CIVIL ENGINEERS'

AND

SURVEYORS'

INSTRUMENTS

W. & L. E. GURLEY'S INSTRUMENT MANUFACTORY. ESTABLISHED 1845.

1893.

W. & L. E. GURLEY,

TROY, N. Y.,

U. S. A.

DEAR SIR:

Please let us call your special attention to the New Illustrated Price List which we send you herewith. You will notice that many of thewood-cuts are new and illustrate our latest improved instruments.

The wood-cuts of the Transits show the new clamp to the horizontal limb, by which the limb is securely fastened without any possibility of springing the plates. We supply the new tangent screw with an opposing spring (so that all lost motion is avoided) to the limb, the telescope axis and the leveling head of Transits, and to the leveling head of Engineers' Y Levels.

You will notice the Verniers to the limb, heretofore placed at right angles to the telescope and beyond the view of the engineer without a change of position, are now located in the right place—at an angle of 30° with the telescope—so that they can be read at once without any movement of the observer.

The limbs of all our Transits Nos. 1 to 25 are now graduated on rolled silver and without extra charge. We also put stadia wires in the telescopes of our Transits and Y Levels, without extra charge, if requested when the instrument is ordered.

Among the new instruments please see the Reconnoissance Transit, which has already obtained an extensive sale and has proved itself a most desirable and a very portable instrument.

See also the following:

The Builders' Transit ; the Architects' Level, with spring tangent and clamp to the spindle ; Geological and Dial Compasses of aluminum of the U. S. G. S. pattern; simple Traverse Table, with Compass, Ruler-Alidade and tripod; a Clinometer Pocket Compass of approved form.

The Split Leg Tripod, considered to be a very rigid tripod.

Several improved forms of Plane Table movements.

We think we show here the first really practical Hand Level with telescope that has yet been made. With it better light as well as considerable magnifying power is obtained.

We show also in this pamphlet the new method of attaching the telescopic sight to Pocket Compasses, dispensing with the cross-bar and making a strong and portable instrument for approximate work.

See the Positive Motion Odometer for use on a wagon wheel ; the illustrations of Price's Current Meters for measuring the rapidity of streams of water; and here also we show Anemometers for use in coal mines and all places where ventilation and a supply of pure air is essential.

When any articles can be sent safely by mail, we have printed the cost of postage for same so that, by remitting with the order the cost of the article and postage, the goods can be sent by mail at small expense.

As heretofore, we have made our list prices of Engineers' and Surveyors' instruments as low as we can put them and furnish warranted instruments of the latest pattern.

W. & L. E. GURLEY.

Troy, N. Y., U. S. A., January, 1893.

ILLUSTRATED CATALOGUE

AND

PRICE LIST

OF

CIVIL ENGINEERS' AND SURVEYORS'

INSTRUMENTS,

With Descriptions and Illustrations of Latest Improvements.

MADE AND SOLD BY

W. & L. E. GURLEY,

TROY, N. Y.

U. S. A.

JANUARY, 1893.

The prices named in this Catalogue take precedence over those in the Editions of our "Manual" of previous date wherever a change in price has been made.

See "Special Notice" on back cover.

INFORMATION TO PURCHASERS.

SELECTION OF INSTRUMENTS.—Where only original surveys or the bearing of lines in the preparation of County Maps are required, the Plain Compasses will answer.

The Vernier Compass or Vernier Transit Compass will be required where the variation of the needle is to be allowed, as in retracing the lines of an old survey, etc.

When in addition to the variation of the needle local attraction must be taken into account, and the angles taken independently of the needle, an instrument with a divided limb must be employed, and for this purpose the Railroad Compass will be sufficient.

For a mixed practice of general surveying, including farm and city work, the establishment of grades of roads, the running of levels, etc., such an instrument as the Surveyors' Transit, with its various attachments, is amply sufficient.

The various forms of the Engineers' Transit, the Mountain Transit and the Y Leveling instruments, are designed for engineering of the highest class.

In the U. S. public land surveys, an instrument with solar apparatus is required, and the Solar Transit is usually selected.

In surveys of Mining claims, especially in the high elevations of Colorado, and for the surveys of mines in general, the Mountain Transit, either with the Solar Attachments or with other extras, has proved an almost universal favorite.

The new Drainage Level is, we believe, the most simple and efficient instrument designed for the drainage of farms, etc.

The Architects' Level and the Builders' Transit are employed in laying out buildings, determining the level of their floors, sills, windows, and the general work of the builder.

The various forms of the Pocket Compass, with or without Telescopic Attachments, and the Reconnoissance Transit, are very desirable for a large class of work where extreme lightness and portability are demanded.

Where iron ores are also to be traced, the Miners' or Dip Compass, the Dial Compass and the Pocket Solar Compass are often required.

We do not pretend to make any instrument by which veins of gold and silver can be traced, or the presence of those metals detected.

Our instruments are *not* for sale by dealers in books and apparatus; we do not deem it advisable to add to our prices to enable us to give to such dealers a large *discount*, which, of course, would be paid by the purchaser.

WARRANTY.—All our instruments are examined and tested by us in person, and are sent to the purchaser adjusted and ready for immediate use.

When purchased directly of us they are warranted correct in all their parts—we agreeing, in the event of any defect appearing after reasonable use, to repair or replace with a new and perfect instrument, promptly at our own cost, express charges included, or we will refund the money and the express charges paid by the customer.

Instances may sometimes occur, in a business as large and widely extended as ours, where, owing to careless transportation, or to defects escaping the closest scrutiny of the maker, instruments may reach our customers in bad condition. We consider the retention of such instruments in all cases an injury very much greater to us than to the customer himself.

TRIAL OF INSTRUMENTS.—It may often happen that this statement of the prices and quality of our instruments may come into the hands of those who are entirely unacquainted with us or the quality of our work, and who therefore feel unwilling to make a final purchase of an article, of the excellence of which they are not perfectly assured.

To such we make the following proposition: If requested to do so, we will send the instrument to the express station nearest the person giving the order, and direct the express agent, on delivery of same, to collect our bill, together with charges of transportation, and hold the money on deposit one or two weeks, as may be desired, until the purchaser shall have had an actual trial of its quality.

If not found as represented, he may return the instrument before the expiration of that time, and receive the money paid in full, including express charges, and direct the instrument to be returned to us.

The privilege of trial applies only to our larger Transits, Levels and Compasses, and is not given unless requested, and is only granted in the United States.

EXTENT OF OUR BUSINESS.—The manufacture of surveying instruments has been conducted by us since 1845, and thousands of our instruments have been distributed to customers in all parts of the United States, and in Canada, Mexico, Central America, Cuba, South America, Sandwich Islands, Japan and other foreign countries.

Our facilities for manufacturing, which for many years have been far superior to those of any other similar establishment, we have now greatly increased by the introduction of new machinery and tools of the most improved construction. Our manufactory has been enlarged to nearly three times its former size, and we are better prepared than ever before to fill orders for any of our instruments with promptness and satisfaction.

LOW PRICES OF OUR INSTRUMENTS.—It is often urged by other makers, and persons prejudiced in their favor, that it is impossible to make first-rate instruments at the prices charged by us, and which are so very far below those of other skillful manufacturers.

We have only to reply, in addition to what we have stated in our warranty, that a visit to our works and a comparison of our facilities with those of our competitors, would dispel all questions as to our ability to surpass them, not only in the cheapness, but also in the superior quality of our work.

PACKING, ETC.—Each of our Transists, Levels and Surveyors' Compasses is packed in a well finished mahogany case, furnished with lock and key and brass hooks, and leather strap for convenience in carrying. Each case is provided with screw-drivers, adjusting pins, and wrench for center pin, and if accompanied by a tripod, with a brass plumb bob. With all instruments used for taking angles without the needle, a reading microscope is also furnished.

Unless the purchaser is already supplied, each instrument is accompanied by our "Manual," giving full instructions for such adjustments and repairs as are possible to one not provided with the facilities of an instrument maker.

When sent to the purchaser the mahogany cases are carefully inclosed in outside packing boxes of pine, made a little larger on all sides to allow the introduction of elastic material, and so effectually are our instruments protected by these precautions, that of many thousands sent out by us since 1845, in all seasons, by every mode of transportation, and to all parts of the Union, and Canada, Mexico, Central America, South America and many other foreign countries, not more than three or four have sustained any serious injury.

Instruments packed for foreign shipment are hermetically sealed in tin cases.

MEANS OF TRANSPORTATION.—Instruments can be sent by express to almost every town in the United States, Canada and Mexico, regular agents being located

at all the more important points, by whom they are forwarded to smaller places by stage. The charges of transportation from Troy to the purchaser are in all cases to be borne by him, we guaranteeing the safe arrival of our instruments to the extent of express transportation, and holding the express companies responsible to us for all losses and damages on the way.

FINISH OF INSTRUMENTS.—Customers ordering instruments will do us a favor by mentioning whether they prefer them of bright or bronze finish, the cost being the same in either case.

If no direction is given we usually send Transit and Leveling instruments of bronze finish, and Compasses of bright finish.

TERMS OF PAYMENT are uniformly cash, and we have but one price, whether ordered in person or by mail. Our terms are as low as we think instruments of equal quality can be made, and will not be varied from the list given on the following pages.

Remittances may be made by a draft, payable to our order at Troy, Albany, New York, Boston, or Philadelphia, which can be procured from banks or bankers in almost all the larger villages, or by Post Office money order, or by registered mail.

These may be sent by mail with the order for the instrument, and if lost or stolen on the route, can be replaced by a duplicate, obtained as before, and without additional cost.

The customer may also send the money in advance through the express agent, or, may pay the agent on receipt of the instrument in funds current in New York or Boston. Goods ordered for shipment to foreign countries must be paid for in advance of shipment.

Customers ordering instruments and desiring changes in construction from our regular patterns, must make a payment in advance when ordering of 50 per cent. of the price.

The cost of returning the money on bills collected by express, of amounts under $20, will be charged to the customer.

REPAIR OF INSTRUMENTS.

Hundreds of instruments, of our own and others' make, come to us every year for refitting and repairs, and so much correspondence arises therefrom, that we are led to believe that a brief statement in this place of the cost of such repairs, etc., will be of service to our customers and ourselves.

Most instruments sent to us for repairs are injured by falls; many are worn and defective in parts after long use; and others are sent for repolishing and renovating.

We advise our customers having instruments in need of repairs, etc., to send them immediately to us, as our facilities enable us to do the work much more economically and promptly than any other maker, however accessible.

They should always, when practicable, be placed in their own boxes, and then enclosed in an outside packing case, an inch larger in all its dimensions, that the interval between the two may be filled with paper wadding, hay or fine shavings.

A note specifying the repairs needed should accompany the instrument, and a letter should also be sent by mail to us, giving not only directions as to the repairs, but also stating when the return of the instrument is required, and the precise location to which it should be forwarded. It should also be remembered that each instrument is made to fit its own spindle, and no other; and therefore this part, with the parallel plates and leveling screws, if it has any, should always be sent with it.

The legs and brass heads in which they are inserted need never be sent, unless themselves in need of repairs.

When requested to do so, we will send an estimate of the cost of the repairs on any instrument sent us, before beginning the work.

Compasses.—These come to us with the plates sprung, the sights bent or broken, the glass or level vials fractured, and the pivot so dulled as to render the needle sluggish and unreliable. The cost of repairing the defects above named ranges from $2 to $8 or $10. A new pair of sights fitted costs $5; a new needle with jeweled center and pivot complete, $2.50; a new jeweled center, $1.50; graduating compass circle, $5.

The compass should always be accompanied by the ball spindle, and if a new ball spindle is required, the whole instrument, or at least the socket in which the spindle fits, should be sent to us; a new ball spindle costs $1.50. See also page 47.

Repairs to Railroad Compasses cost from $10 to $20.

Repairs to Solar Compasses cost from $20 to $40 or $50.

Transit Instruments.—The repairs of the Vernier Transits cost about the same as those of the compasses above stated.

The injuries sustained by the falls of Engineers' and Surveyors' Transits are usually much more serious; in these the plates, standards and cross-bars of telescopes are often bent, and sockets or centers usually so deranged as to be entirely useless.

The cost of repairing an instrument with such injuries ranges from $10 to $30 or even $50, the new sockets alone costing from $15 to $20. See also page 47.

Variation Plate added to any Engineers' Transit sent for repairs, costs	$15 00
Regraduating horizontal limb and vernier, to read to one minute	10 00
Regraduating vertical limb and vernier, to read to one minute	5 00

Platinum Cross-Wires.—None but a practiced hand and provided with the best facilities can properly set the platinum wires in a cross-wire diaphragm, and it is useless, therefore, to send a parcel of wire for that purpose.

The only way in which they can be replaced without sending the telescope is to take out the ring and send it to us with its screws, washers, etc., and we will return it properly secured.

The price of platinum cross-wires, plain, replaced in old ring, is	$2 00
Stadia wires, replaced in old ring	3 00

If sent by mail add 15 cents for postage and registry.

When it is desirable to substitute platinum for spider-web, a new ring, with screws, etc., will be required.

The price of platinum cross-wires, with diaphragm, screws, etc., plain, is	$3 00
Stadia wires, with diaphragm, etc	5 00

Leveling Instruments are generally much less injured by falling than Transits, the damages being included usually in the bending of the cross-bar, the springing of the sockets, and the breaking of the level vial.

The cost of repairs varies from $5 to $15; a new level vial set in the tube costs $2. See also page 47.

Repolishing Instruments.—The cost of repolishing an instrument, involving, of course, its complete readjustment, varies with the different kinds, but may be stated generally as follows:

Compasses (Plain and Vernier,) from	$5 00 to $7 00
Railroad Compasses, from	8 00 to 10 00
Solar Compasses, from	15 00 to 20 00
Transits, from	12 00 to 20 00
Engineers' Y Levels, from	12 00 to 15 00

These prices are in addition to the cost of repairs.

