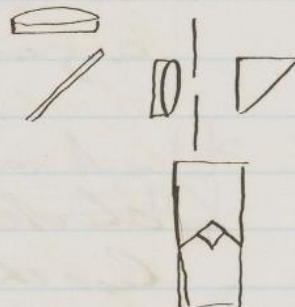
Double image plate C B A
 H placed at focus of
 objective thus forming
 two images of apertures m n.



Two of these should be superimposed and press
 together through aperture B and aperture C.
 Other two will be cut-off by C. Hence one
 image only will be seen of each star.

The same method is applicable to the West
 equatorial, replacing lens D by two achromatic
 lenses, and removing E. It may then be used
 for measuring β Kessie, &c. comparing both stars.

Dec 2, 1874.

16 *Muridia Photometer.*

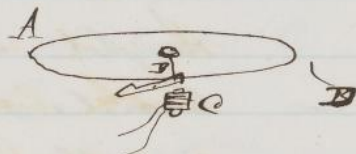
Star reflected in glass
 Light varied by cat-eye.
 Handled equal to pole star
 or reduced to limit of visibility
 For faint stars reduce pole star by cat-eye.
 For very bright stars introduce shade glass.
 Nov 24. 1879.

17. Time distributor.

To distribute time signals differing by a given amount from a standard clock

A a disk revolving by clockwork in a little less than two seconds.

B a pin which rests on and turns with it unless held up by the armature of the magnet C. The standard clock sends signals every two seconds through C and lets B fall on the wheel. It is carried round with it and deposited again on the armature. Meanwhile it makes a connection at with the line on which the signal is to be sent. The distance of D from C determines the interval between the signals received and sent. If the clock circuit is closed by mistake the other end of the armature of C comes up and stops the pin B. By moving D clock rates between 0 and +2 seconds may be corrected.

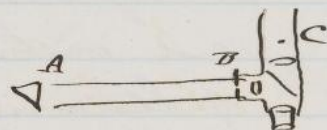


Dec. 30. 1879.

18. Bright of the Moon.

The comparative light of different portions of the Moon's surface may be measured by Photometer H.

Remove the objective at



A and insert a diaphragm with small circular aperture at B. Insert a circular vial of same size at C.

With this instrument the following points may be determined:-

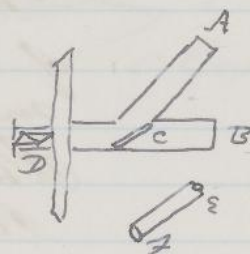
- 1 Scale of brightness reduced to photometric standard.
- 2 Variation of plains with varying incidence.
- 3 Comparison of craters with the outside of moon.
- 4 Measure of unilluminated portion of moon.
- 5 Bright of a series of standard objects.

Inserting a lens at A the standard may be varied at will.

Jan. 9. 1880.

19. Light of Planets. Moon etc.

Light of planet coming through
A reflected at plate of glass C
and varied by Nicol D. Light
of star seen through C and B.



To measure light of Moon reduce it to point
by small telescope G. H. focused for parallel
rays. Plans given to Mr. C. Feb. 1.

Feb. 1. 1880.

20. Meridian Photometer for H. Stars.

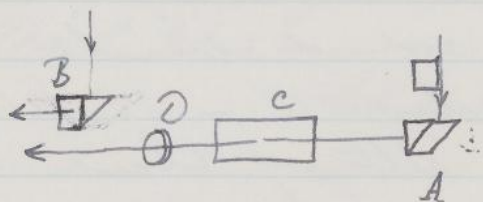
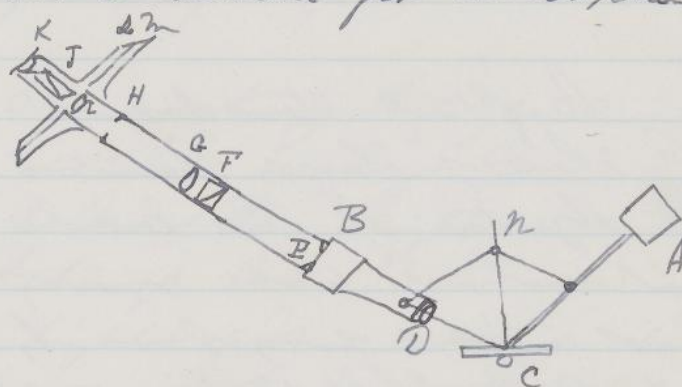
Light of stars from 4 - 10 mags.
 A plate of glass placed in front
 of objective of East-Meridian Circle,
 and inclined to its axis 57° . A
 wheel in front of eyepiece by turning
 which the reflected image of the star may be
 reduced at will. Stars having a declination of
 about 24° or $22^\circ - 26^\circ$ can alone be observed.

Setting of telescope and readings of circle made by
 a assistant.

Feb. 3, 1880.



21. Photometric for Absorption Reflectance



A B prisms reflecting light from same source
to reflecting plate C and to field of telescope.
D, objective receiving parallel rays and forming
image from them on F.

