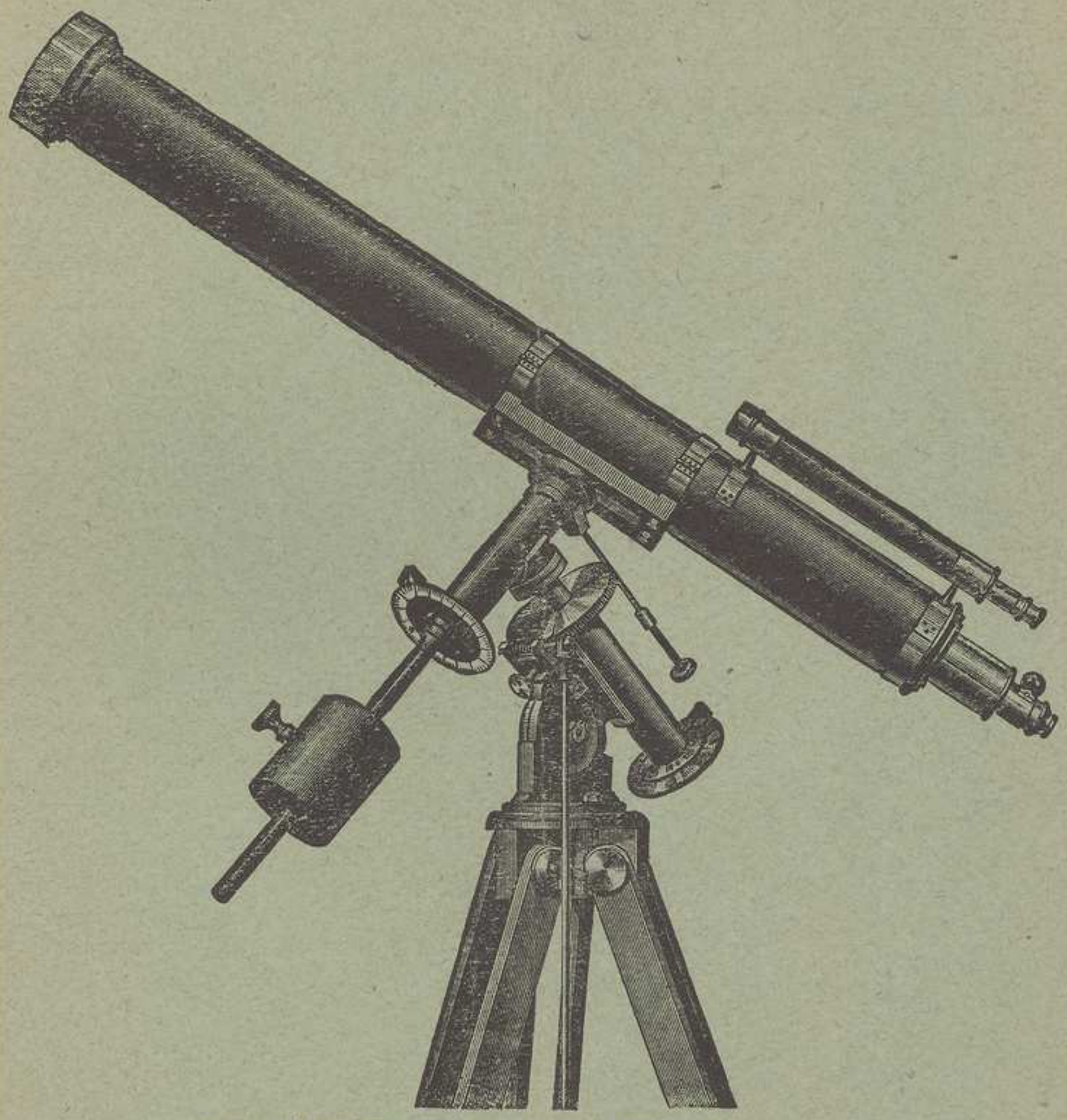
ALL PREVIOUS QUOTATIONS CANCELLED

ASTRONOMICAL DEPARTMENT.

TELESCOPES

EQUATORIAL MOUNTINGS.



QUEEN & CO., INC.

1901

1010 Chestnut St. PHILADELPHIA.

New York Office, 59 Fifth Avenue

ASTRONOMICAL DEPARTMENT,

COMPRISING

REFRACTING AND REFLECTING

TELESCOPES,

EQUATORIAL MOUNTINGS,

WITH AND WITHOUT CIRCLES,

DRIVING CLOCKS,

ACHROMATIC OBJECTIVES IN CELLS,

NEGATIVE AND POSITIVE EYE-PIECES,

DIAGONAL PRISMS,

HELIOSCOPES, SPECTROSCOPES,

MICROMETERS, ASTRONOMICAL CLOCKS,

CHRONOGRAPHS,

TRANSIT INSTRUMENTS.

PHILADELPHIA:

QUEEN & CO., Inc.

1010 CHESTNUT STREET

TESTIMONIALS.

CRESTLINE, O., April 16th, 1884.

JAMES W. QUEEN & Co., Philadelphia.

DEAR SIRS:—We are well satisfied with our telescope.

Respectfully,

J. H. SNYDER,

Professor of Astronomy.

WASHINGTON, GUERNSEY CO., OHIO.

The telescope (four and one-half equatorial) bought of you four years ago is doing good service and is a source of *very great* interest in our High School. You are at liberty to refer to me when I may be of service to you.

Respectfully,

(REV.) W. R. SCOTT,

Superintendent of Schools.

PEDDIE INSTITUTE,

HIGHTSTOWN, N. J., February 17th, 1885.

MESSRS. JAMES W. QUEEN & Co., 924 Chestnut Street, Philadelphia.

GENTLEMEN:—The telescope imported by you for the Peddie Institute, and mounted on one of your portable equatorial movements, stands the test of use, works smoothly, and is simple, compact, and handsome. The objective deserves special mention. You promised us an objective equal to a superior Fraunhofer, and gave us one much better. I have only words of praise for the instrument, for so perfect a specimen of optical and mechanical work.

Respectfully yours,

AARON H. COLE, A. B.

September 21st, 1885.

MESSRS. JAMES W. QUEEN & Co.

I have now been using the three-inch achromatic object-glass, purchased from you, for nearly three years. The good opinion which I formed of its performance at first has grown stronger with time and use. I regard it as in all respects the best objective I have ever used.

R. M. LUTHER,

1420 Chestnut Street, Philadelphia.

KOKOMO, IND., February 9th, 1885.

. . . . . The 4-inch equatorial telescope imported by you for the *Kokomo High School* has given great satisfaction in every respect.

Respectfully yours,

C. E. SOMERS,

President.

TOWANDA, PA., October 20th, 1885.

. . . . . The telescope furnished by you for the Institute has given fine satisfaction.

Very truly,

E. E. QUINLAN.

FIFE LAKE, MICH., September 15th, 1887.

. . . . . The telescope is a fine one, and more than meets my expectation. The school and the whole town are in ecstasies over it.

E. B. DENNIS,

Principal of Graded School.

TESTIMONIALS.

KOKOMO, IND., February 9th, 1885.

MESSRS. QUEEN & Co., Philadelphia, Pa.

SIRS:—The 4-inch equatorial telescope imported by you for the Kokomo High School has given satisfaction in every respect.

Respectfully yours,

C. E. SOMERS.

CAMDEN, N. J., July 25th, 1889.

J. W. QUEEN & Co.

GENTLEMEN:—After having used the 5½-inch glass you furnished for the Camden Astronomical Society for nearly a year, it gives me great pleasure to certify to its general excellence. It gives star discs that are absolutely circular and without wings, while it is at the same time as thoroughly achromatic as a refractor can be.

At the same time I want to certify to the excellent character of the sidereal clock we purchased from you. It gives us entire satisfaction, and we are delighted with its accurate work.

Yours truly,

E. E. REED, JR.,
President Camden Astronomical Society.

PRINCETON COLLEGE INSTITUTE.

PRINCETON, KY., September 9th, 1890.

QUEEN & Co., Philadelphia, Pa.

GENTLEMEN:—The telescope ordered from you came to hand several days since. To say that I am pleased hardly expresses my satisfaction. Indeed it is a great pleasure to use in studying the stars, etc. Yours truly,

WM. MARTINDELL.

BELMONT, O., March 22d, 1890.

DEAR SIRS:—The telescope (4½ in. Equa.) we got of you several years ago is giving good satisfaction. We may want to get some more accessories to it. Send your Supplementary Catalogue, also, please. Truly,

REV. W. R. SCOTT, PH. D., Belmont, Ohio.

CLINTON, IOWA, November 8th, 1889.

JAMES W. QUEEN & Co., Philadelphia.

GENTS:—The Equatorial came to hand all right, and I would have acknowledged the receipt of it before now but I thought I might as well try it and then I could tell you how I liked it. I have got it in working order now, and am highly pleased with it. I subscribe myself, Respectfully,

JAMES A. GREENHILL.

To DEPT. No. 5.

SEATTLE, WASH., February 26th, 1890

JAMES W. QUEEN & Co.

DEAR SIRS:—In reply to your inquiry regarding the telescope which I purchased of you, I will say that I am very well pleased with it. The instrument is first class in every particular, and I can safely recommend your telescopes to any one who is intending to buy. Yours respectfully,

1134 Repub. St. D. T. DENNY, Seattle, Wash., Per V.

MESSRS. J. W. QUEEN & Co.

DEAR SIRS:—The four and one-half-inch Equatorial made by you has more than fulfilled all you promised, and has greatly exceeded my anticipations of its capacity. I regard the object-glass as a remarkable one, and the whole of the work on the telescope and the stand is done thoroughly, skillfully, and conscientiously.

If I needed another telescope to-day, I would, without a moment's hesitation, order it from your firm, and I heartily wish you the abundant success that your very high grade of work, and your prompt and honorable business methods equally deserve.

Yours very sincerely,

J. D. MORRISON,

October 10th, 1890. St. John's Rectory, Ogdensburg, N. Y.

QUEEN & CO., INC., PHILADELPHIA.

ASTRONOMICAL TELESCOPES.

THE REFRACTING TELESCOPE or "Refractor" consists of a large lens, styled the object-glass, which forms the image for observation; and a set of two lenses called the eye-piece or ocular, which serves to magnify the intercepted image. All the better refracting telescopes of the present day are furnished with an achromatic object-glass; this is composed of two kinds of glass: the crown and the flint; by this combination of elements of different density and dispersing power, both chromatic aberration (fault of color) and spherical aberration (defect of curvature) can be corrected. When either of these defects exist, the image will appear misty, or not very distinct when magnified by the eye-piece; a well-corrected lens on the other hand will readily bear a power of 50 times to each square inch of its diameter with *perfect distinctness*. Very small bubbles in the glass of an objective are no impediment to its good performance (Webb's celestial objects), but if it contains striæ or waves, however minute or unnoticeable, the objective will be of no use for astronomy.