No additional charge is made for bronzing or blackening an instrument when repolished.

Payment of Repairs, etc., may be made at the express office where the instrument is received, the customer paying for the first transportation of the instrument to us or not, as he may prefer. Whenever the freight is paid in advance, the express receipt should be mailed immediately to us.

TRANSITS.

No. 3.

Engineers' Transit, 5-inch needle. Price, $150.00.

ENGINEERS' TRANSITS.

The cut represents our latest greatly improved Engineers' Transit, so generally preferred in railroad practice.

It has the two opposite verniers of the limb at an angle of 30° with the telescope and thus in front of the observer, so as to be easily read without a change of position.

The sockets are long and the upper parts of the instrument brought down closely to the leveling head which is itself permanently attached to the centers.

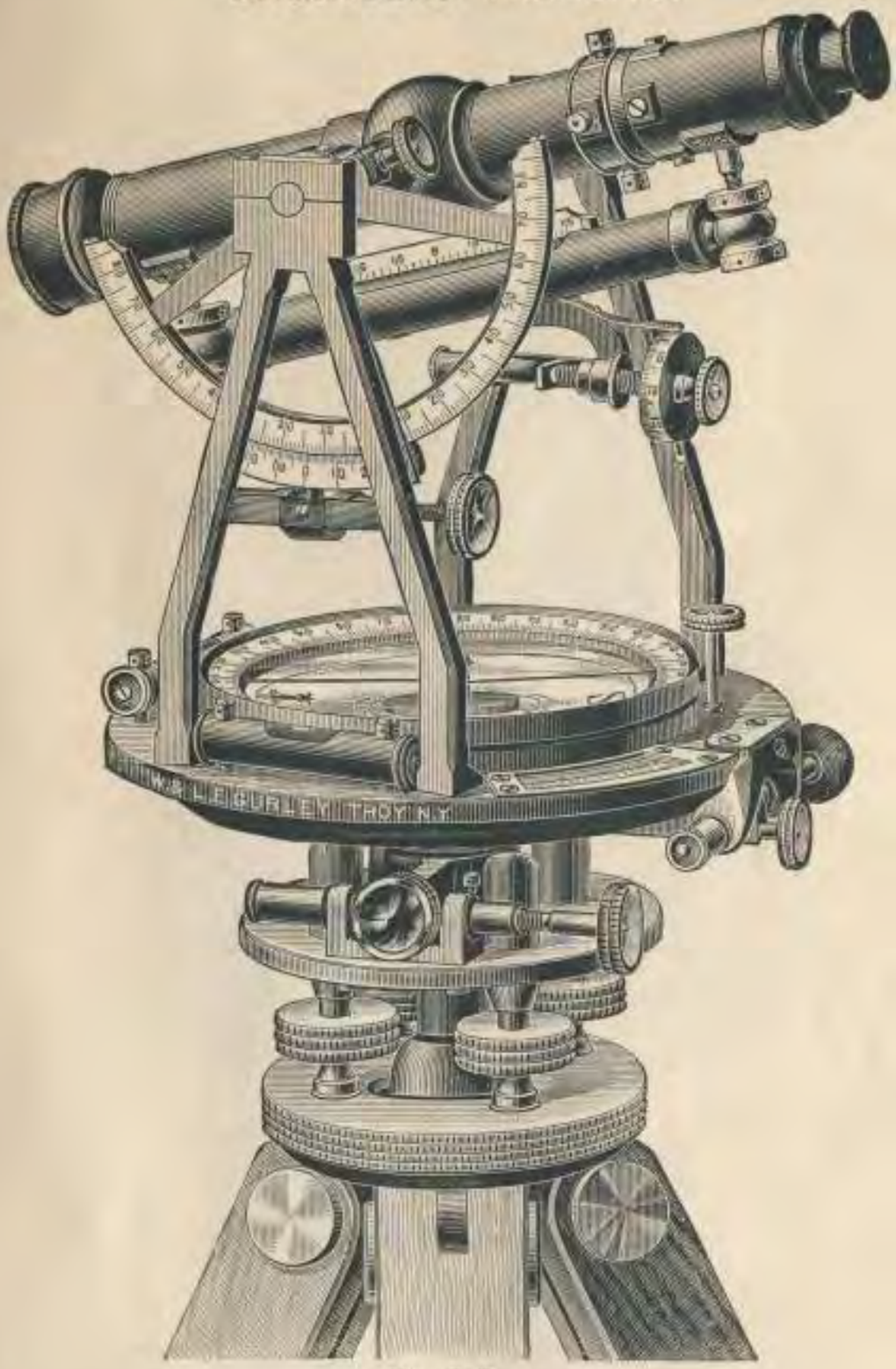
The tangent movements have each a single screw with opposing spring and are very sensitive; the clamp to the limb being also attached to the solid center of the instrument instead of the upper plate as heretofore.

The telescopes of all our Transits, Nos. 1 to 24, are now furnished with rack and pinion movements to both eye and object slides without extra charge.

In the Engineers' Transit the compass circle is usually solid with the upper plate; when, however, it is required to set off the variation of the needle, the instrument is made with movable compass circle like that of the Surveyors' Transit.

NOTE.—The limbs of all our Transits, Nos. 1 to 25, are now graduated on rolled silver. We also put stadia wires in the telescopes, if requested when ordering a transit, and without extra charge.

ENGINEERS' TRANSITS.



No. 3 B

Price . . . . . $198.00.

No.		Prices.
1.	—Engineers' Transit, two verniers to limb, 4-inch needle, plain telescope*	$145 00
2.	—Engineers' Transit, two verniers to limb, 4½-inch needle, plain telescope	150 00
3.	—Engineers' Transit, two verniers to limb, 5-inch needle, plain telescope	150 00
3 A.	—Engineers' Transit, two verniers to limb, 5-inch needle, but with 4½-inch vertical circle on silver, reading with vernier to single minutes, level on telescope with ground bubble and scale, and clamp and tangent movement to axis of telescope	180 00
3 B.	—Engineers' Transit, two verniers to limb, 5-inch needle, but with 6-inch vertical arc on silver, with vernier moved by tangent screw and reading to 30 seconds, level on telescope, gradienter combined with clamp and tangent	198 00
3 C.	—Engineers' Transit, two verniers to limb, 5-inch needle, same as No. 3A, but omitting vertical circle	168 00
3 D.	—Engineers' Transit, 5-inch needle, with 6-inch vertical arc on silver, with vernier moved by tangent screw and reading to 30 seconds, level on telescope, with clamp and tangent movement to telescope axis	186 00

*A "plain" telescope is one without any attachments or extras, as we term them, such as the clamp and tangent, vertical circle and level.

NOTE.—All of our transits, Nos. 1 to 25 inclusive, are furnished with a tripod and leveling screws and clamp and tangent to spindle.

Also, see note on bottom of page 6.

ENGINEERS' TRANSIT WITH SOLAR ATTACHMENT.

No. 5.

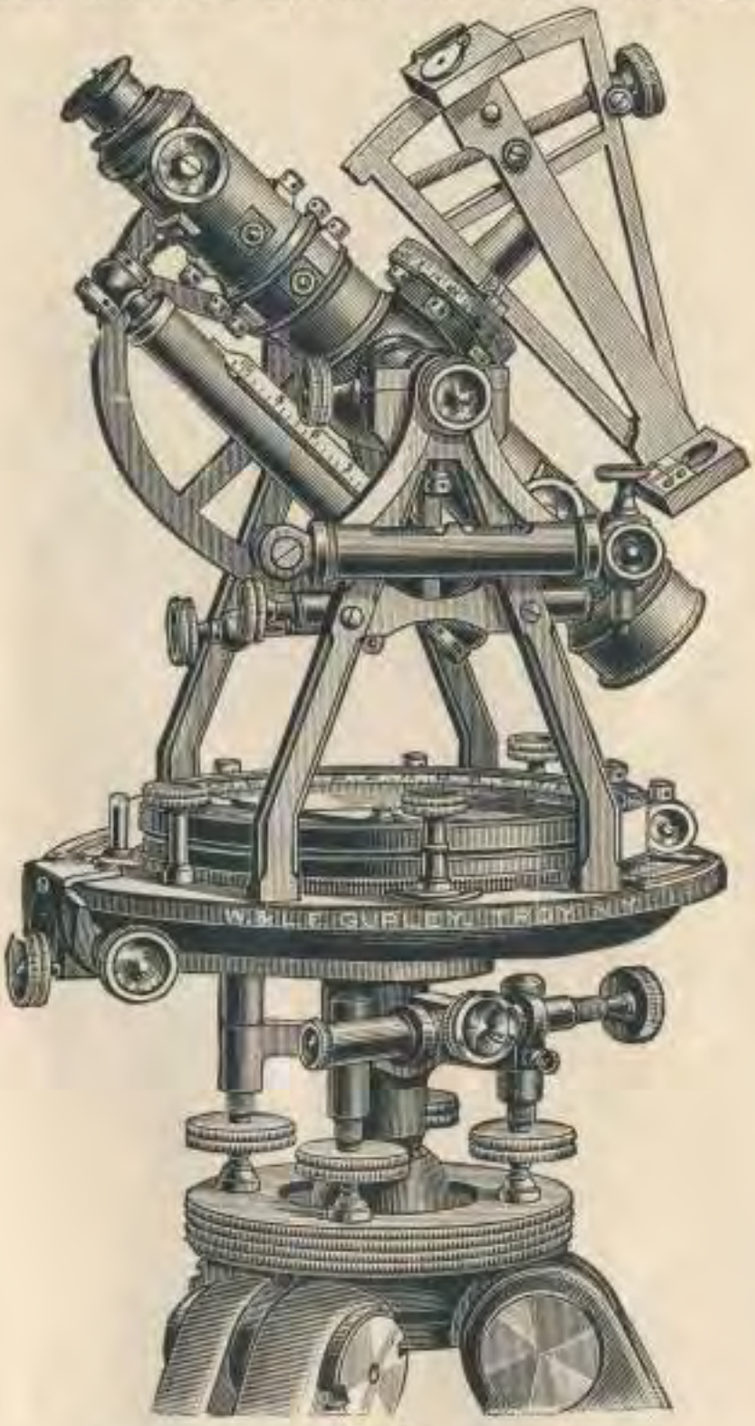
Five-inch Engineers' Transit with solar attachment. Price, $250.00.

The engraving represents our Engineers' Transit with five-inch needle and attachments of vertical arc six inches in diameter divided on silver and reading to thirty seconds, level on telescope, clamp and tangent to axis, and solar apparatus with declination arc reading to thirty seconds.

The horizontal limb reads to single minutes, and is graduated on rolled silver. The telescope is fitted with stadia wires.

The compass circle is also made movable, with pinion and clamp, for setting off the variation of the needle.

LIGHT MINING OR MOUNTAIN TRANSITS.



No. 7.

Price $245.00

This is an extra light Engineers' Transit for mine or mountain use, introduced by us in 1876 to meet a demand for a light transit of the best quality. It has met with a very large sale and been universally approved.

This instrument has all our recent improvements in position of verniers, tangent screws, etc., as the Engineers' Transit, No. 3, and when ordered with a Solar Apparatus, it has also our new patent latitude level, as shown in the cut.

The horizontal limb, latitude and declination arcs, and hour circle, are all graduated on rolled silver. The telescope is always fitted with stadia wires.

We confidently recommend it to all our friends as a transit of the first class, capable of any work, and specially adapted for mining or rough country use where great portability is required.

PRICES.

No. 6.—Light Mountain Transit, four-inch needle, variation arc, two verniers to limb, telescope of finest quality, power twenty diameters, patent extension tripod shortening to half length. The instrument is packed in a mahogany case, covered with a light sole-leather case, with straps for "packing." With plain telescope $150.00

No. 6A.—Light Mountain Transit, but with 4½-inch vertical circle, level on telescope, and clamp and tangent movement to axis of telescope 180.00

No. 6B.—Light Mountain Transit, same as No. 6A, but omitting vertical circle 168.00

No. 7.—Light Mountain Transit, with patent solar attachment, vertical arc reading to one minute, level on telescope, and clamp and tangent to axis of telescope, complete, as shown. 245.00

No. 7A.—Light Mountain Transit, with level, vertical arc, clamp and tangent to axis of telescope, same as No. 7, but omitting solar attachment 180.00

No. 7B.—Light Mountain Transit, with vertical arc, level on telescope, and gradienter combined with clamp and tangent movement 198.00

No. 8.—Light Mountain Transit, with patent solar attachment, Jones' patent latitude arc complete, level on telescope, and clamp and tangent to axis of telescope, as shown on page 12 . . . . . 229.00

THE SOLAR ATTACHMENT.

EXPLANATION OF THE SOLAR APPARATUS.

In the cut we have a graphical illustration of the Solar apparatus; the circles shown being intended to represent in miniature those supposed to be drawn upon the concave surface of the heavens.

When the telescope is made horizontal by its spirit level the hour circle will be in the plane of the horizon, the polar axis will point to the zenith and the zeros of the vertical arc and its vernier coincide.

In this position of the instrument, if the arm of the declination arc be placed at zero, and one lens directed to the sun, his image will be seen between the lines on

the silver plate of the opposite block, and will indicate his position in the heavens, on an instrument placed at the north pole of the earth at the time of equinoxes, or when the equator is in the plane of the horizon.

Now if we incline the telescope as shown in the cut, the polar axis will descend from the direction of the zenith. The angle through which it moves, being laid off on the vertical arc, and shown by its vernier to be 40°, will be the co-latitude of the place where the instrument is supposed to be used, the latitude itself being found by subtracting 40° from 90°, making it just 50°.

Now if the declination arm remains at zero, and the lens be again directed to the sun, his image will appear on the opposite plate as before, the instrument being used at time of the equinox and at a latitude of 50°.

When, however, the sun passes above or below the equator, his declination or angular distance from it, as given in the Ephemeris, can be allowed for and set off upon the arc and his image brought into position as before.