F. Double image given forming two images of E which are projected on H by G

H a diaphragm which cuts off the two extra images leaving them to be compared. These are seen by the eyepiece K. I. A. Nicot. I adjust to vary the light. The charge is measured by the scale do not include Mr. By turning F either polarized beam may be measured.

Placing A into line with the axis the reduction in light may be determined and the constant of the instrument eliminated.

With this instrument the light spectrum
reflected from glass, quartz, diamond, &
silver sheet nickel copper &c may be measured

When the obj mirror is small its image may be formed on E in a parallel beam by using the convex reflected side may be multiplied by the cosine of the angle of incidence. The light transmitted by one or more plates of glass may also be determined.

For diffuse reflection it is only necessary to use a strong beam of light, as that of the sun. The photometer may be attached to an equatorial stand. The reflecting plate may be set at any angle independently of the prism A , it may also be tipped around the horizontal line lying in the plane of the equator.

For specular reflection the parallelogram AB above to keep the mirror equally inclined to the ^{incident} ~~incident~~ and reflected rays. For transmission A is placed in line with the axis and C turned so will.

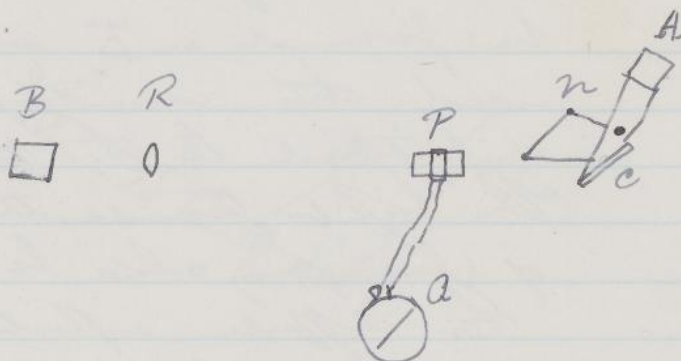
The variation in light of a planet for various phases may be studied by replacing C by a sphere of marble, quartz, chalk, plaster, clay (granular), quartz, &c, &c.

Relative albedo may also be compared by moving B and placing two objects at C .

If the distance AC is about six times the diameter of A observations may be made at an angle of incidence of 5° and observations should be made at every 5° to 85° .

April 2, 1880.

22. Thermochromes.



Apparatus 21 may be used with slight modification for ~~thermal~~ measuring radiant heat. $A B C R$ have the same value as in fig. 34. P is the wire of the galvanometer. The heat is varied by R . With suitable conditions it is not impossible that greater accuracy may thus be obtained than photometrically. Rock salt prisms are not necessary if sunlight is used. If they are preferred the faces may be covered with thin cover glass since the absorption will be slight and the salt will be protected from moisture. If the wire is exposed by a metronome pendulum vibrating synchronously with the galvanometer needle the vibrations of the latter will be much reduced. A shield may be placed in front of the wire to protect the light from C .

April 2, 1880.

in order to determine its proper motion.

D. The diameter of the nebula to be measured ^{when it appears as a disk}.

E. The light of the nebula to be determined by Photometer I, also that of two adjacent stars one slightly brighter, the other slightly fainter.

~~F. The relative~~ Their ratio to be taken on at least two evenings. These settings in each case.

F. The relative light of the stars and nebula to be estimated by the eye.

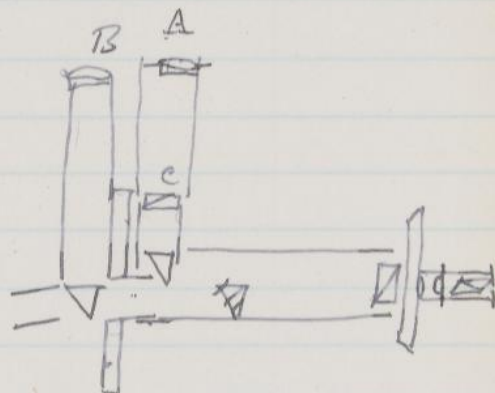
G. If the nebula shows a disk, its depth to be measured with Photometer II.

H. A continuous spectrum ^{to the nebula} to be looked for carefully on a dark night.

July 15, 1880.

Minid. Phot. for H. lens.

A, telescope for hole stars
 stand eccentrically and
 revolved ^{around} center by disk
C.



Slowness of hole stars passes
 through hole, and may be
 turned slightly in its own
 plane. Instrument may rotate
 through 180° around a base holding through the
 hole and hence any other be varied.

Graduated circle at C and hole stars (? 2) thus
 set in center of field, by turning circle C and A to
 different times.

Some or time moving have again decided so
 that $1 \text{ star} = 2.5 = 10 \text{ Revs.}$ Head movable and set
 at zero as first star. ~~Position~~ Error of clock
 the end of hole cycle thus eliminated and P.A.
 found by gradually rotating turn of second hole
 cycle. ^{Revolutions} Revisions measured to within 2 or 3 o.c. of one
 second star near hole to be measured
 each evening and corrected thus determined.
 This will probably be better than to allow
 by brightness of the 2 stars. Or, several
 bright stars may be measured and light
 thus determined.

Dec. 20. 1880.