The larger telescopes are generally provided with a finder, which is a small telescope of small magnifying power mounted parallel with the large tube, so that an object seen in the centre of the finder may also be found in the large instrument; two wires crossing at right

angles are inserted in the tube of the finder so that they are distinctly seen; the object, as a star for instance, is brought near the intersection of these wires, and will, if in proper adjustment, be visible in the telescope. The eye-pieces commonly in use are the positive, sometimes styled Ramsden's, and the negative, known as the Huyghenian; the positive eye-piece is composed of two plano-convex lenses of similar focus, the convex sides turned inward and placed at a distance of $\frac{2}{3}$ the focal length of either lens. The equivalent of a single lens to this eye-piece is found thus:

Divide the product of their focal lengths, by their sum less the distance between them.

$$\text{A } \frac{1.5 \times 1.5}{3 - 1} = \frac{2.25}{2} = 1.125 \text{ inch.}$$

The focus of this eye-piece being beyond the field lens, it is best suited for instruments requiring wires or micrometers.

The *negative* eye-piece is also composed of two plano-convex lenses, but both convex surfaces are turned away from the eye, and the ratio of their focal length is 3 to 1, the shortest lens nearest the eye; a stop is also placed between them—the distance between them equals half the sum of their focal length, the focal length of an equivalent lens is equal to twice the product of the focal lengths divided by their sum, thus:

$$\text{B } \frac{3 \times 1 \times 2}{4} = \frac{6}{4} = 1\tfrac{1}{2} \text{ inches.}$$

The power of the telescope is ascertained by dividing the focal length of the object-glass by the focal length of the equivalent lens of the eye-piece employed: $1\frac{1}{2} : 72$ inches $= 48$ times or diameters for a telescope of 6 feet with eye-piece as figured at B.

A very convenient way of increasing the power of any eye-piece is by placing some 4 or 5 inches from the eye-piece, an achromatic concave lens, which intercepts the converging rays coming from the object-glass, rendering them less convergent, and, therefore, increas-

ing the virtual focal length of the objective; the result being an enlarged image equivalent to higher power; this lens is now generally sold as the "Barlow lens."

The celestial tests, listed by J. N. Lockyer, in his work entitled, *Star Gazing*, 1878, are inserted below. It must, however, be understood that some of those test-objects require considerable experience in order to make them out; this is the case more particularly where a very small star is close to a star of great brilliancy.

THE ACHROMATIC OBJECTIVE.

The progress made in the production of suitable glass for the construction of achromatic objectives is almost incredible; so late as the beginning of the present century a six-inch glass was not often met with, and now quite a number of objectives ranging from 24 to 30 inches can be counted, the latest being a 37-inch glass of 57 feet focal length. Smaller sizes of objectives are now not only much cheaper, but the quality of the glass is far better and free from veins and bubbles, and the corrections for achromatism and sphericity are carried out much more completely. The space of a catalogue does not permit to attempt a theoretical description of the objective, and therefore we offer a few general remarks about them, referring those seeking more extensive information to the pages of the *British Encyclopædia*.

An objective intended for celestial observation must be composed of glass tested for the purpose, as it is necessary that its density should be absolutely homogeneous, otherwise there will be defects in the star images, such as wings and irregular radiations, interfering with definition of close double stars—thus it frequently happens that a fine terrestrial telescope is quite useless when supplied with a celestial ocular and turned on celestial objects.

When an objective is to be tested for chromatic correction point the telescope toward the moon or Jupiter and focus carefully; there should be no color visible around the edge of the object if properly in focus, but if on slightly moving the eye-piece in toward the ob-

jective a purple ring appears around the object, or if when drawing it out a greenish ring is visible, the objective is correct, as the colors alluded to are the central ones of the spectrum appearing as they should do. To test the correction for spherical aberration point the telescope toward a star of second or third mag. and focus carefully—then cover the objective with a card-board having a circular hole of half the diameter of the objective; if the star is then still found in focus, the spherical error is corrected, but if the eye-piece requires to be pushed in, it is overcorrected, and if it must be drawn out it is undercorrected.

In a well-corrected objective a star as above will appear as a small bright disc, surrounded by one or more very fine concentric threads; this disc is a spurious appearance and is due to the wave-lengths of the light which prevent the rays coming from a star from uniting in an absolute point; the longer the telescope the smaller this spurious disc; Mr. Dawes gives it 1 sec. for a $4\frac{1}{2}$-in. objective and 0.5 sec. for a 9-in. It may be noted here, therefore, that a larger objective, as, for example, a 6-inch, if stopped down to two inches will have a great advantage in definitism and separation of double stars over a telescope of two inches aperture, even if the magnification be the same.

TESTS FOR TELESCOPES.

By J. N. Lockyer.

2 inches diameter, powers 60 to 100.

α Polaris.	γ Arietis.	α Geminorum.
α Piscium.	ρ Herculis.	γ Leonis.
μ Draconis.	ζ Ursæ Majoris.	ζ Cassiopeiæ.

4 inches diameter, powers 80 to 120.

β Orionis.	α Lyræ.	δ Genimorum.
ε Hydræ.	ε Leonis.	σ Cassiopiæ.
ε Bootis,	γ Cetil.	ε Draconis.

6 inches diameter, powers 240 to 300.

ε Arietis.	20 Draconis.	ζ Herculis.
32 Orionis.	χ Geminorum.	ζ Boötis.
λ Ophiuchi.	ι Equulei.	

Scale of Diameters of Achromatic Objectives, Giving the Smallest Stars Visible.

(From Newcomb & Holden's Astronomy..)

MAGNITUDE OF STARS ACCORDING TO STRUVE'S SCALE.

Aperture. Inches.	Minimum Magnitude.	Inches.	Minimum Magnitude
1.0	9.0	4.5	12.3
1.5	9.9	5.0	12.5
2.0	10.5	5.5	12.7
2.5	11.0	6.0	12.9
3.0	11.4	6.5	13.1
3.5	11.7	7.0	13.3
4.0	12.0		

A FEW HINTS TO THOSE WHO WISH TO CONSTRUCT THEIR OWN TELESCOPES.

Very minute descriptions have frequently been published how to construct the body of a telescope of paper, etc.; also as regards mounting the small lenses for eye-pieces; these need not be repeated, as any person with sufficient mechanical ability will invent various ways of accomplishing it; it is our purpose here to direct attention to the necessary adjustment without which no good result can be obtained.

1. The ends of the tube should be cut off on a lathe to be perfectly true; it should be lined with dark-colored cloth or should have diaphragms placed at convenient intervals to prevent any reflected light reaching the eye-piece.

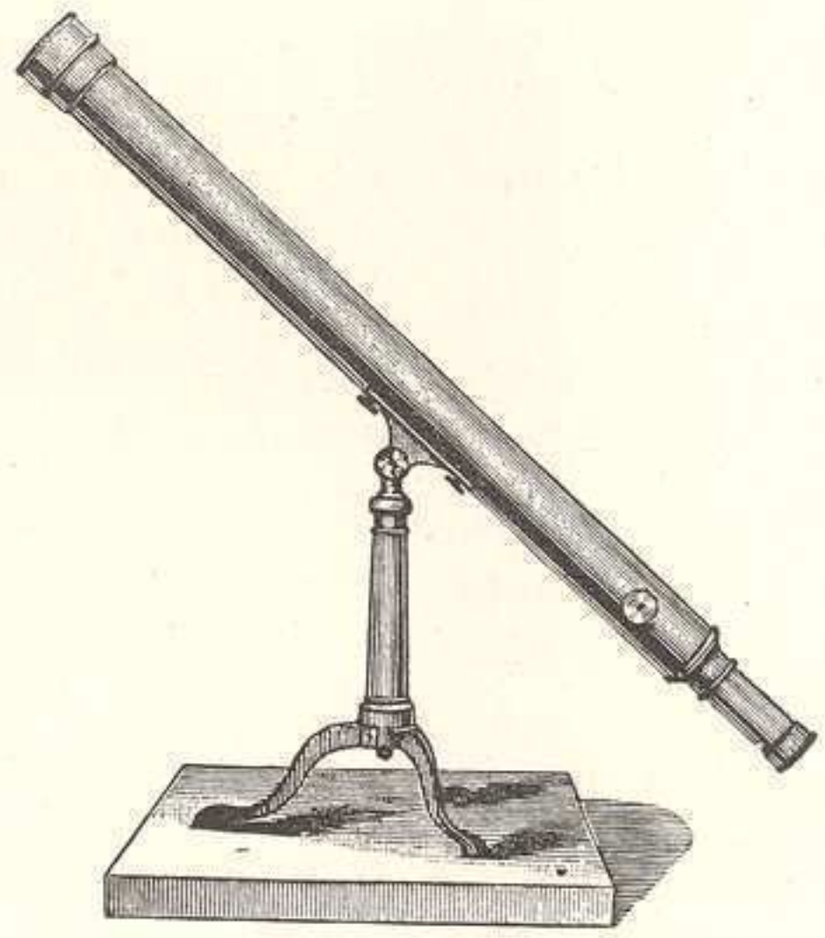
2. The small tube holding the eye-piece must be made to slide smoothly and *perfectly parallel* with the main tube.

3. The objective must be set at exactly right angles to the centre of the main tube; if not, the image formed by it will be distorted.

4. The setting of the eye-lens is a very difficult job and should be done on the lathe and the lens itself correctly centered. We recommend the purchase of a complete ocular when the necessary facilities do not exist.

The Library Series of Telescopes.

We have added these instruments to our catalogue, as there is frequent inquiry for a first-class small telescope for both celestial and terrestrial use. The mounting as represented in the cut is polished brass; the stand is furnished with **smooth vertical and horizontal** movements holding the tube firmly in any position whilst observing. One of the principal features is the rack and pinion for fine adjustment of focus. The optical qualities are as perfect as lenses can be made, and comparison has proven them equal to the costly Munich glasses. Both telescope and stand are packed in a walnut box with lock and handles.



No. 2309. **Achromatic Telescope,** objective, 2⅛ inches diameter, terrestrial power 35, celestial power, 70.
Price $50 00

No. 2311. **Achromatic Telescope,** objective, 2½ inches diameter, terrestrial power 45, celestial power 90.
Price 75 00

ASTRONOMICAL TELESCOPES

on Tripod

with Altazimuth Movement.