In order to do this, however, it is necessary not only that the latitude and declination shall be correctly set off upon their respective arcs, but also that the instrument should be moved in azimuth until the polar axis points to the pole of the heavens, or, in other words, is placed in the plane of the meridian, and thus the position of the sun's image will indicate not only the latitude of the place, the declination of the sun for the given hour, and the apparent time, but also determine the meridian or true north and south line passing through the place where the observation is made.

ADVANTAGES OF THE SOLAR ATTACHMENT.

It will be readily understood that the more perfect horizon obtained by the use of the telescope level, and the use of a telescope in place of sights, render the new attachment more accurate than the ordinary solar compass.

It can also be put on the telescope of any good transit at comparatively small cost, and thus enable the surveyor to establish the true meridian, to determine the correct latitude, and to obtain true time very nearly.

Its adaptation to the purposes of illustration and instruction in practical astronomy in colleges and schools, will occur to every teacher; and we believe that for the Government surveyor it furnishes a long-sought and much-needed instrument, superior in many respects to the solar compass once so commonly used.

In experiments made by us, an error of one-quarter of a minute in the direction of the true meridian, or in latitude, could be easily detected by observing the sun's image by a magnifier; and we feel confident that any one who uses the new solar will be surprised and delighted with its work. When desired it can be removed from the telescope and packed in the instrument case.

The weight of the new Solar Attachment is but little over ten ounces, and is so distributed as not to disturb the counterpoise of the instrument, thus obviating the objection which has hitherto prevented the successful application of the telescope to the solar apparatus.

It is evident that all transits to which the Solar Attachment is to be applied should be furnished with the appliances of a level on telescope, clamp and tangent movement to axis, and vertical arc with adjustable vernier, and should have a horizontal limb and verniers and magnetic variation arc, and be leveled by leveling screws and parallel plates.

Of course it will be understood, in all cases, that where transits of any kind are to be supplied with the new Solar Attachment, they must be in perfect order, especially in respect to the sockets, before correct work can be done.

LIGHT MOUNTAIN TRANSIT.

No. 8.

Light Mountain Solar Transit, with Jones' Patent Latitude Arc, and Reversible Level Bubble.

Price, including extension tripod . . . . . $299.00.

R. M. JONES' PATENT LATITUDE ARC.

(Patented Jan. 16, 1883.)

In this new attachment, which has now been secured exclusively to us, the usual vertical arc is omitted, and replaced by a double latitude arc attached to the under side of the telescope, as shown. The smaller arc, having its center directly under the cross bar of the telescope, has an arm with vernier reading the arc to single minutes, and carries also a level tube open both top and bottom, with a divided scale over against each opening, in order to read the level accurately. The larger arc, with vernier reading to ten seconds, is used in conjunction with the smaller arc to enable the observer to obtain a finer reading.

PRICES.

Jones' Patent Latitude Arc, with reversible level bubble. $72 00

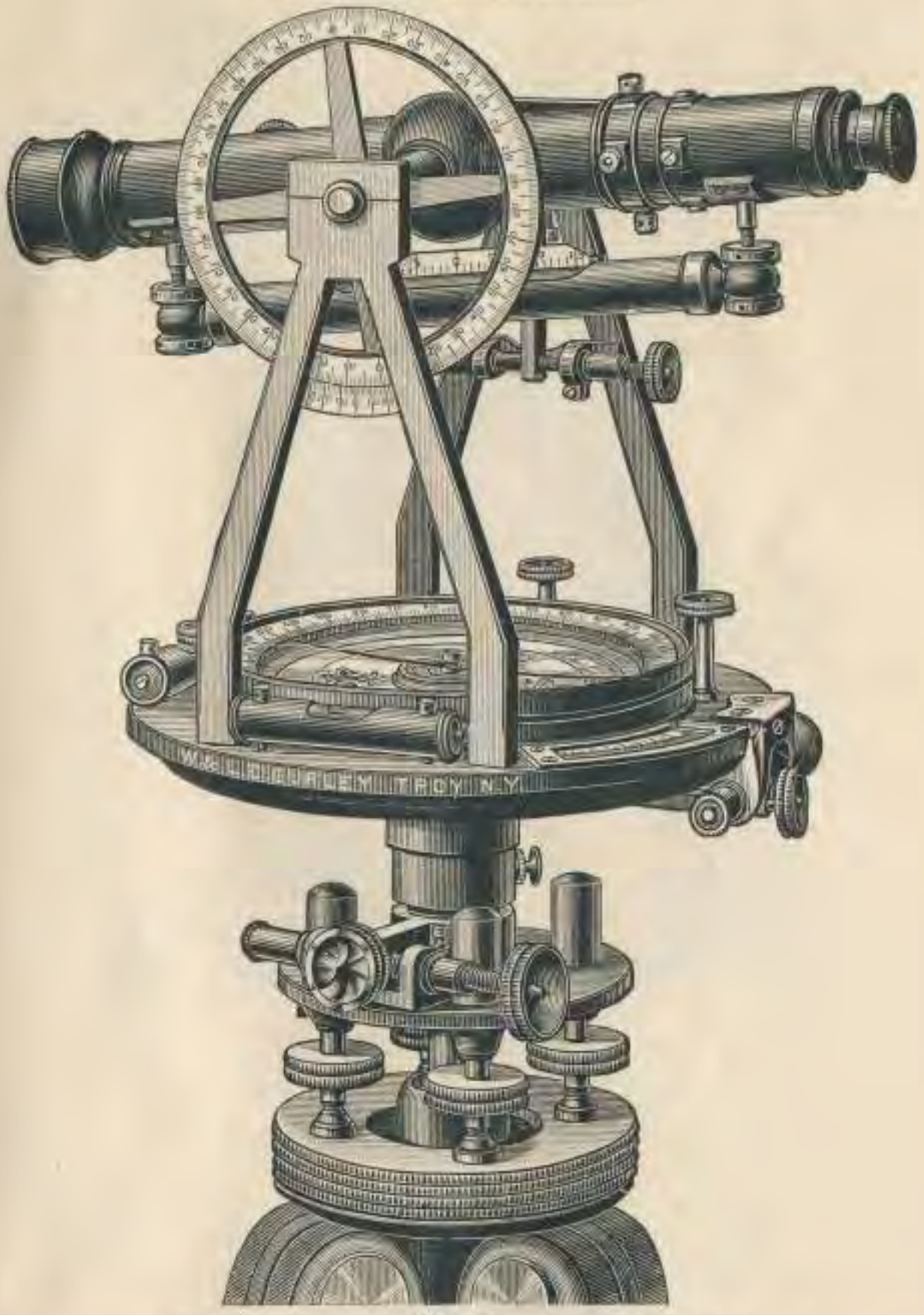
When furnished with a new transit of our make, in place of the ordinary vertical arc, the Jones' Patent Latitude Arc with reversible level bubble increases the cost of the instrument 54 00

Thus: The Light Mountain Transit, with Patent Solar Attachment and Jones' Patent Latitude Arc, costs 299 00

NOTE.—The standards, vernier openings and tangent movements are now made as shown in No. 7.

SURVEYORS' TRANSITS.

(WITH TWO VERNIERS TO LIMB.)



NO. 15.

Price . . . . . $160.00.

The Surveyors' Transit has a telescope from ten to twelve inches long. The compass circle is divided to half degrees, and is provided with a vernier for adding or subtracting the magnetic variation of the needle. The leveling head is arranged with shifting center, for setting the instrument quickly over a given point without altering the position of the legs. The limb or divided circle outside the compass box and under the main plate, is provided with two opposite verniers covered with glass and placed in front of the observer so as to be read without changing his position. The verniers read to single minutes, and the instrument is furnished with all our later improvements.

PRICES.

No. 12.—Surveyors' Transit, 4-inch needle, two verniers to limb, plain telescope $125 00

No. 12A.—Surveyors' Transit, same as above, but with 4½-inch vertical circle, level on telescope, and clamp and tangent to axis of telescope, as in engraving 155 00

No. 12B.—Surveyors' Transit, 4-inch needle, same as No. 12A, but omitting vertical circle . 143 00

No. 13.—Surveyors' Transit, 5-inch needle, two verniers to limb, plain telescope 130 00

No. 14.—Surveyors' Transit, 5½-inch needle, two verniers to limb, plain telescope 190 00

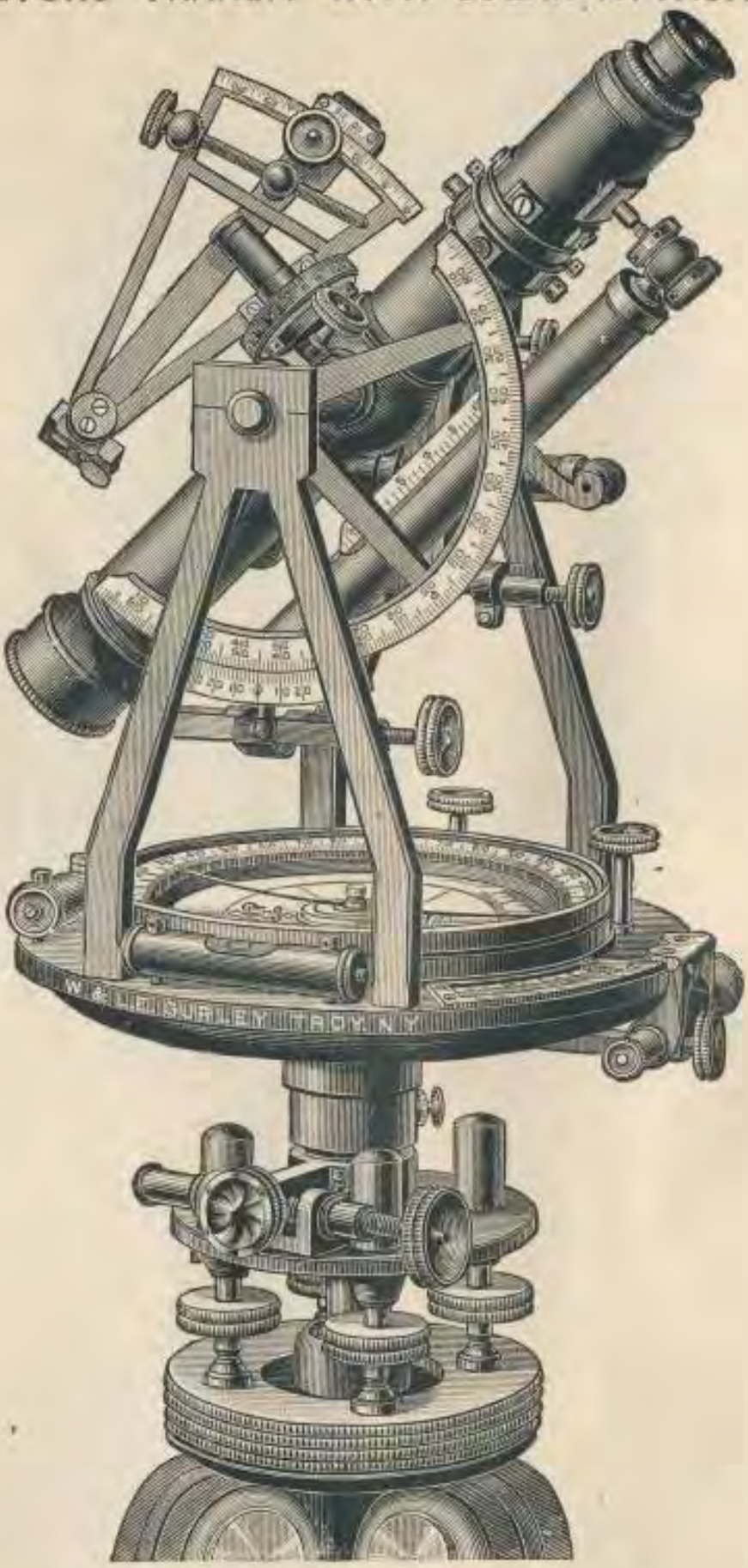
No. 15.—Surveyors' Transit, 5 or 5½-inch needle, but with 4½-inch vertical circle on silver reading with vernier to single minutes, level on telescope with ground bubble and scale and clamp and tangent movement to axis of telescope, as shown 160 00

No. 15A.—Surveyors' Transit, 5 or 5½-inch needle, same as No. 15, but omitting vertical circle 148 00

No. 15B.—Surveyors' Transit, 5 or 5½-inch needle, two verniers to limb, and with 4½-inch vertical circle on silver reading with vernier to single minutes, level on telescope with ground bubble and scale, and gradienter combined with clamp and tangent movement to axis of telescope 172 00

See notes at bottom of pages 6 and 7.

SURVEYORS' TRANSIT WITH SOLAR ATTACHMENT.



No. 16.

Price . . . . . $226.00.

The cut represents our Surveyors' Transit with 5-inch needle, to which is adapted the Solar Attachment with vertical arc, etc.; both the vertical arc and that of the declination arm being divided on silver and reading to thirty seconds. The instrument has shifting center to leveling head and is furnished either with one vernier to limb, or with two verniers to limb, as may be desired.

The horizontal limb is graduated on rolled silver and reads to single minutes. The telescope is fitted with stadia wires.

PRICES.