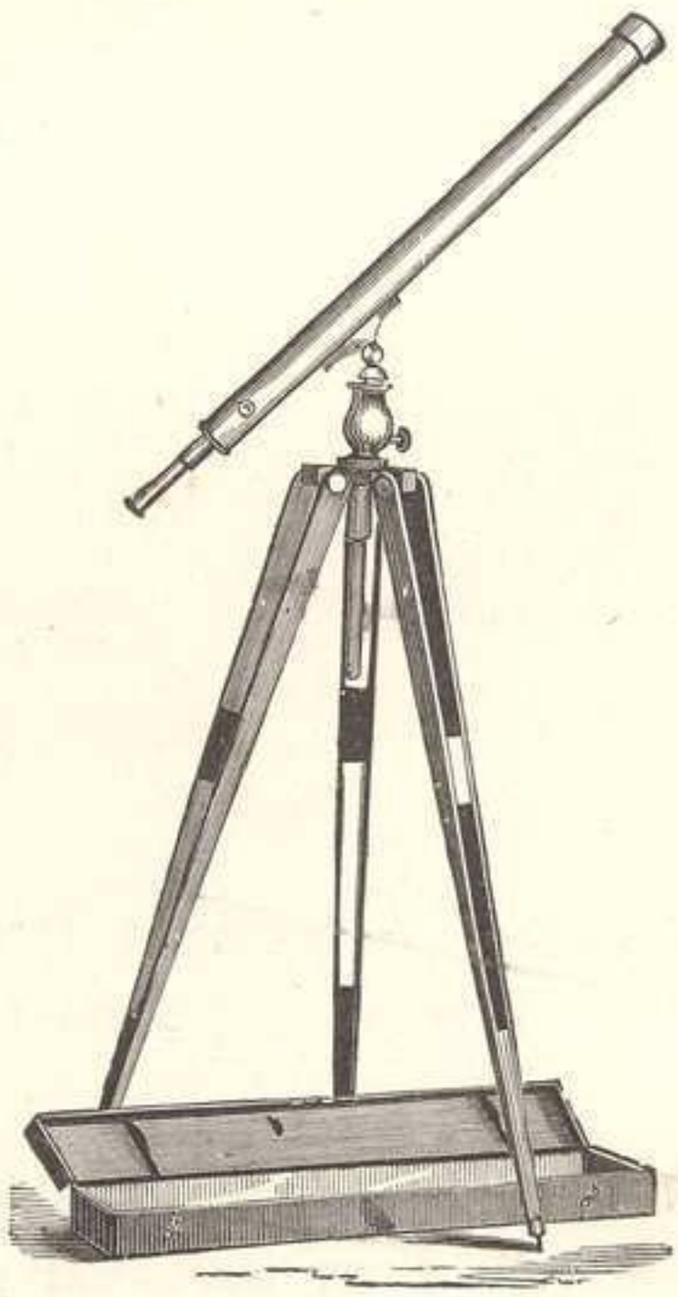
The stand is made of polished mahogany, with fine brass mountings and elevating stem, which carries the brass altazimuth joint. The body of the telescope is polished brass and lacquered, and furnished with rack and pinion to adjust the focus. The achromatic objectives are A 1 in every respect.

No. 2313. **Achromatic Telescope,** with objective, 3 inches diameter, 1 terrestrial ocular, power 50, and 1 celestial ocular, power 100. **Price, $100.00**

No. 2314. **Achromatic Telescope,** with objective, 3½ inches diameter, 1 terrestrial ocular, power 55, and 1 celestial ocular, power 130. **Price, $175.00**

No. 2315. **Achromatic Telescope,** with objective, 4 inches diameter, 1 terrestrial ocular, power 60, and 1 celestial ocular, power 150. **Price, $225.00**

The oculars are all furnished with dark glass caps, and extra powers can be supplied, each **$5.00**



ASTRONOMICAL TELESCOPES

WITHOUT STAND.

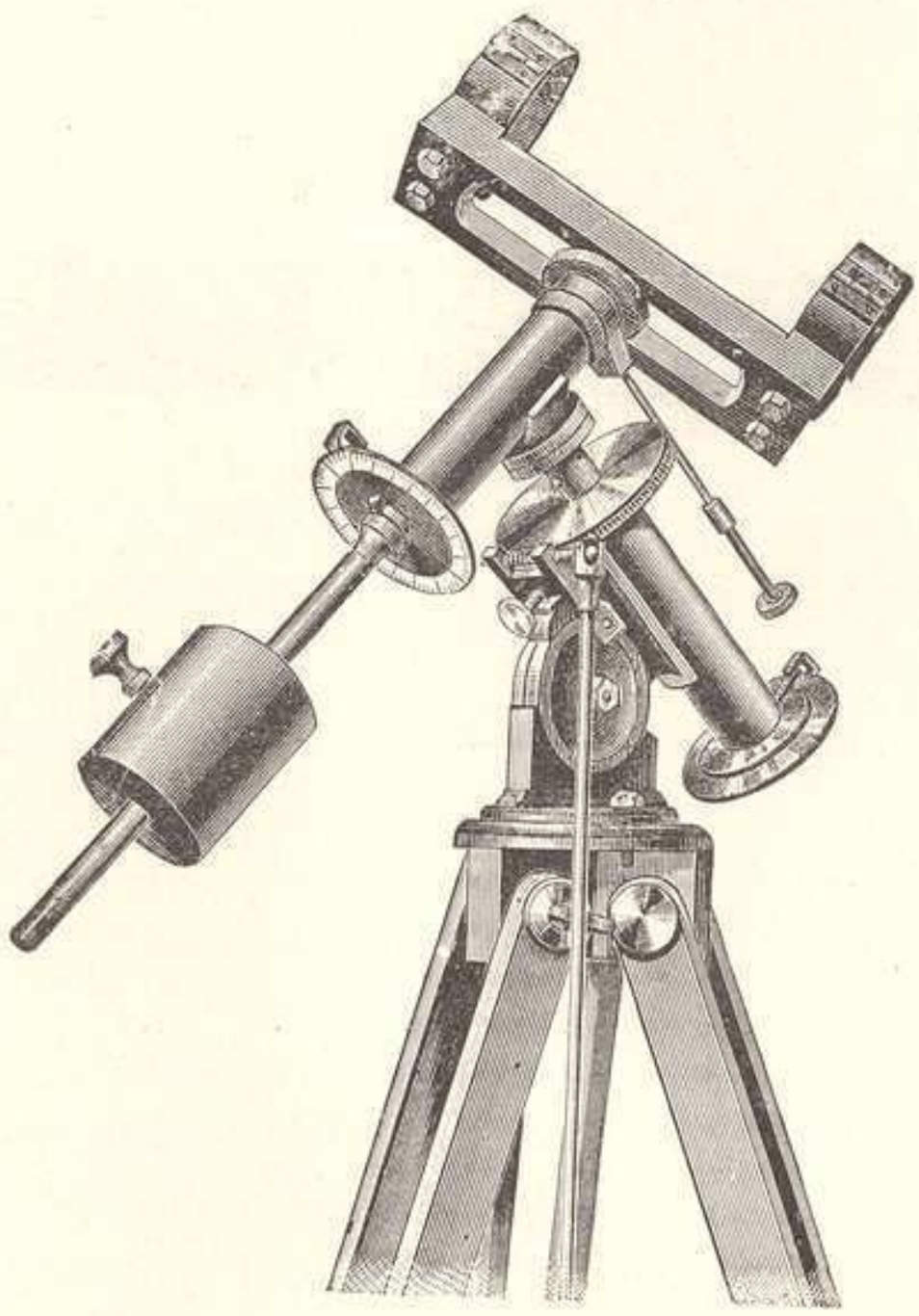
CLASS A.

The body of these telescopes is made of steel, with invisible joints and lacquered black with dull surface or ebony finish, being the stiffest and most durable tubes and very moderate weight; the end rings for receiving the cell of the objective and the other for carrying the rack and pinion tube are made of bright brass, polished and lacquered; the draw tube for the oculars slips in a spring-collar; the finder is a miniature of the large telescope and of proportionate size.

No.		Price.
1 A.	**Astronomical Telescope,** finished as above, with achromatic objective 3 inches clear aperture, 3 celestial oculars,	$125 00
2 A.	**Astronomical Telescope,** finished as above, with achromatic objective 3½ inches clear aperture, 4 celestial oculars,	175 00
3 A.	**Astronomical Telescope,** achromatic objective 4 inches clear aperture, and 4 celestial oculars,	250 00
4 A.	**Astronomical Telescope,** achromatic objective 4½ inches clear aperture, and 4 celestial oculars,	315 00
5 A.	**Astronomical Telescope,** achromatic objective 5 inches clear aperture, and 4 celestial oculars,	425 00
6 A.	**Astronomical Telescope,** achromatic objective 6 inches clear aperture, and 6 celestial oculars,	600 00

PORTABLE UNIVERSAL EQUATORIAL MOUNTING.

CLASS B.



B I.—Class B Universal Equatorial, with quick and slow motion in R. A. and handle to control from eye-end; clamps in R. A. and declination, and 5-inch discs and index to each axis, ... $100 00

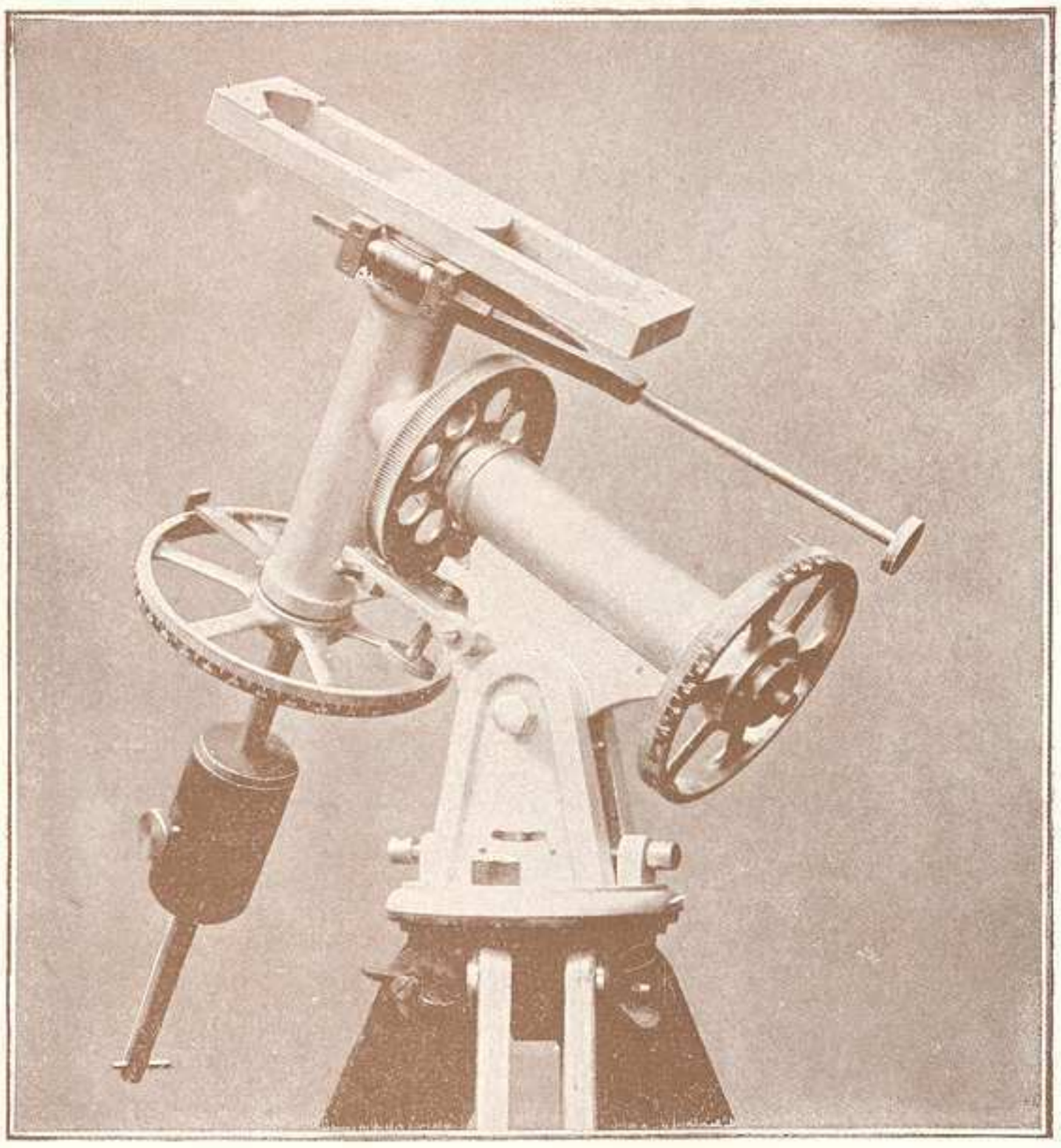
B II.—The same, but with slow motion in declination, and controlled from eye-end, ... 125 00

B III.—The same, but with circles 7 inches in diameter, divisions in silver, with verniers and reading microscopes, ... 250 00

Portable Equatorial Stand

For Astronomical Telescopes for High Schools and Colleges

CLASS A.



In this Equatorial, specially designed for High Schools and Colleges, are incorporated many features which have not been considered in construction by other makers. As a portable instrument it is made as light as its usefulness will permit. To this end heavy iron castings are discarded and a lighter metal is substituted for it. Again, being calculated for use in any latitude in the United States, we have restricted the universal adjustment to these

limits, and a firm setting can easily be effected by means of opposing screws acting on the projecting end of the axial joint. In this way the telescope is always securely seated and cannot, by any possibility, slip or fall while being adjusted. The circles represented in the cut will be found sufficient for most of the work undertaken by students, but if accurate astronomical work is contemplated, then extra circles, finely divided on silver, and the requisite verniers can be furnished.

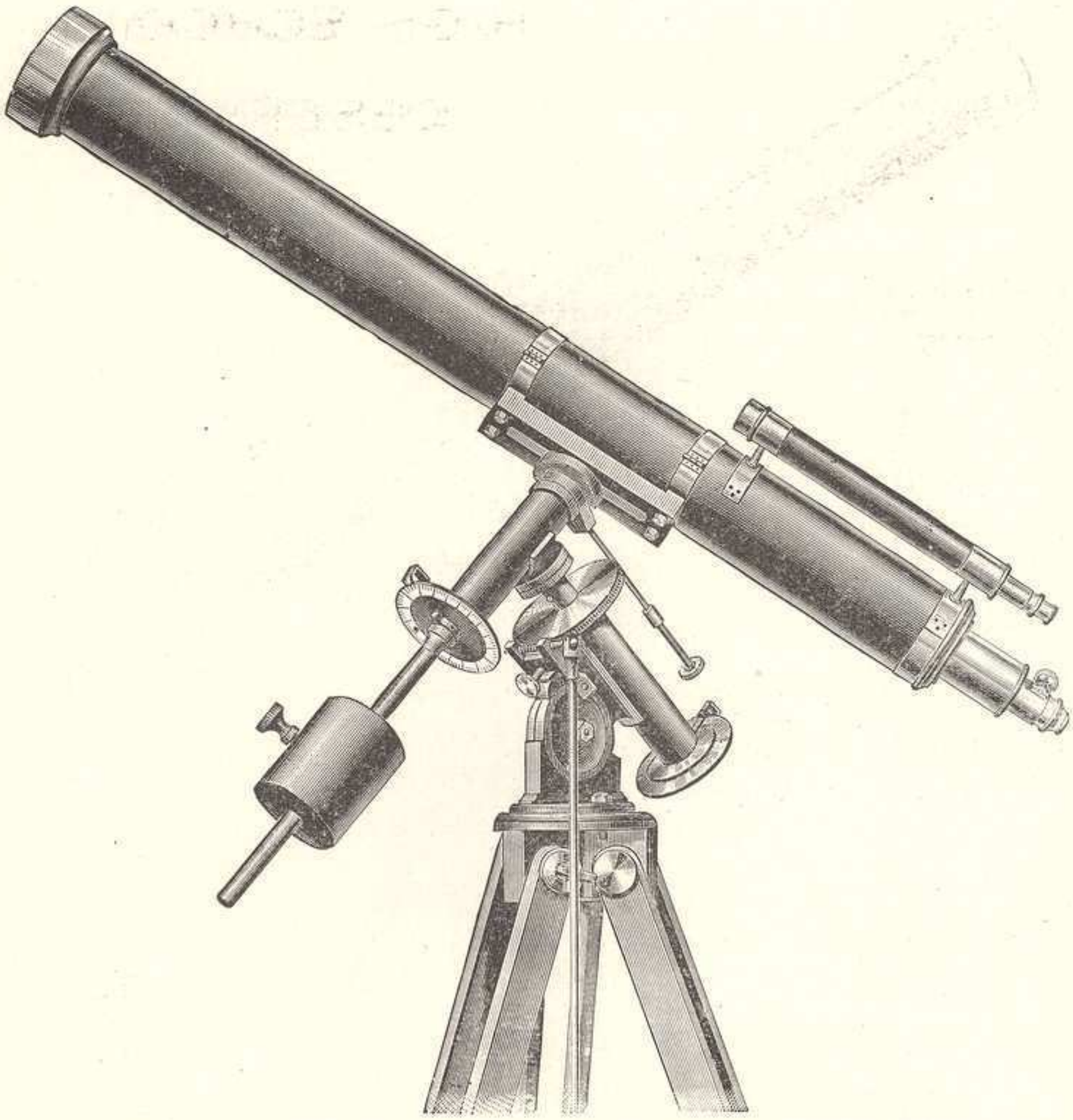
We also make a mounting for smaller telescopes marked Class B. On these the circles are omitted and plain discs about 4½ inches diameter are substituted. These discs are also graduated and provided with indexpost. Class C:

C I.—For telescopes of 3 inches diameter, objective, Price $50 00
C II.—For telescopes of 3½ inches diameter, objective, Price 60 00

Equatorial. Class A.

A I.—For telescope with 4-inch objective $100 00
A II.—For telescope with 4½-inch objective 110 00
A III.—For telescope with 5-inch objective 125 00
A IV.—For telescope with 6-inch objective 150 00

Including handles for R. A. and declination movements.

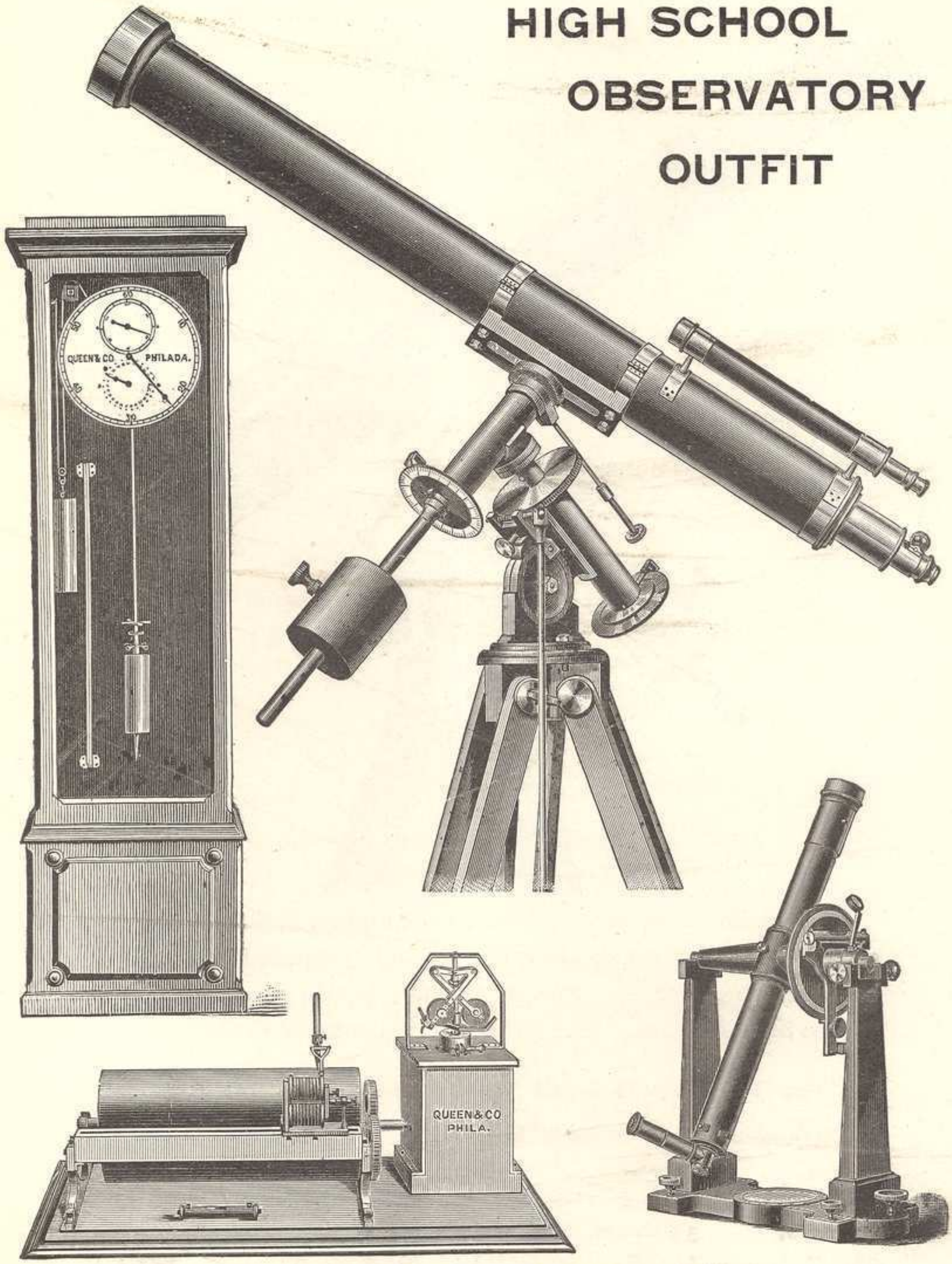


The achromatic objectives are of the highest optical properties as regards both color and definition, and are guaranteed equal to the best Munich objectives. Special attention is also given to the correction of the oculars. The finder is a miniature of the telescope.

The Telescope Mounted on Universal Equatorial Stand, class B, complete, with celestial oculars:

Clear aperture of Objective.	Number of Oculars.	Powers.	Price.
3 inches,	3 oculars,	50. to 300.	$200 00
3½ "	4 "	50. to 350.	275 00
4 "	4 "	50. to 400.	350 00
4½ "	5 "	50. to 500.	425 00
5 "	5 "	50. to 500.	550 00
6 "	6 "	50. to 500.	750 00

HIGH SCHOOL OBSERVATORY OUTFIT



Composed of Equatorial Telescope-Astronomical Clock,
Transit Instrument and Electric Chronograph $850 00

High School Observatory Outfit

The plate on the preceding page represents an observatory outfit for student and amateur composed of an Equatorial Telescope, a Transit, a Siderial Clock and a Chronograph, each one of which is sufficiently accurate to be used advantageously by the professional astronomer.

The Telescope has an objective of 4 inches clear aperture of the highest optical character and a finder. The tube is made of rolled steel and appears seamless and without rivet, being finished in a dead black lacquer. The end mountings are of polished brass and lacquered and has a rack and pinion tube to carry the oculars.

The equatorial mounting is of the universal Type and can be adjusted to any latitude. It has slow motion in R. A., and clamps for both R., A. and D. movement. The circles are divided for reading with a lens, but large white figures on black bands show the coarse divisions at sight.