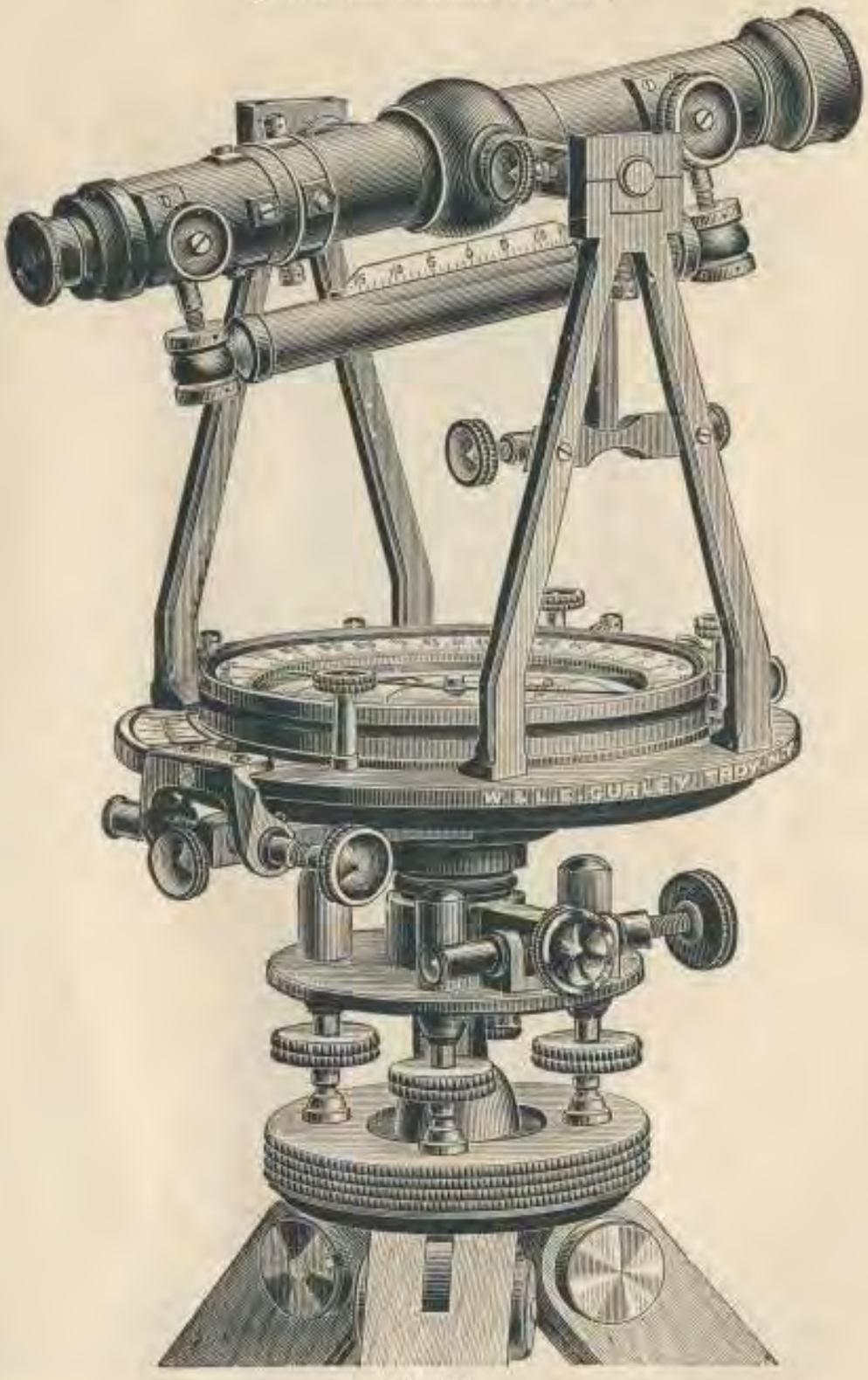
No. 16.—Surveyors' Transit, two verniers to limb, 5-inch needle, with Solar Attachment, vertical arc, level on telescope, clamp and tangent to axis of telescope, and tripod . . $226 00

No. 24.—Surveyors' Transit, one vernier to limb, 5-inch needle, with Solar Attachment, vertical arc, level on telescope, clamp and tangent to axis of telescope, and tripod . . 211 00

Both styles have been for years in successful use in different parts of the country.

SURVEYORS' TRANSITS.

(WITH ONE VERNIER TO LIMB.)



No. 23.

Price . . . . . $133.00.

The Surveyors' Transit has a telescope from ten to twelve inches long. The compass circle is divided to half degrees, and is provided with a vernier for adding or subtracting the magnetic variation of the needle. The leveling head is arranged with shifting center for setting the instrument quickly over a given point without altering the position of the legs.

The limb, or divided circle outside the compass box and under the main plate, is provided with a vernier covered with glass and placed like that of the Engineers' Transit and reads to single minutes. The telescope, as in the other Transits already described, has a rack movement to both eye and object tubes as shown in the cut.

PRICES.

No. 20.—Surveyors' Transit, 4-inch needle, one vernier to limb, plain telescope $110 00

No. 20A.—Surveyors' Transit, same as above, but with level on telescope, and clamp and tangent to axis of telescope 128 00

No. 21.—Surveyors' Transit, 5-inch needle, one vernier to limb, plain telescope 115 00

No. 22.—Surveyors' Transit, 5½-inch needle, one vernier to limb 115 00

No. 23.—Surveyors' Transit, same as above, 5 or 5½-inch needle, but with level on telescope, and clamp and tangent movement to axis of telescope 133 00

No. 23A.—Surveyors' Transit, same as above, 5 or 5½-inch needle, same as No. 23, but with addition of 4½-inch vertical circle and vernier 145 00

No. 23B.—Surveyors' Transit, 5 or 5½-inch needle, one vernier to limb, and with 4½-inch vertical circle on silver reading with vernier to single minutes, level on telescope with ground bubble and scale, and gradienter combined with clamp and tangent movement to axis of telescope 157 00

See notes on bottom of pages 6 and 7.

RECONNOISSANCE TRANSIT.

No. 25.

Price . . . . . $115.00.

In response to a demand for a very light Transit for rapid work and where extreme accuracy is not required, we have recently introduced what we term a Reconnoissance Transit.

It has a needle of 3½ inches, a limb of 5 inches in diameter, graduated on rolled silver, reading by one double vernier to single minutes, and is supplied with our new spring tangent movement like the larger instruments.

The telescope has a power of from 18 to 20 diameters, and is furnished with stadia wires for measuring distances; it has also, as shown, a long level to telescope, vertical circle reading to five minutes, and the clamp and tangent to axis.

The compass circle is arranged to set off the variation of the needle, the movement being made by a pinion.

It has also, as shown, a leveling head with a shifting center, and with spring clamp and tangent, and the instrument is set upon our light extension tripod, the legs of which close up to about three feet long.

The weight of this transit without tripod is about 7¾ lbs.; with tripod complete, about 15 lbs. Its portability, with its capabilities for a large variety of rapid work, have already made this a very popular instrument.

THE BUILDERS' TRANSIT.

No. 27.

Price, as shown . . . . . $80.00.

In the use of the Architects' Level it was often desirable to determine a point in a vertical plane either above or below the object observed, or to determine points on either side and in line of the center of the instrument, more conveniently than could be done with the Architects' Level.

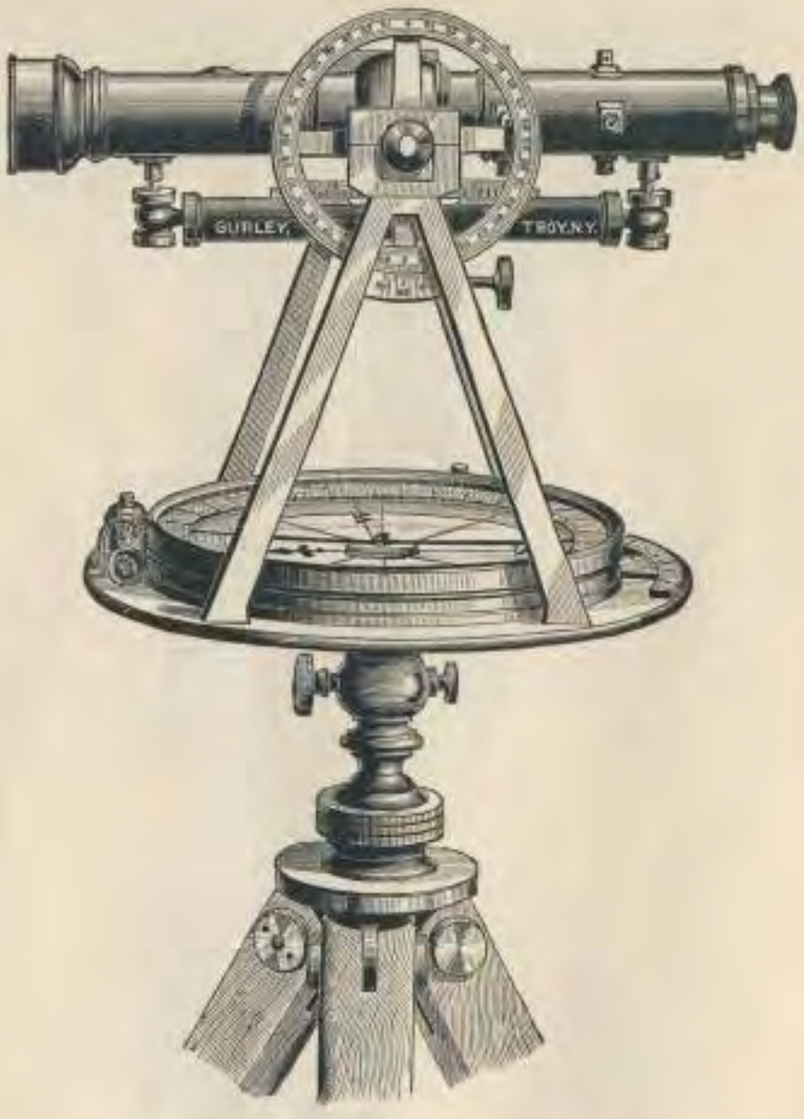
To meet this want we have devised the Builders' Transit, shown in the cut. It has a telescope with long graduated level, clamp and tangent to the axis, a graduated limb reading by an index to one degree, clamp and tangent movement to both limb and leveling head, and plain tripod and trivet plate.

In use the instrument is set up either upon the tripod or trivet, and the plate accurately leveled by the two levels shown upon it.

If it is desired to run a level line, the bubble of the telescope level is brought into the centre by the clamp and tangent of the axis, in which position the horizontal wire of the telescope will determine a level line when directed to any point in the horizontal plane, as by the telescope of the ordinary level, and any angle desired may be read off upon the limb. When desired to obtain points in a vertical plane, either above or below a given point (the plates being clamped and the clamp of the axis released), the telescope may be directed either above or below to the place desired.

To determine two points in a straight line with the instrument and on either side of its center, direct the telescope to one of the points, then clamp the plates and the other point may be obtained by reversing the telescope on its axis.

VERNIER TRANSIT COMPASS.



No 31.

Price as shown, with 6-inch needle and tripod, $101.00.

The Vernier Transit or Transit Compass has the same general properties as the Vernier Compass, but is furnished with a telescope in place of the ordinary sights. The telescope is from ten to twelve inches long, and sufficiently powerful to see and set a flag at a distance of two miles on a clear day.

Stadia wires are put in the telescope, if desired, without extra charge.

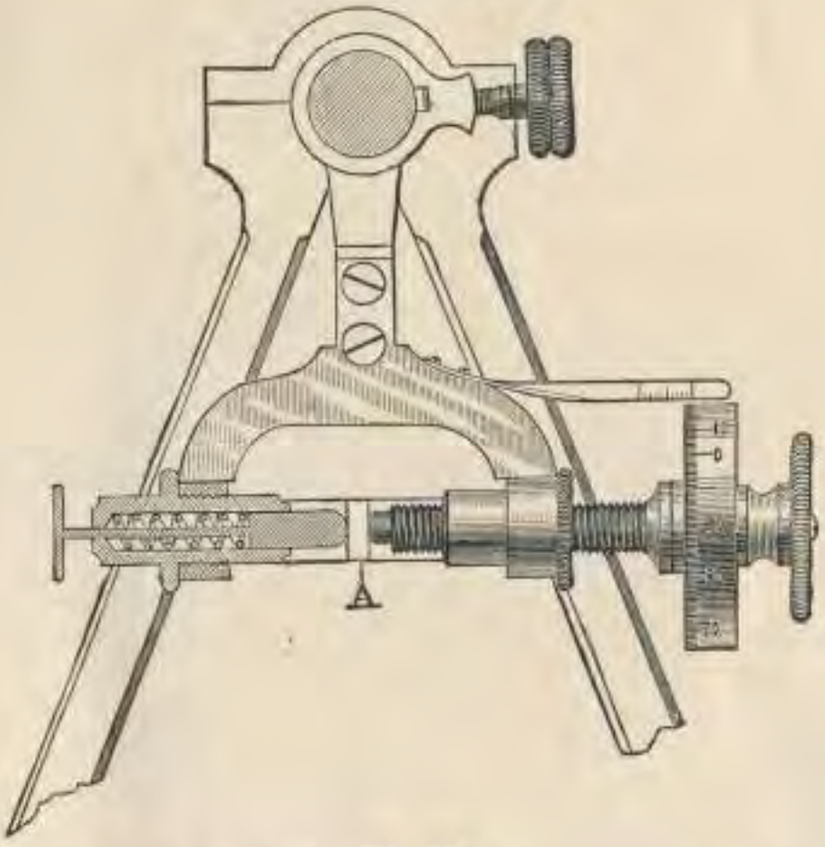
The figure represents the instrument with 6-inch needle; in the smaller sizes, the vernier of the compass-circle is within the box under the glass, as with that of the Surveyors' Transit.

The needle lifting-screw is also underneath the plate, but is concealed in the cut.

PRICES.

No. 28.—Vernier Transit, 4-inch needle, compass tripod, plain telescope $70 00
No. 28A.—Vernier Transit, same as above, but with 3½-inch vertical circle, level on telescope, and clamp and tangent movement to axis of telescope 96 00
No. 29.—Vernier Transit, 5-inch needle, compass tripod, plain telescope 70 00
No. 29A.—Vernier Transit, same as above, but with 3½-inch vertical circle, level on telescope, and clamp and tangent movement to axis of telescope 96 00
No. 30.—Vernier Transit, 6-inch needle, compass tripod, plain telescope 75 00
No. 31.—Vernier Transit, same as above, but with 3½-inch vertical circle, level on telescope, clamp and tangent movement to axis of telescope, as shown 101 00

GRADIENTER.