The Transit instrument has an achromatic objective, about 20 in. focus, with adjustment in altitude and azimuth finely graduated declination circle with tangent and clamp, an erecting eyepiece with cross lines and sunglass.

The Siderial Clock has a dead beat escapement with independent second hand and electrical connection with the chronograph.

The Electric Chronograph runs so accurately that its record of seconds forms a straight line across, the clock runs one hour but can be rewound without interfering with the going or recording.

Price of complete outfit $850 00

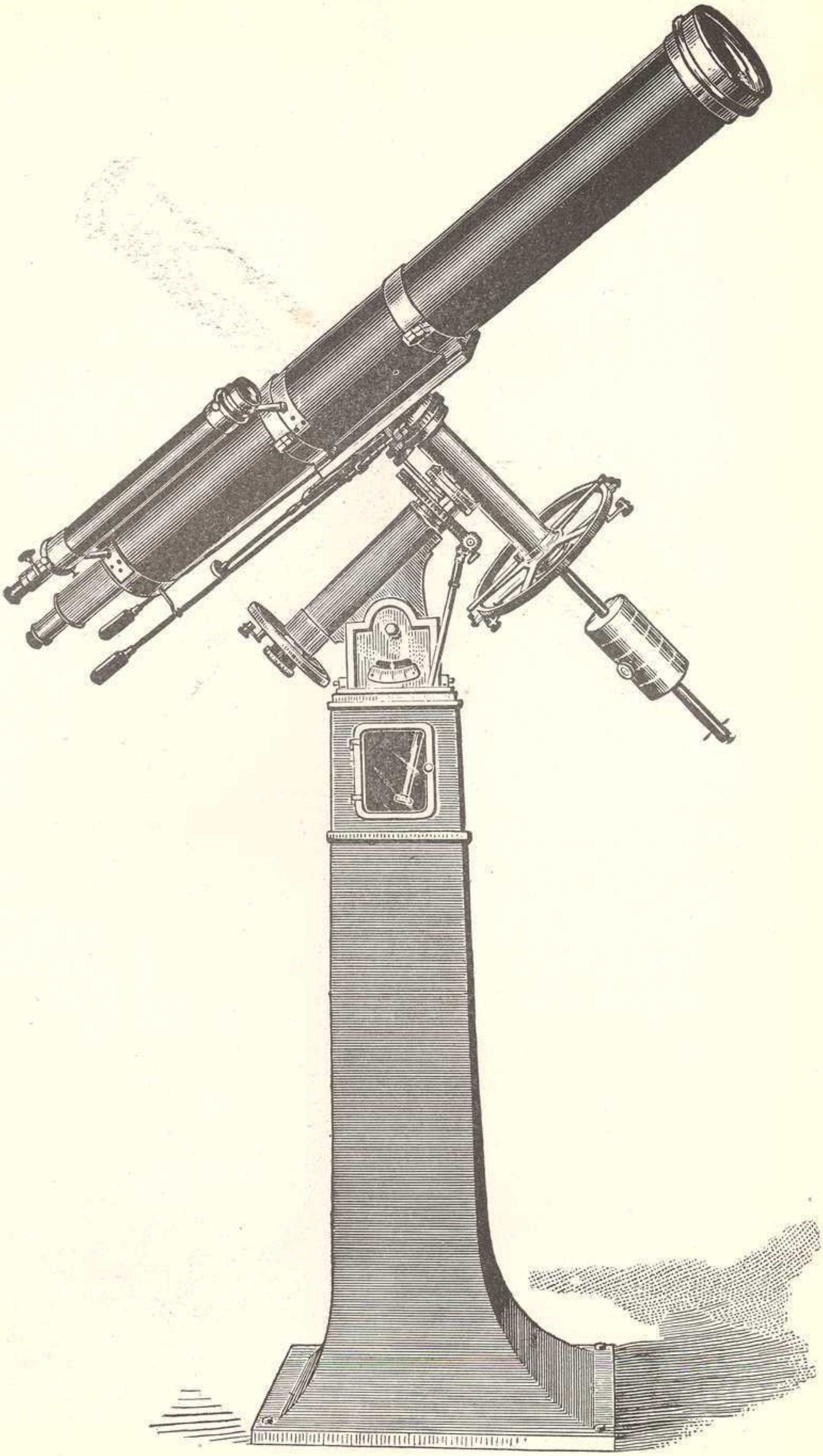
Large Telescope for an Observatory.

Instruments with an objective of six inches and over are always mounted on an iron pillar located on a solid stone foundation; a *driving clock* in the upper part of the pillar is connected with the polar axis to furnish motion in R. A.

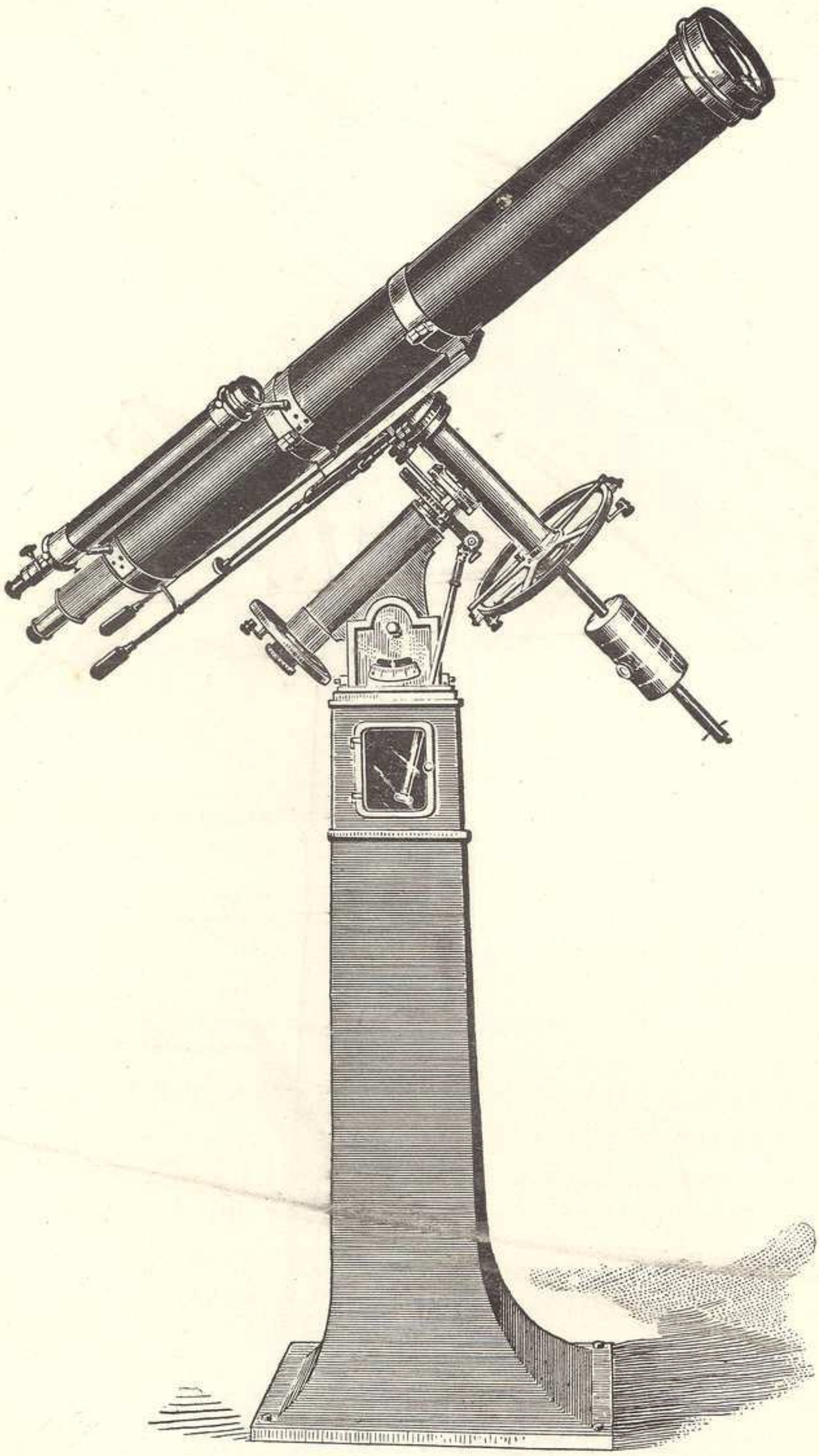
The motion in declination is effected by the handle carried to the eye-end within convenient reach for the observer; the several clamps are also similarly located and operated. Such instruments being intended for practical astronomical work carry larger circles than the smaller educational and portable telescopes; there is a graduation in large marks on the edge of each circle and on the face of same the graduations are engraved on a band of silver—these are read by verniers and microscopes.

The eye-end is furnished with a large cylinder moved by rack and pinion, which carries the sliding tubes with the various accessory parts, such as the micrometer, the polariscope, and the different oculars.

As these instruments are made to order and such specifications for construction and selection of accessories given by purchaser, it is not possible to give a schedule of prices and we invite correspondence of parties intending to order, which will receive our prompt and careful attention. We are prepared to furnish telescopes with six, eight, and ten inch objectives with but little delay, larger sizes require somewhat longer time.



10-INCH TELESCOPE.
QUEEN & CO.

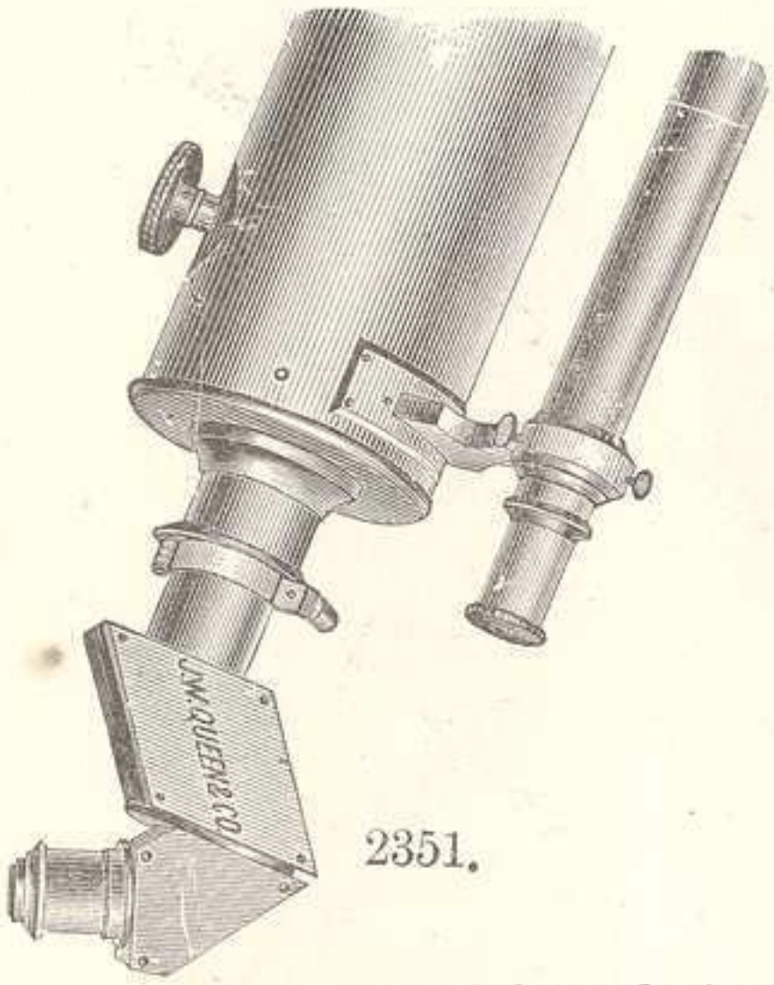


8-INCH TELESCOPE.
QUEEN & CO.

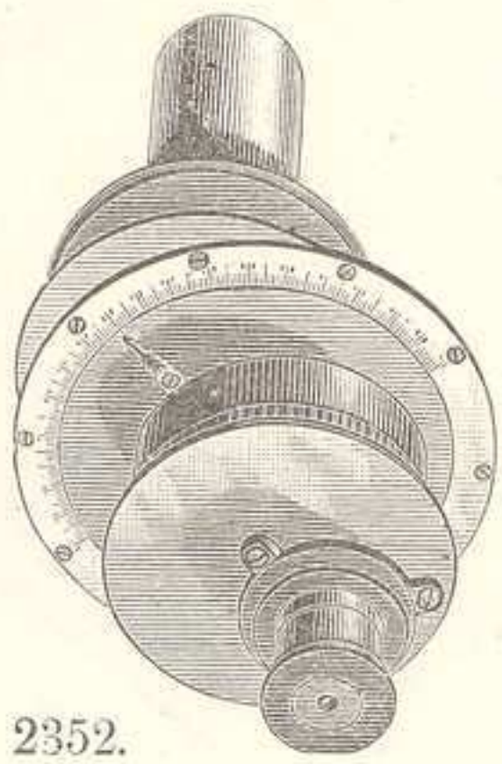
6-INCH TELESCOPE.
QUEEN & CO.

THE HELIOSCOPE;

OR, COMPOUND REFLECTING AND POLARIZING DIAGONAL, FOR OBSERVATIONS OF THE SUN.



2351.

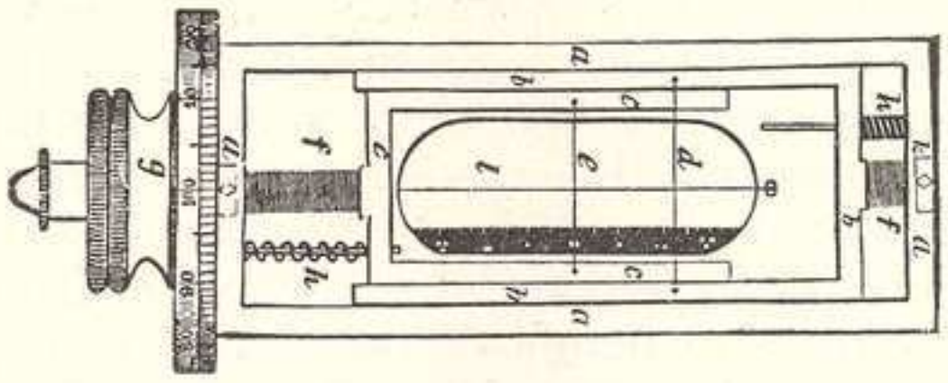


2352.

It is commonly supposed that a dark glass cap placed over the eye-piece of the telescope is all that is required to observe the sun. For small instruments under 2 in. this contrivance answers tolerably well, if employed only for a few moments or at a time when the sun is not very high, but in a short time the sun's heat will cause a *very minute* fracture in the centre of the dark disc, and render it useless. For larger telescopes it is, therefore, customary to employ a prism, set so that the sun's rays fall upon the digaonal surface, which reflects a very small portion ($\frac{1}{5}$ its volume) and allows the remainder to pass through the prism to be dispersed. In this way a great amount of heat is diverted, and the employment of the dark sun-cap becomes more practical. But even this arrangement is not sufficient for critical and lengthy observations and recourse must be had to another property of light, causing its beams to be further split up to lessen the heat and also to dispense with the sun-cap. This is effected by one or more reflecting surfaces, placed at the proper angle (52° about) for polarization, and the instrument so constructed is called a polarizing diagonal and is the best means for observing the sun, as not only can every degree of darkening be effected, but the sun's image does not become tinged with color, as is the case with dark glasses.

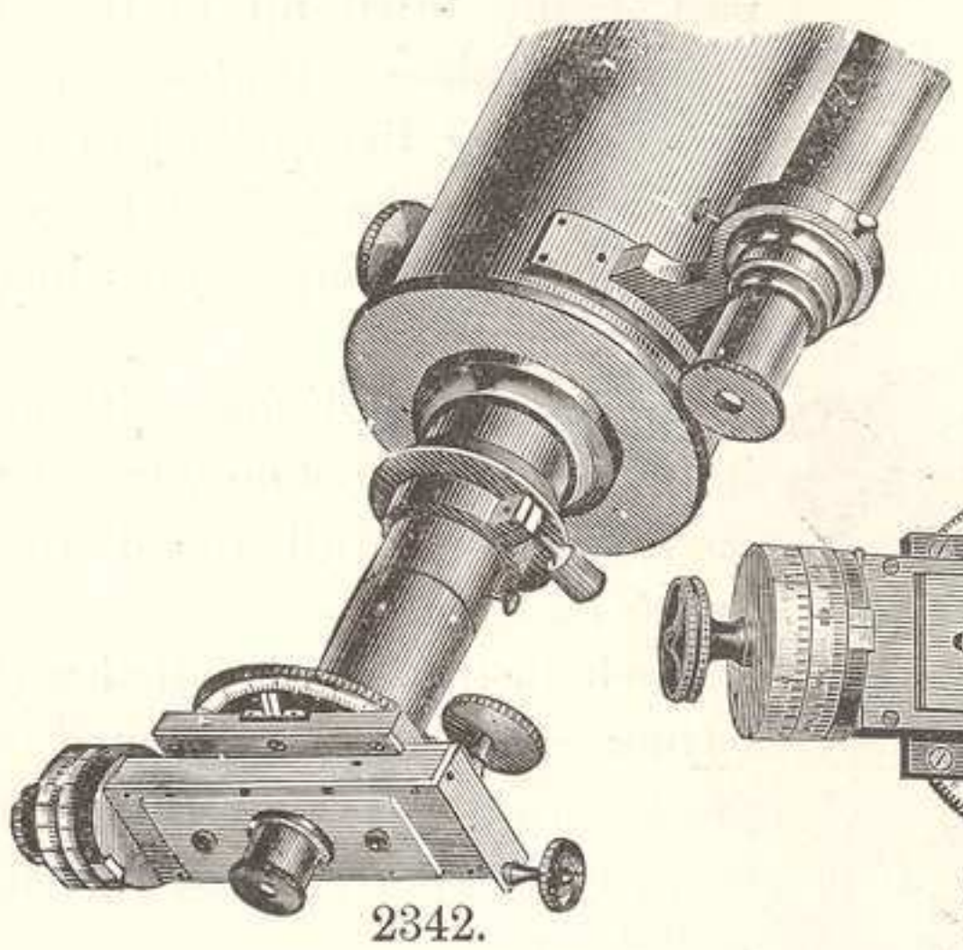
2350.	**Helioscope,** with 2 reflecting surfaces, . .	$40 00
2351.	" " 3 " " . .	45 00
2352.	" Munich pattern, with 4 reflecting surfaces, ...	**75 00**

THE MICROMETER.

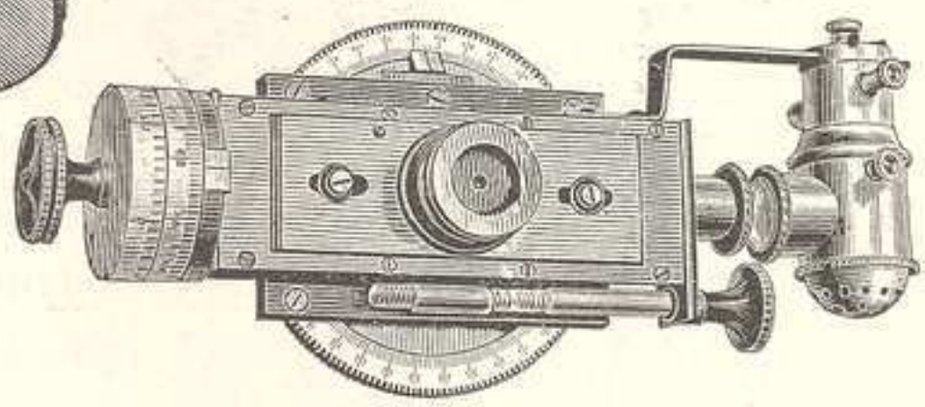


An approximate idea of this instrument may be gathered from above cut. A pair of movable wires (d e) are established exactly in the plane of the image, formed by the telescope, and can be controlled by means of thumb-screw (g) attached to a graduated drum to indicate at index (a) the number and fraction of revolutions required to measure a space; the screws (f) have a hundred threads to the inch, and one revolution of the screw carries the line (d) over the $\frac{1}{100}$ of an inch and the drum being divided into 100 spaces, each space indicates $\frac{1}{10000}$ of an inch, but the real value of these must be found in seconds of space. These wires are rendered visible at night by means of a small electric glow lamp attached to the Micrometer, so that bright lines can be shown on a dark field, or the reverse: dark lines on a bright field.

2342. **Queen & Co. Filar Micrometer,** $35 00



2342.



2343.