No. 45.

Price, as shown . . . . . , $18.00

This attachment, as shown, is often used with transits for fixing grades, determining distances, etc.

It consists mainly of a screw attached to the semi-circular expanded arm of the ordinary clamp of the telescope axis; the screw is accurately cut to a given number of threads, and passing through a nut in one side of the arm presses against a little stud, *A*, fixed to the inside surface of the right hand standard.

In the other side of the semi-circular arm is inserted a hollow cylinder containing a pin actuated by a strong spiral spring, the end of the pin pressing against the side of the stud opposite that in contact with the screw.

Near the other end of the screw, and turning with it is a wheel, or micrometer, the rim of which is plated with silver, and divided into one hundred equal parts.

A small silver scale, attached to the arm and just above the micrometer wheel, is divided into spaces, each of which is just equal to one revolution of the screw; so that by comparing the edge of the wheel with the divisions of the scale, the number of compound revolutions of the screw can be easily counted.

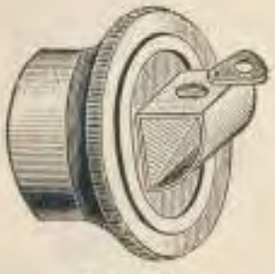
It will be seen that when the clamp is made fast to the axis by the clamp-screw, and the gradienter-screw turned, it will move the telescope vertically, precisely like the tangent-screw ordinarily used.

And as the value of the screw-thread is such that a complete revolution will move the horizontal cross-wire of the telescope over a space of one foot on a rod at a distance of one hundred feet, it is clear that when the screw is turned through fifty spaces on the graduated head, the wire will pass over fifty one-hundredths, or one-half a foot on the rod, and so on in the same proportion.

In this way the Gradienter can be used in the measurement of distances.

Grades can also be established, with great facility, as follows: 1st, level the instrument; bring the telescope level to its center by the clamp of the gradienter-screw; move the graduated head until its zero is brought to the edge of the scale; and then turn off as many spaces on the head as there are hundredths of feet to the hundred in the grade to be established.

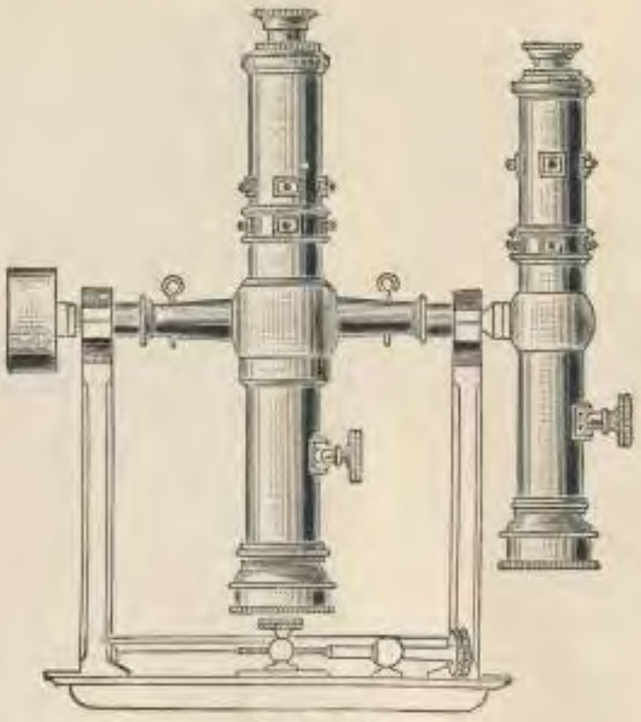
No. 38.
PLUMMET LAMP.



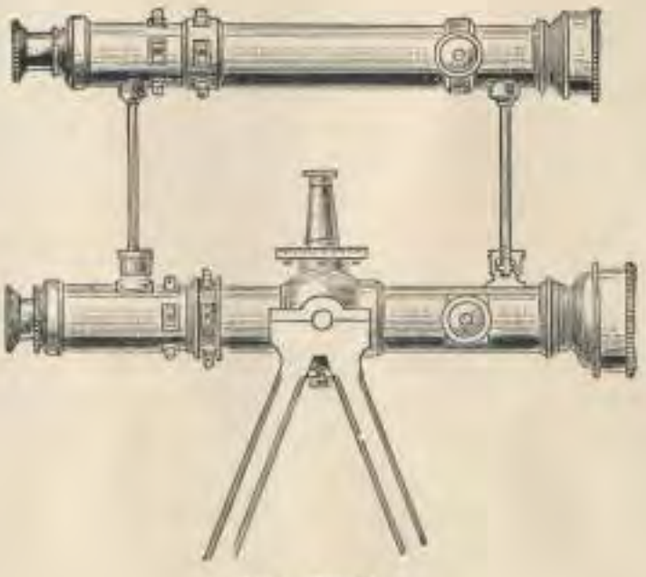
No. 39.
DIAGONAL PRISM.

No. 40
REFLECTOR.

EXTRA TELESCOPES
FOR VERTICAL SIGHTING.



No. 50 A.



No. 50 B.

EXTRAS AND ATTACHMENTS FOR TRANSITS.

	PRICE.	POST.
35.—Patent Solar Attachment	$60 00	$0.15
36.—Variation Arc furnished with new Engineers' Transits, Nos. 1 to 3D, when ordered	4 00	
37.—Variation Arc added to any Engineers' Transit sent for repairs	15 00	
38.—Plummet Lamp for Mining Engineering, hung in gimbals	10 00	.30
39.—Diagonal Prism for Eye-piece	8 00	.04
40.—Reflector for illuminating cross-wires of Telescope	4 00	.04
41.—Vertical Circle, 3½ inches diameter, divided on silver, vernier reading to five minutes	8 00	.08
42.—Vertical Circle, 4½ inches diameter, divided on silver, reading to single minutes	12 00	.10
43.—Vertical Arc, 6 inches diameter, divided on silver, with vernier movable by tangent screw, reading to 30 seconds	18 00	.10
44.—Clamp and tangent movement to axis of telescope	6 00	.08
45.—Gradienter, combined with clamp and tangent	18 00	.12
46.—Level on telescope, with ground bubble and scale	12 00	.15

EXTRAS AND ATTACHMENTS FOR TRANSITS.

(Continued.)

	PRICE.	POST.
47.—Rack and pinion movement to eye-piece	$5 00	
48.—Sights on telescope with folding joints	8 00	
49.—Sights on standards at right angles to telescope	8 00	
50.—Detachable telescope for vertical sighting, either style, A or B	25 00	$0.35
52.—Special Graduation of limb to read to 20″ or 30′, extra	10 00	
53.—Special Graduation of limb to read to 10″, extra	20 00	
54.—Special Graduation on 4½-inch vertical circle, to read to 20″ or 30″, extra	5 00	
55.—Jones' Patent Latitude Arc, with reversible level bubble	72 00	
56.—Patent Latitude Level, for use with Solar Transit	6 00	0.10
57.—Attached microscope to read verniers of horizontal limb, each	5 00	
58.—Quick-leveling attachment	6 00	0.30
59.—Quick-leveling attachment when ordered with new Transits, Nos. 1 to 24, extra	5 00	
60.—Leveling tripod head, with clamp and tangent movement, fitted to Vernier Transit compasses, Nos. 28 to 31, extra	13 00	
61.—Patent extension tripod, furnished instead of regular tripod, with any new Transit Nos. 1 to 5, and 12 to 24, extra	5 00	
62.—Patent extension tripod, furnished instead of regular tripod, with any new Transit Compass, Nos. 28 to 31, extra	7 00	
63A.—Patent extension tripod, for Transits, Nos. 25 to 31	12 00	
63B.—Patent extension tripod, for Transits, Nos. 1 to 5 and 12 to 24	15 00	
64.—Split leg tripod, for Transits, Nos. 1 to 5 and 12 to 24	15 00	
65.—Split leg tripod, for Transits, instead of regular tripod, extra	5 00	
66.—Split leg tripod, instead of extension tripod, at same price		

PATENT LATITUDE LEVEL. (No. 56.) PATENTED SEPT. 2, 1884.

This attachment is for recovering the Latitude of a Solar Transit, without referring to the Vertical Arc; and generally for setting the telescope at any desired angle in running grades, etc.

It consists of a level connected by a short conical socket with the end of the telescope axis, to which it is clamped by a milled head screw and made adjustable by a tangent screw and spring on the enlarged end of the tube. When the clamp-screw is released the level turns vertically upon the axis, and can thus be set at any angle with the telescope, the final adjustment being made by the tangent-screw.

The latitude being set off upon the vertical arc, as usual, the level is clamped and brought into the center as above described.

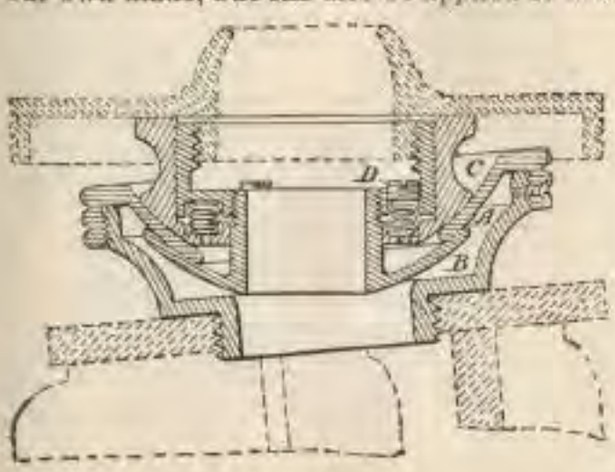
The telescope may then be released and used in running lines, etc., until it is desired to recover the latitude again; this is easily and accurately done by the level alone without referring to the Vertical Arc.

Its use in running any desired grade is readily understood.

We make no additional charge for this attachment on new Solar Transits furnished by us; and when put on our Solar Transits heretofore sold, the cost will be six dollars.

QUICK-LEVELING ATTACHMENT.

We have for several years past made a quick-leveling arrangement, which was patented by us November 5, 1878, and has given general satisfaction; it is especially adapted to tripod-heads of our own make, but can also be applied to those of other makers



The cut shows the Quick-Leveling Attachment designed for Level or Transit, as screwed fast to a Tripod.

To use the quick-leveling attachment, screw the instrument on the tripod as usual; if not nearly level, unscrew the leveling head a very little—a bare loosening of the screw is sufficient. The instrument will then be free to move upon the spherical surfaces, *A*, *B*, *C*, in any direction required to bring the plates approximately level, and will be held in this position by the friction of the same surfaces.

Now, screw the head fast again, firmly clamping the whole instrument to the tripod. The final adjustment of the levels is then completed by the use of the leveling screws.

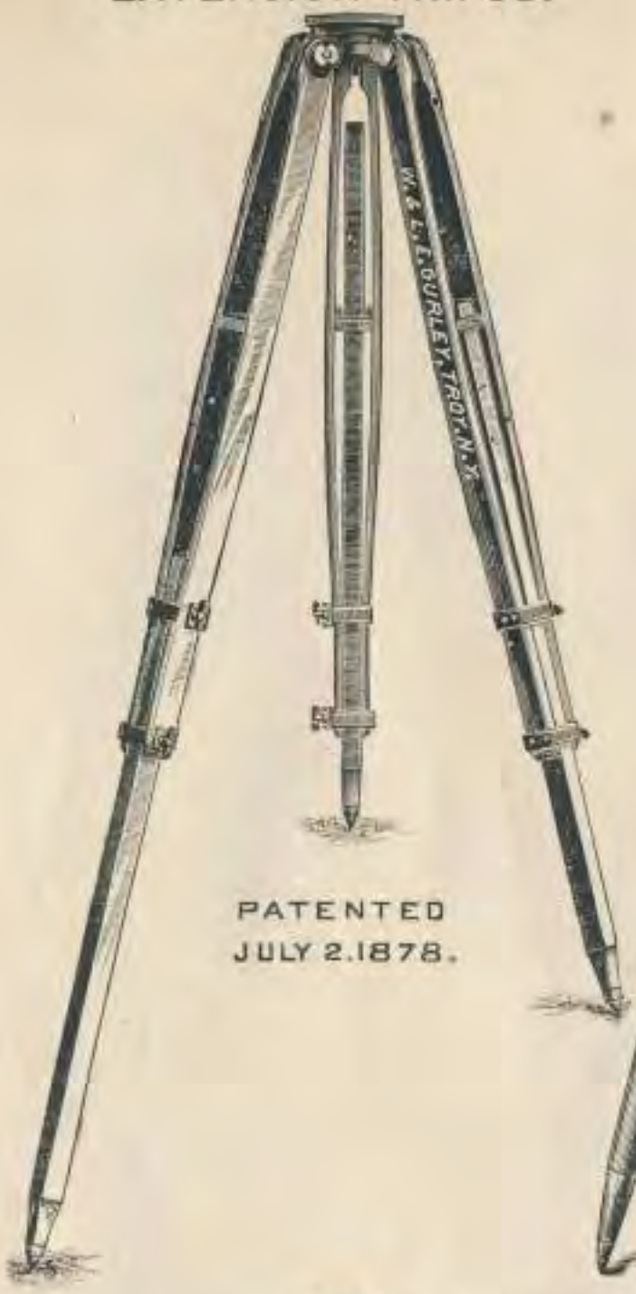
The friction of the spherical surfaces may be increased or diminished at will, by turning the screws (*D*) which compress the spiral-springs.

PRICES.

When furnished with a new instrument	$5 00
For same, adapted to any instrument already in use	6 00

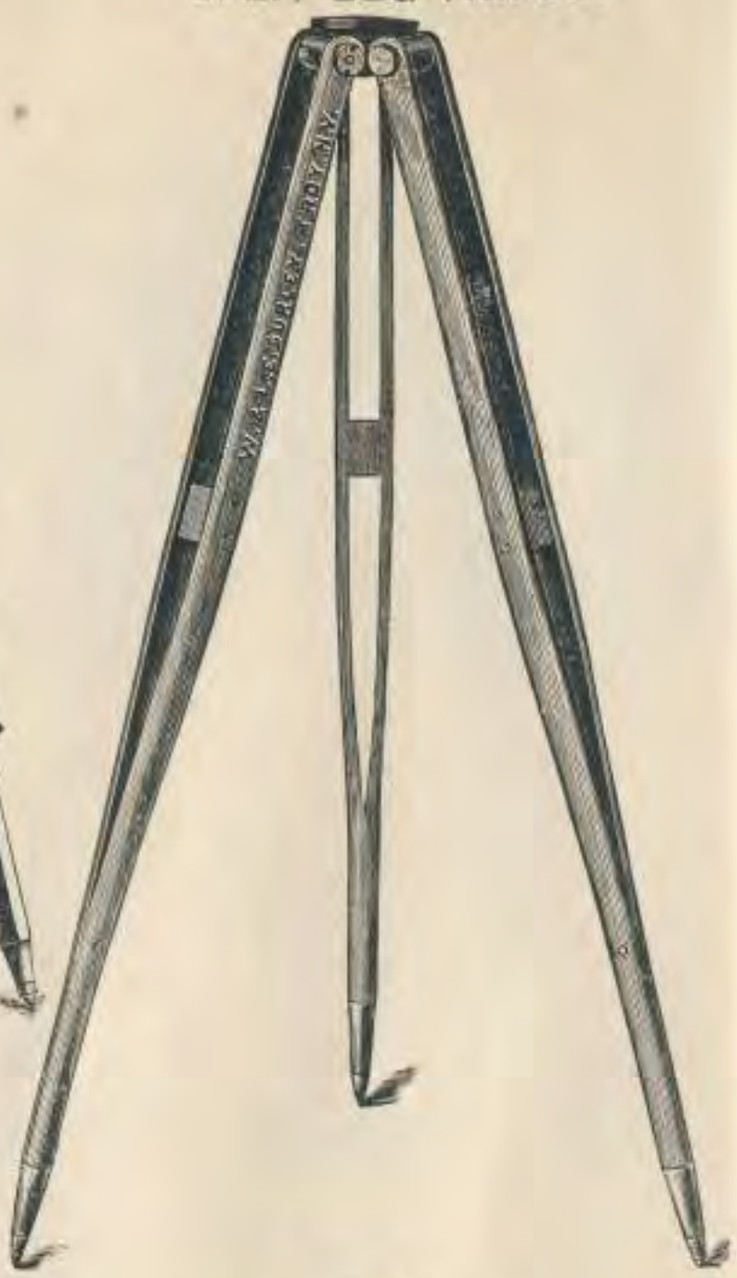
N. B.—When ordered for any instrument already in use, the lower plate of the leveling-head, as shown in outline of same figure, or the brass head of the tripod, the legs being removed, may be sent to us by mail or express, prepaid, with the remittance—of say $7.00—to pay for attachment and return charges.

EXTENSION TRIPOD.



No. 63.

SPLIT LEG TRIPOD.



No. 64.

EXTENSION TRIPODS.

We make three sizes of extension tripods, of which the medium size is shown in the cut.

The Light Mountain Transit is almost always used upon our patent extension tripod, in which all its legs can be shortened or lengthened at will. It is thus adapted for use in mountain surveys, where one or more legs must be shortened; or for mines, where in many places a short tripod is indispensable.

If desired, the sliding pieces can be easily turned end for end, the points being thus put out of the way, and the tripod more safely transported. The tripod when closed is only three feet long, and is carried by an ordinary shawl strap.

A larger size with bronze head and heavier legs is used with the larger transits, and leveling instruments; and a smaller and lighter one with the various pocket compasses.

SPLIT LEG TRIPODS.

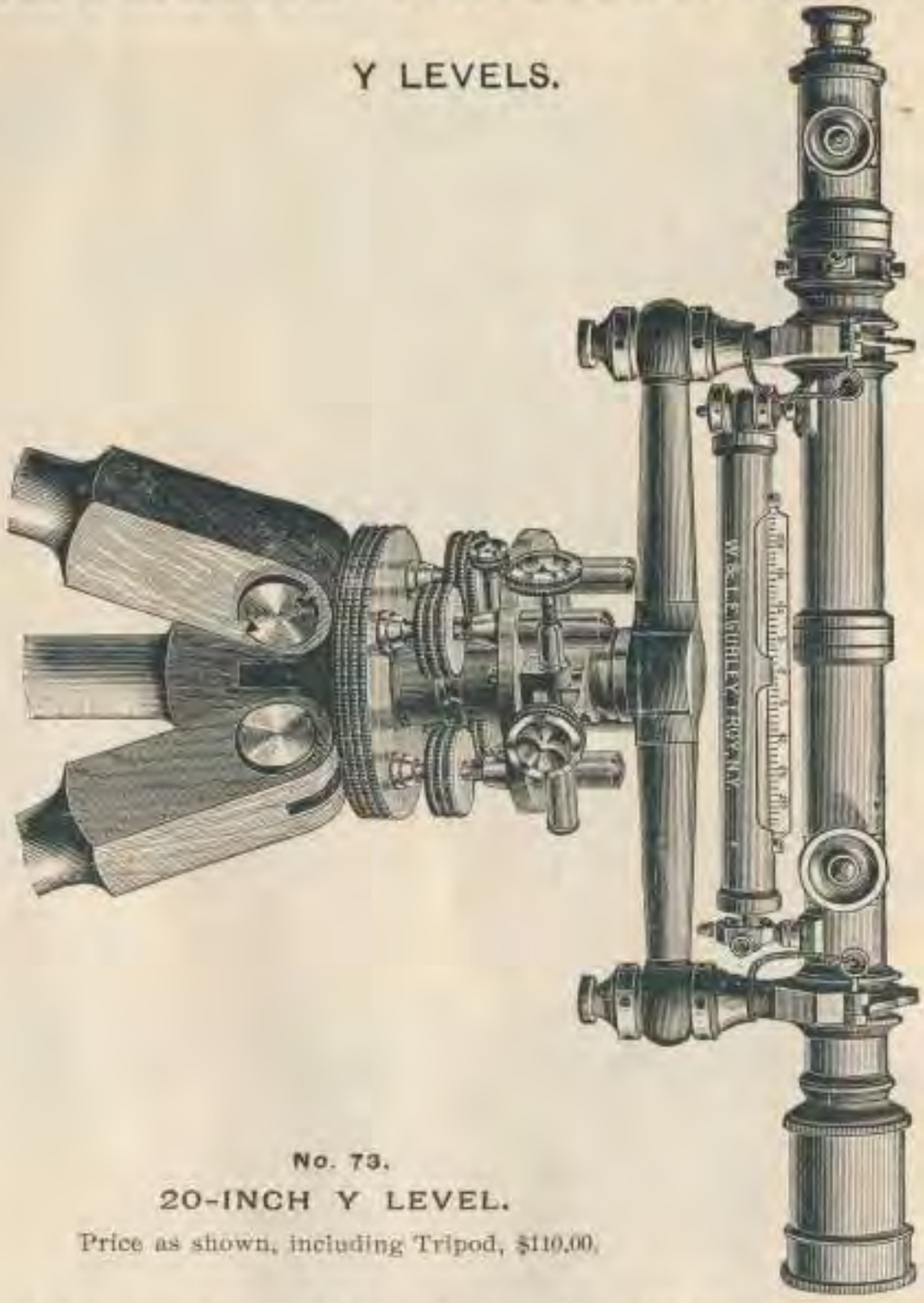
The split leg tripod is shown with a brace between the two parts of the leg, and having a broad bearing on the brass head for the attachment of the leg above.

The arrangement supplies a very firm and light tripod, though more bulky and expensive than that with solid legs.

NOTE.—For prices of extension tripods, or of split leg tripods, see pages 21, 23, 35, 37 and 41.

LEVELING INSTRUMENTS.

Y LEVELS.



No. 73.

20-INCH Y LEVEL.

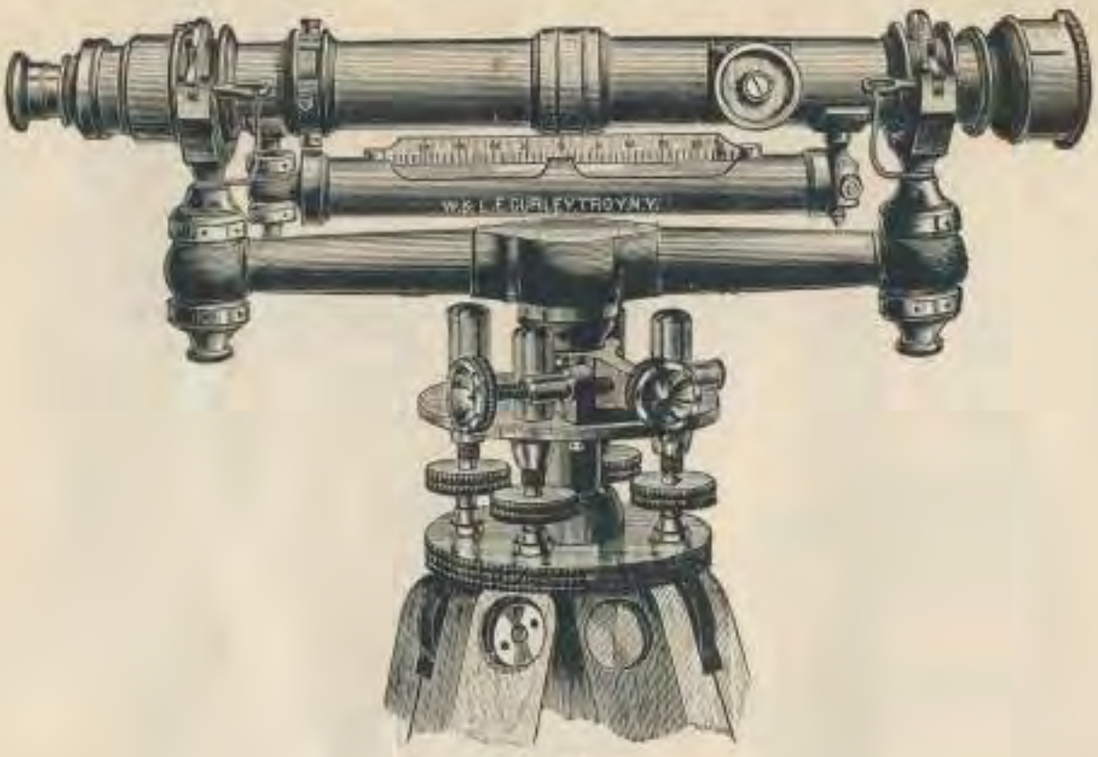
Price as shown, including Tripod, $110.00.

Y level, of the most improved form and construction, with telescope either 15, 18, 20 or 22 inches long. In this instrument the telescope is made to revolve readily and truly in the Y's by rings of bell metal, which when desired may be firmly clamped by the clips and held in any position. One Y clip is furnished with a horizontal stud fitting into a semi-cylindric cut on the flange of the ring of the telescope, insuring the accurate position of the horizontal cross wire. It has a rack and pinion movement to both object and eye-glasses, and adjustment for centering the eye piece, and another for insuring the accurate projection of the object glass in a straight line. Both of these are completely concealed from observation and disturbance by a thin ring which slides over them. The Y's of this level are made large and strong of the best bell metal, and each has two nuts, both being adjustable with the ordinary steel pin. The level bar is made round of fine bronze, and shaped so as to possess the greatest strength in the parts most subject to sudden strains. The leveling plates are the same as those used with the Engineers' Transit. The tangent movement of the leveling head is made with an opposing spring. Stadia wires are furnished with any of our Y levels, free of charge if ordered with the instrument.

No. 70.—Y Level, 15-inch telescope, with tripod and leveling head	$90 00
No. 72.—Y Level, 18-inch telescope, with tripod and leveling head	110 00
No. 73.—Y Level, 20-inch telescope, with tripod and leveling head	110 00
No. 74.—Y Level, 22-inch telescope, with tripod and leveling head	115 00
No. 80.—Patent Extension Tripod for Levels, Nos. 70 to 74, instead of regular tripod, extra	5 00
No. 81.—Patent Extension Tripod for Level No. 75, instead of regular tripod, extra	7 00
No. 82.—Patent Extension Tripod for 15, 18, 20, or 22-inch Y Level	15 00
No. 83.—Split leg tripod for 15, 18, 20, or 22-inch Y Level	15 00
No. 84.—Split leg tripod for Levels, Nos. 70 to 74, instead of regular tripod, extra	5 00
No. 85.—Quick-leveling attachment	6 00
No. 86.—Quick-leveling attachment, when ordered with new instrument, Nos. 70 to 75, extra	5 00

NOTE.—Level No. 70 does not have a rack and pinion movement to the eye-piece.

LEVELING INSTRUMENTS.