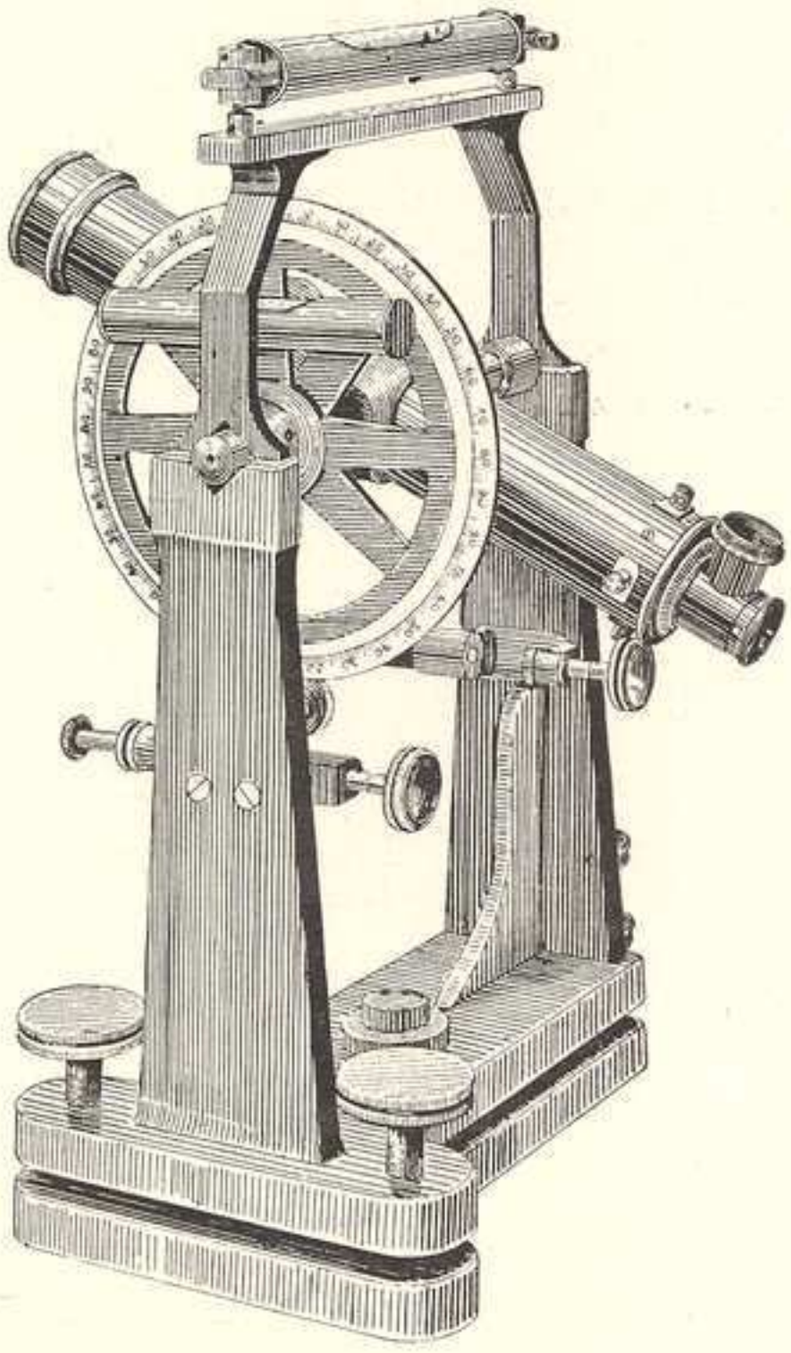
2343. **Queen & Co. Position Micrometer,** with incandescent electric lamp, ... $175 00

THE TRANSIT INSTRUMENT

is a telescope which is fixed permanently in the meridian, and moves only in that plane. It has a graduated circle on its axis, with an index for setting the telescope to the height of a star or of the sun. The eye-piece is fitted with cross-hairs to enable the observer to note the exact moment when a star or other celestial object passes the centre or meridian line of the instrument. The axis of the telescope consists of two hollow cones to permit the rays from a lamp to be reflected upon the cross-hairs at night-time. The following adjustments are required for making correct observations:

1. The cross-hairs and the object observed must be in focus.
2. The axis of the telescope must be horizontal.
3. The line of sight must move in a vertical circle, and be perpendicular to the horizontal axis.
4. The vertical circle just spoken of must coincide with the plane of the meridian.
5. The wires (or hairs) must be truly vertical after the foregoing adjustments have been made.

Small Transit Instrument for Observing Time.



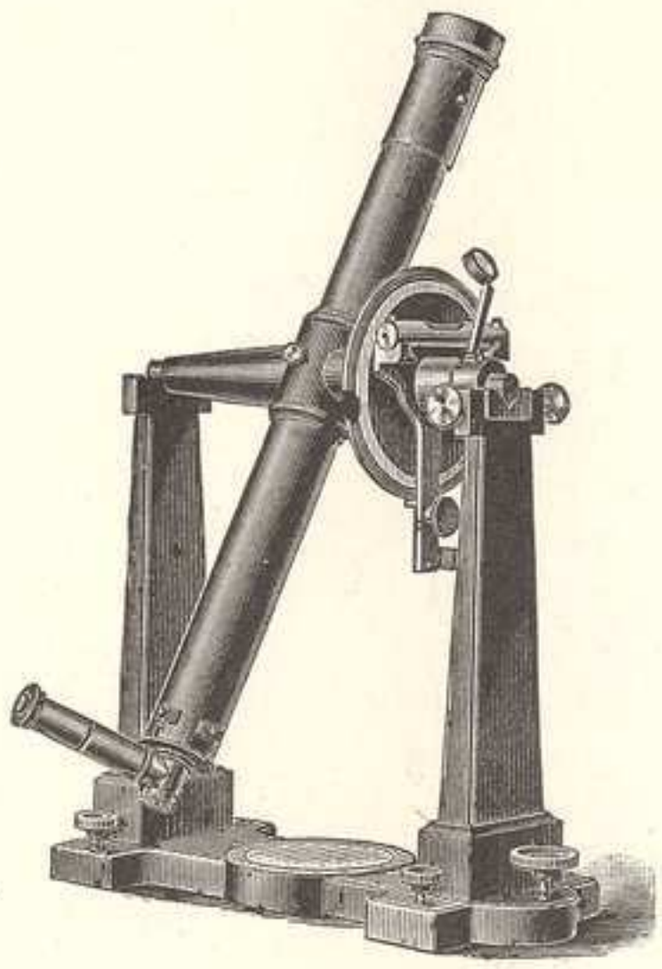
The instrument is small and compact, easily fitted up in the most convenient place. It is of such construction that the method of using it can readily be gained from the pamphlet accompanying each instrument.

Its accuracy and simplicity make it most valuable, not only to *astronomers*, but also to all who desire *accurate time*.

Each instrument is fitted with a setting circle, level, diagonal eye-piece, dark glasses, adjusting screws, etc., and has 3 vertical and 2 horizontal wires.

Price, complete as above in neat box, ... $75 00

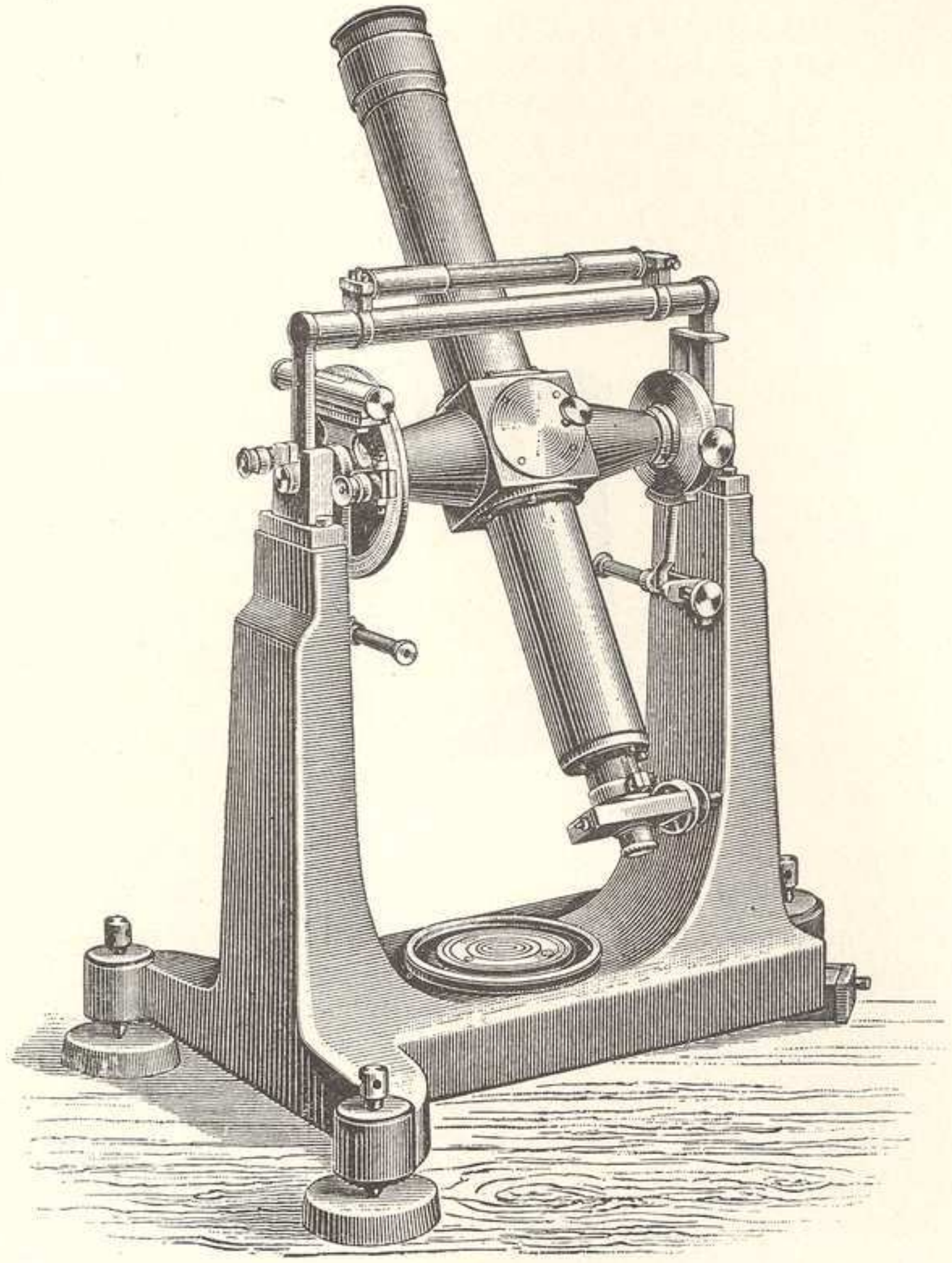
CLARK'S TRANSIT INSTRUMENT.



This Transit Instrument is designed for the purpose of obtaining accurate time in all parts of the world. Its employment is of the simplest character, and does not require any knowledge of astronomy or the stars, or calculations of any kind. In ordinary hands it will easily give time true to the second. The telescope is 18 inches in length, and the object-glass 1¾-inch aperture. The striding level is 9 inches long, and the axis of the Transit Instrument is 9 inches between bearings. The especial convenience of these instruments consists, however, in the means by which the altitude circle is set and adjusted and the telescope held steadily in position while the observation is being taken. This is effected by a tail-piece attached to the vernier circle by a clamping screw which rests against a stop on the uprights or the base plate, with a fine adjusting screw. By this means the star is brought perfectly on to the horizontal wire, and the telescope held firmly in position so as not to be liable to derangement or disturbance by a blow from the rim of the hat or other disturbing cause. The use of the small level is thus dispensed with, and the adjustments are all made indoors, none being required in the open air.

Price.....$125 00

TWO-INCH TRANSIT.