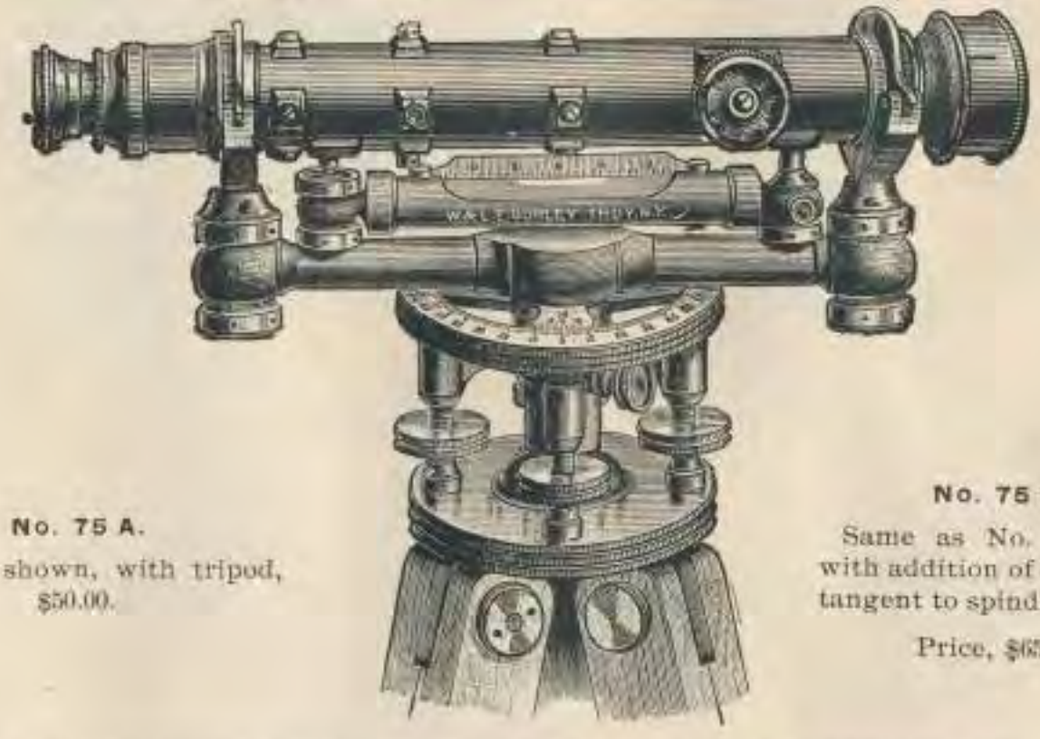


No. 70.

Price as shown, with tripod, $90.00.

Our fifteen-inch Level, as shown, has the same arrangement of sockets, tripod, etc., as the larger instruments, but no pinion movement to the eye-piece. The leveling head remains attached to the spindle, and is packed with it in the box; it is also somewhat smaller and lighter than those furnished with the 18, 20 and 22-inch levels.

THE ARCHITECTS' LEVEL.



No. 75 A.

Price as shown, with tripod, $50.00.

No. 75 B.

Same as No. 75 A, but with addition of clamp and tangent to spindle.

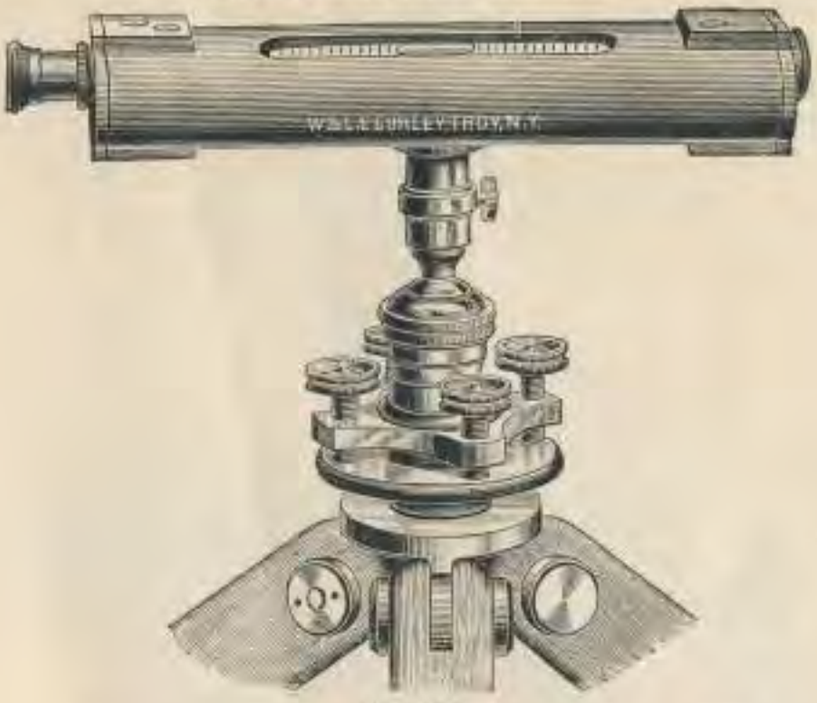
Price, $65.00.

The figure represents the level introduced by us in 1874, and which has since been very largely used by architects, builders, and millwrights, as well as by engineers and surveyors, in the grading of streets, drains, sewers, etc., in all parts of the country. It has a telescope of 12 inches, now furnished with rings, wyes, etc., precisely like the larger levels, and adjusted in the same manner. The leveling head has the ordinary screws and a clamp to the spindle, but no tangent movement; it has also a horizontal circle of three inches diameter, fitted to the upper end of the socket and turning readily upon it; the circle is graduated to degrees, figured from 0 to 90 each way, and is read to five minutes by a vernier which is fixed to the spindle.

As noted above, we also make the Architects' Level with a clamp and tangent to the leveling head, thus making a very complete and low-priced level for the purposes named.

FARMERS' OR DRAINAGE LEVEL.

PATENTED OCTOBER 16th, 1883.



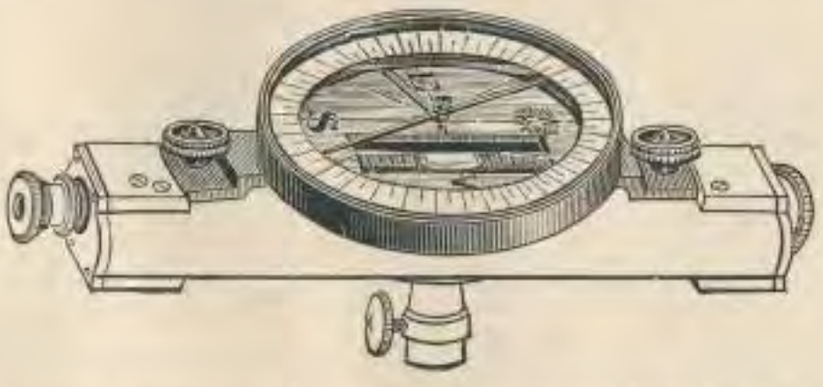
No. 78.

Price . . . . . $25.00.

The figure represents a level devised by us combining the extremes of simplicity and compactness with real efficiency, and all at a very moderate cost. The telescope is about nine inches long and is made especially for this instrument, achromatic, of low but sufficient power, and good light and definition. The cross-wires are fixed in the eye-piece so that they are not easily disturbed. The level and telescope are both enclosed and secured in a strong outside case of bronze from eight to nine inches long, two inches wide, and one and one-quarter inches high, oval in form.

A small socket screws into the under side of the case, and is fitted to a ball spindle, by which it is made approximately level, and then precisely so by the small leveling screws as shown. When desired the leveling-head can be dispensed with, and the instrument leveled on the ball alone.

The advantage of the level in the work of the farmer, manufacturer and builder will be apparent on a simple inspection; drains can be located and leveled, the height of springs ascertained, the accurate levels of lines of shafting, floor timbers, sills, etc., be determined.



In response to many inquiries and suggestions we now add to the Drainage Level, when desired a three-inch needle magnetic compass. This is fitted securely to the upper surface of the case, is removable at pleasure, and while it does not interfere in any way with the reading of the level, it furnishes a ready means of determining the bearings of lines, or measuring angles by the needle.

The instrument, with the staff mountings, adjusting block and screw driver, is packed in a neat mahogany box with lock and key, and brass handle.

PRICES.

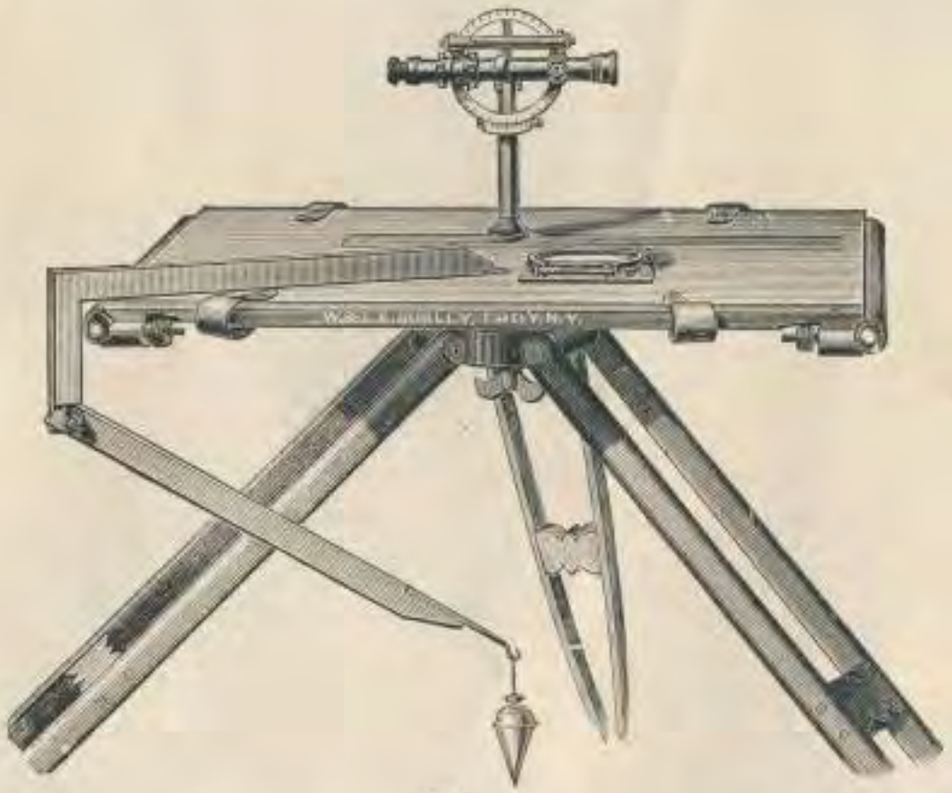
	PRICE.	POST.
No. 76.—Farmers' or Drainage Level, with jacob staff mountings	$15 00	$1 15
No. 77.—Farmers' or Drainage Level, with plain tripod	20 00	1 90
No. 78.—Farmers' or Drainage Level, with tripod and leveling screws	25 00	2 10
No. 79.—Farmers' or Drainage Level, with tripod and leveling screws, and with compass attached	30 00	2 50

NOTE.—An extension tripod, instead of plain tripod, for these levels, is furnished at an extra cost of $5.00.

THE PLANE TABLE.

This instrument which has been so largely employed abroad in topography and map drawing, is now fast coming into use in our own country, especially in colleges and schools where the study of surveying is pursued.

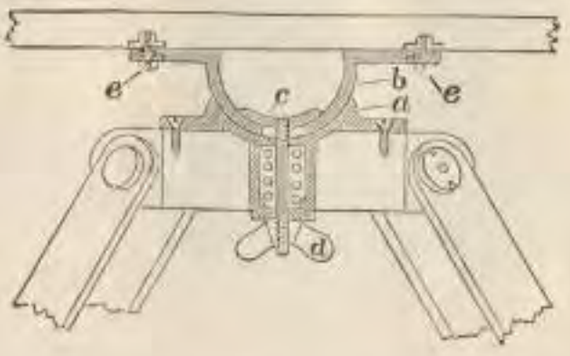
To further popularize the Plane Table we have devised a number of different styles, varying mainly in the Alidades furnished with each, and supplying in all the grades an excellent instrument at a very moderate cost.



No. 92.

Price as shown . . . . . $130.00.

The construction of the socket and tripod head is here shown, in which *a* represents the hemispherical concave metal cup fastened by six screws to the wood top of the tripod, the upper or convex part *b* fitting nicely into the cup and clamped to it at will by the clamping piece *c* and nut *d*; a strong spiral spring in the hollow cylinder between *c* and *d*, serves to hold two spherical surfaces of the socket together, and allow of the easy movement of the one within the other in the leveling of the table.



The flange of the socket *b* supports the table and is connected with its under surface by three segments of brass, two of which are shown at *e e*; a milled head screw passing through one of these segments serves to clamp the board to the flange at will, thus allowing the Plane Table to be moved horizontally when desired.

THE PLANE TABLE (CONTINUED).

Plane Table with Leveling Screws and Tangent Movement.

The engraving shows a modification of the simple Plane Table described on page 26, there being added a tangent movement in azimuth and three screws for leveling.

The board appears as cut away to show in detail the socket and leveling screws and tangent movement by which, as will be seen, a more delicate adjustment in altitude and azimuth may be obtained than by the simple movement before described.

The Plane Table as shown above costs as follows:

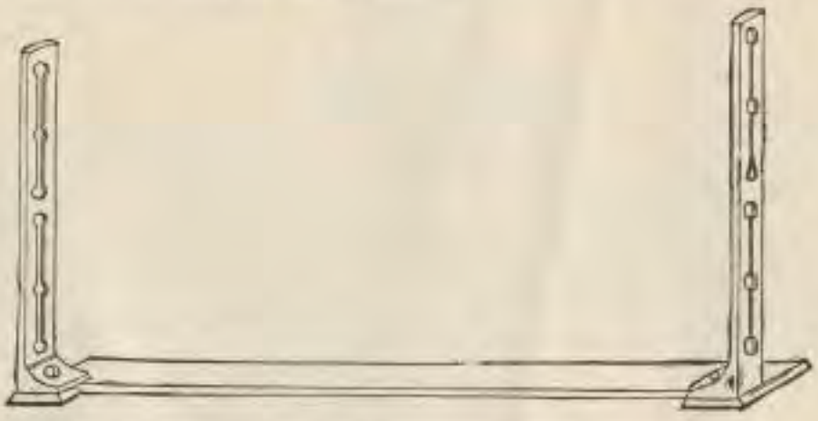
No. 90.—Plane Table, board 30x24 inches, mounted on large tripod, with leveling socket and clamp, and with plumbing bar, plummet, and clamps for paper	$45 00
Combined compass and levels, with square base	15 00
No. 93.—Alidade, with telescope 11 inches long, with stadia, 4½-inch vertical circle on silver to 1 minute, level on telescope, and clamp and tangent, on column, power of telescope 24 diameters	90 00
No. 96.—Set of three leveling screws for any of the above-named Plane Tables, extra	10 00
No. 97.—Clamp and tangent, for movement in azimuth, extra	10 00
Total	$170 00

THE PLANE TABLE (CONTINUED).