The frame of this instrument is of a single hollow casting, on which the pivots are secured, having the necessary adjustments; quick and micrometric motion for the telescope; the objective has a clear aperture of 2⅛ inches; mechanical reversing apparatus; the setting circle is attached to the axis and furnished with 2 verniers and microscopes; divisions are on silver, the illumination is effected through the axis by means of prisms. Price, ... $325 00

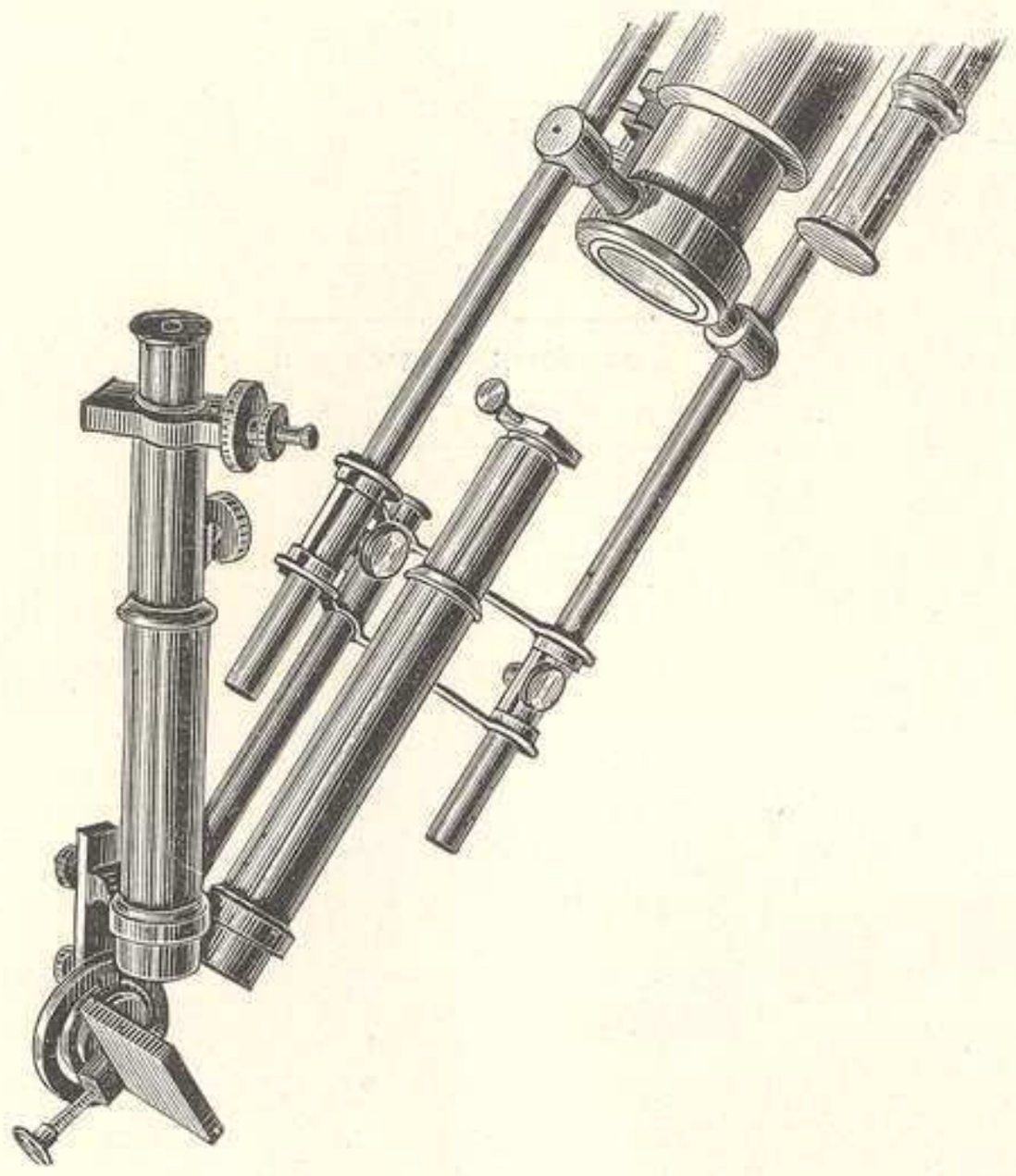
1769. The same construction, with objective 2½ inches clear aperture. Price, ... 450 00

TRANSIT CIRCLE

1770. **Transit Circle.** Constructed same as preceding. Axis balanced. Mechanical reversing apparatus. Objective 3 inches clear aperture. Price, ... $600 00

1771. Same as above, with objective 3¾ inches, ... 800 00

SOLAR AND STELLAR SPECTROSCOPE



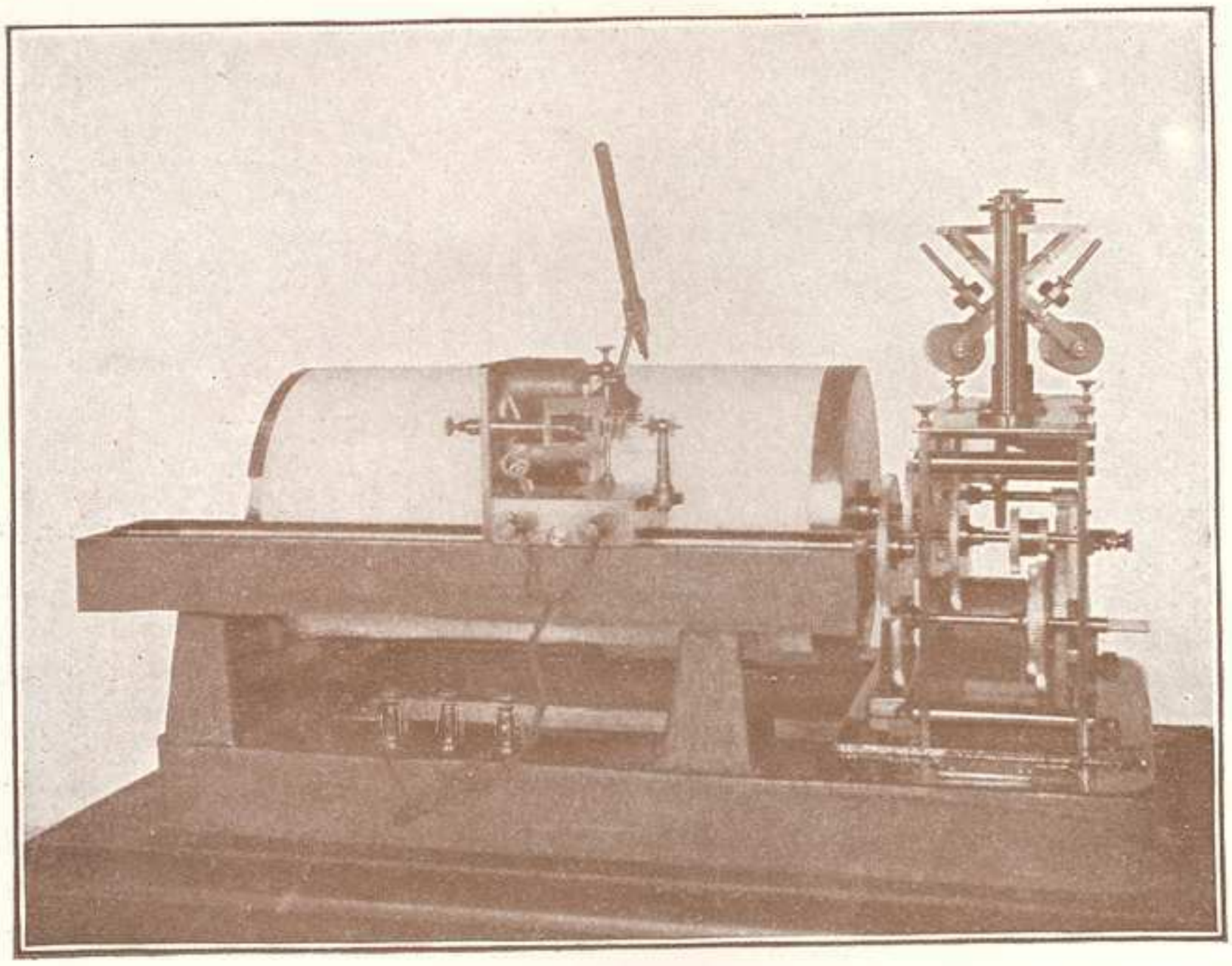
DIFFRACTION GRATING SPECTROSCOPE,

AS MOUNTED FOR THE

ASTRONOMICAL SOCIETY OF CAMDEN, N. J.

☞ Estimates furnished on application. Correspondence Solicited.

Queen & Co.'s New Chronograph



The above cut represents our New Chronograph with all the latest improvements to make it complete.

The cylinder is 14 inches long by 7 inches in diameter, and is revolved by means of an isochronic clock movement, furnished with maintaining apparatus so that it can be wound up without interference. It has two rates of speed, namely, full seconds and half seconds which can be changed in a few moments.

The record of the seconds form straight lines across the cylinder and can be read with perfect ease.

For use in observatories an independent pen for contact by hand can be added.

PRICE, $350.00

QUEEN & CO., Inc.

SCIENTIFIC INSTRUMENTS

59 Fifth Avenue
NEW YORK

1010 Chestnut Street
PHILADELPHIA

FINEST ASTRONOMICAL OBJECTIVES IN CELLS.

2½	inches	clear	aperture,	4	feet	focus		$ 15 00
2⅞	"	"	"	4	"	"		25 00
3	full "	"	"	4	"	4 inch		40 00
3⅝	"	"	"	4	"	9 "		70 00
4	"	"	"	5	"			90 00
4½	"	"	"	5	"	6 "		135 00
5	"	"	"	5	"	6 "		175 00
6	"	"	"	5	"			325 00

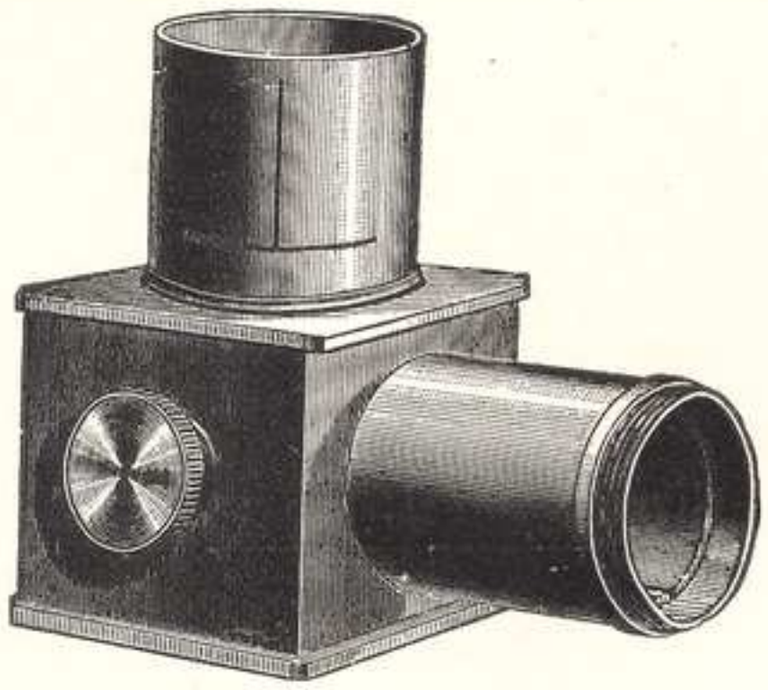
IMPROVED HUYGHENIAN OCULARS

Free from reflections; with concavo-convex field lens and plano-convex eye lens— Mittenzwei patent.

The image is formed between the two lenses.

A	Equivalent focus	¼	inch		$ 5 00
B	"	⅜	"		5 00
C	"	½	"		5 00
D	"	¾	"		5 00
E	"	1	"		6 00
F	"	1¾	"		9 00
G	"	2	"		15 00
Adapters for A, B, C and D					1 25

2355. COMBINED TOTAL REFLECTION AND SOLAR DIAGONAL.



The prism is contained in the cubical box, and is set by the knob at the sides; the ocular fits into cell on top, and the lower arm screws into draw tube of telescope. Price $12 00