THE ALIDADES.

One style of Alidade is shown in the cut of the Plane Table on page 26, the brass rule being three inches wide. The column supports the telescope with its attachments, the vertical circle being divided on silver and reading to five minutes. The telescope is nine inches long, of a power of 20 diameters, provided with stadia, and adjusted and used like that of the Transit.

No. 90.



Price, $15.00.

The most simple Alidade is shown above and consists of a brass rule or straight edge, twenty inches long and two or three inches wide, at the ends of which are screwed sight-vanes, like those of the ordinary compass; the edge of the rule being chamfered and in line with the slots of the vanes.

No. 90.—Plane Table, board 30x24 inches, mounted on large tripod, with leveling socket and clamp, and with plumbing bar, plummet, and clamps for paper $45 00
Combined compass and levels, with square base 15 00
Alidade, with compass sights. 15 00

Total $75 00

No. 91.

Price, $50.00.

No. 91 shows the simple Alidade to which is fitted the telescopic sight, having a level, clamp and tangent, and vertical circle reading to five minutes, attached to the telescope, which is also supplied with micrometer wires.

The telescope is placed in line with the straight edge.

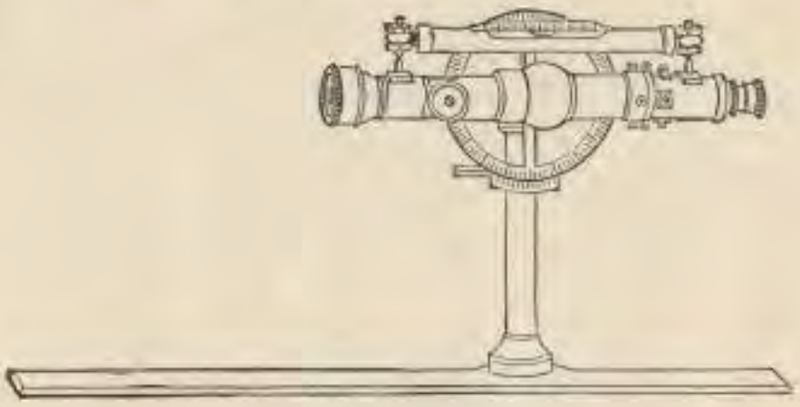
No. 91.—Plane Table, with board, etc., as in No. 90. . . . . $45 00
Combined compass and levels 15 00
Alidade like No. 90 supplied with telescopic sight, No. 132, with stadia, vertical circle to 5 minutes, level, and clamp and tangent 50 00

Total $110 00

No. 92.—Plane Table, with board, etc., as in No. 90. . . . . $45 00
Combined compass and levels 15 00
Alidade, with telescope 9 inches long, power 20 diameters, with stadia, vertical circle to 5 minutes, level on telescope, and clamp and tangent, mounted on column as in engraving 70 00

Total $130 00

THE PLANE TABLE (CONTINUED).



No 93.

Price $90.00

In the Alidade shown in No. 93, the telescope is precisely the same as that used on our best Transits, being also supplied with the level, clamp and tangent, vertical circle on silver reading to single minutes, and micrometer wires for measuring distances.

It is placed on a brass rule about four inches wide, and is adjusted and used in the same manner as No. 92.

No. 93.—Plane Table, with board, etc., as in No. 90.	$45 00
Combined compass and levels	15 00
Alidade, with telescope 11 inches long, with stadia, 4½-inch vertical circle on silver to 1 minute, level on telescope, and clamp and tangent, on column, power of telescope 24 diameters	90 00
Total	$150 00
No. 96.—Set of three leveling screws for any of the above-named Plane Tables, extra . . .	10 00
No. 97.—Clamp and tangent, for movement in azimuth, extra	10 00

JOHNSON'S IMPROVED PLANE TABLE MOVEMENT.

We illustrate on page 30 what is known as the Johnson Plane Table Movement, complete with large alidade, plumbing bar and compass.

The board is shown cut away to give a better view of the tripod and movement. In the lower left hand corner is shown the movement alone with a portion cut away to show the construction.

This movement was patented by W. D. Johnson, May 3, 1887, and has been largely used by the topographers of the U. S. Geological Survey.

As shown in the cut this movement supplies an arrangement whereby the table can be easily made horizontal and then secured by the large wing nut *A*. If desired to turn the board in azimuth the wing nut *B* is loosened, leaving the hemispherical surface bearing the board secured to the flange free to turn, and it can be clamped at will by screwing up the same nut. This movement as modified in recent years supplies an extremely efficient and at the same time a portable Plane Table.

PRICES.

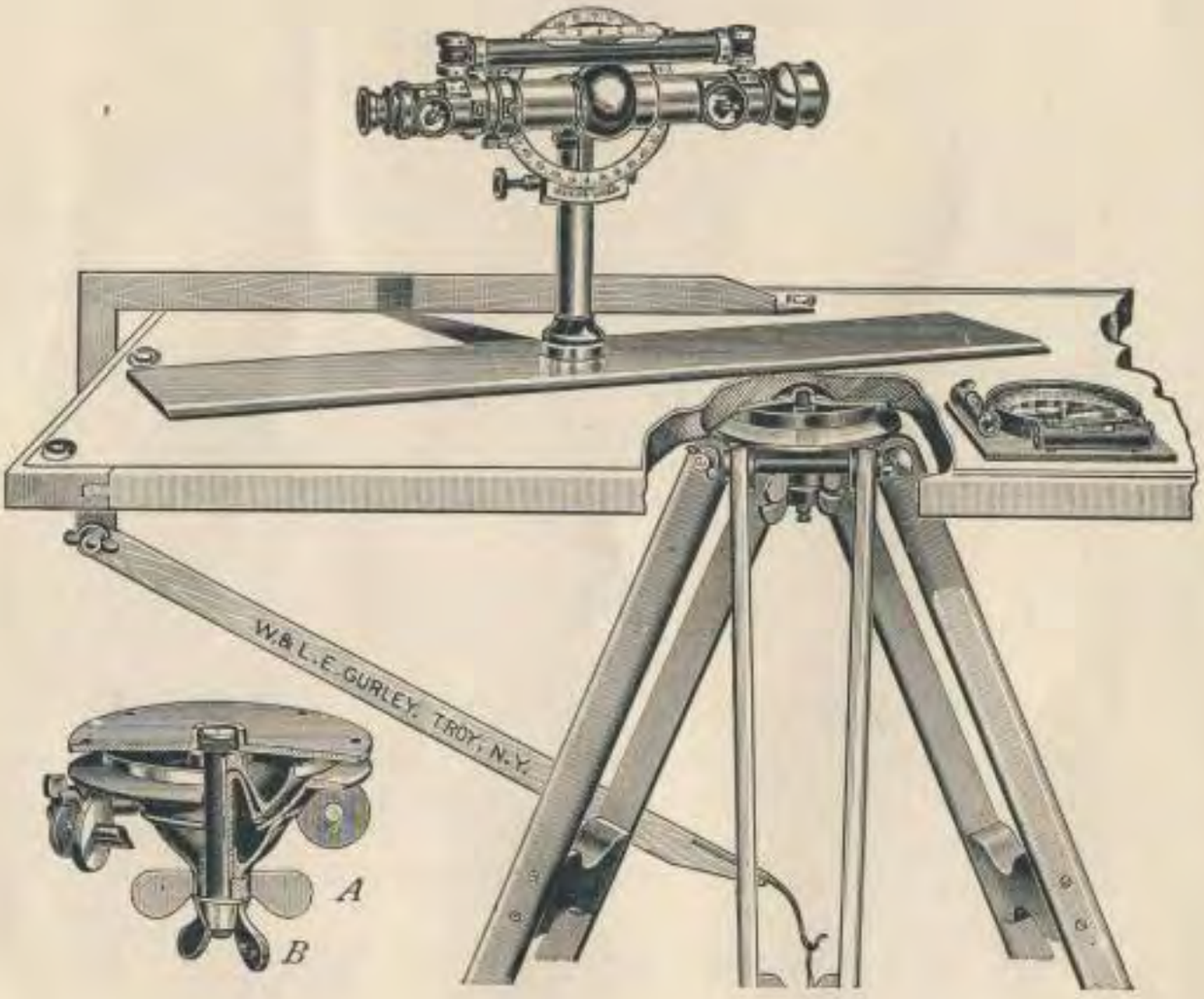
No. 98A.—Johnson's Improved Plane Table movement, mounted on large tripod	$45 00

EXTRAS.

No. 98B.—Plane Table Drawing Board 31x24 inches, fitted, and with screw sockets and clamps for paper	5 00
No. 98C.—Plumbing bar and plummet	4 00
No. 98D.—Combined Compass and levels with square base	15 00

NOTE.—The Alidades as before described can be used with Johnson's Plane Table when desired.

THE PLANE TABLE (CONTINUED).



The Johnson Plane Table as shown above costs as follows:

No. 98A.—Johnson's Improved Plane Table movement, mounted on large tripod	$45 00
No. 98B.—Plane Table Drawing Board 31x24 inches, fitted, and with screw sockets and clamps for paper	5 00
No. 98C.—Plumbing bar and plummet	4 00
No. 98D.—Combined Compass and levels with square base	15 00
No. 93.—Alidade, with telescope 11 inches long, with stadia, 4½-inch vertical circle on silver to 1 minute, level on telescope, and clamp and tangent, on column, power of telescope 24 diameters	90 00
Total	$159 00

THE PLANE TABLE (CONTINUED).

TRAVERSE PLANE TABLE.

No. 99.

Price as shown, $25.00; if the tripod has extension legs, add extra $5.00.

The cut represents a simple form of Plane Table and Alidade which is used extensively by the U. S. Geological survey for traverse work.

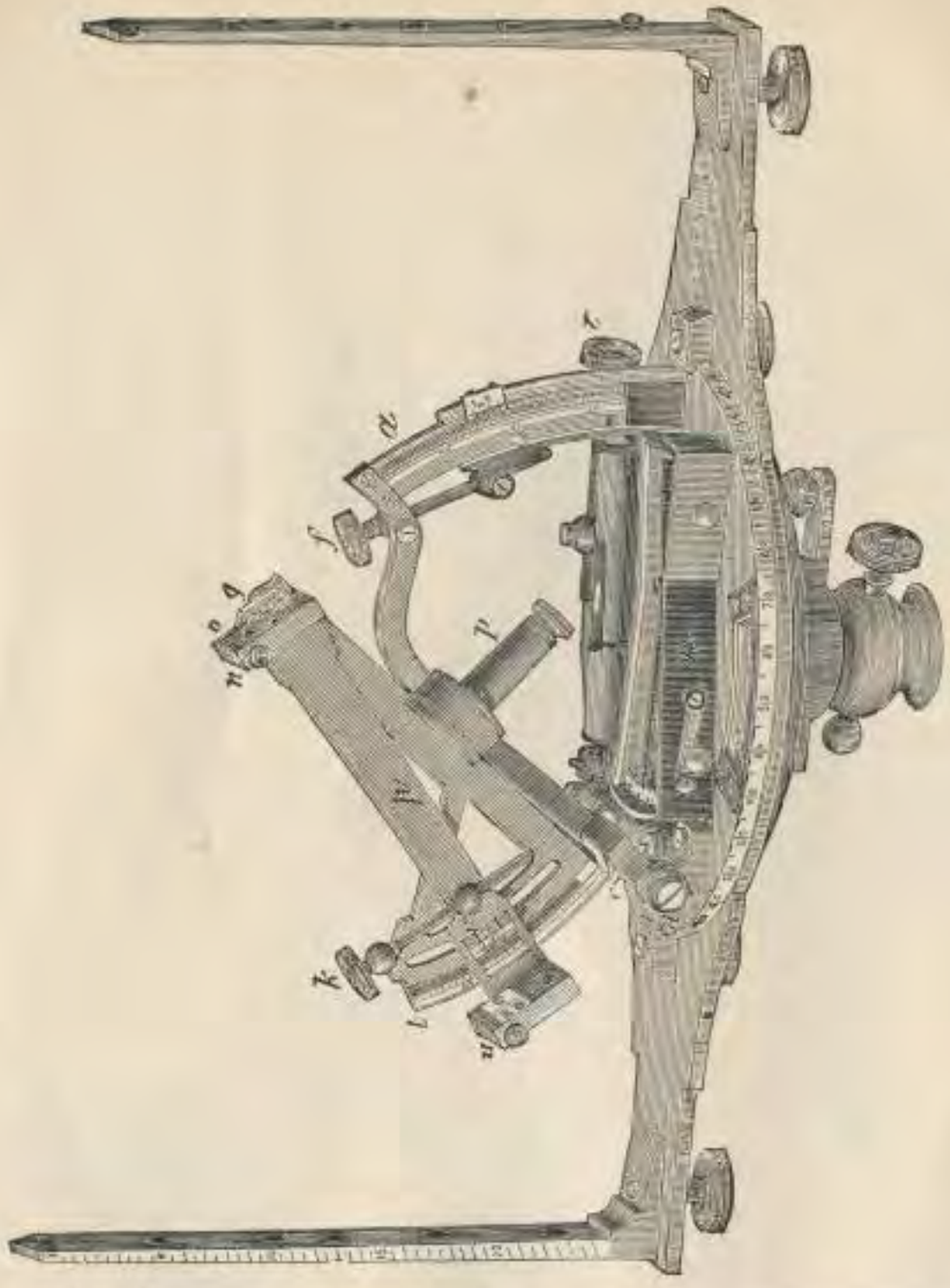
The board is fifteen inches square and has on the under side a small brass flange into which the clamp screw of the tripod head enters and secures the board to the tripod.

The Alidade consists of a brass ruler, beveled and graduated on one edge, having at each end hinged sights which fold closely to the surface of the ruler. Inserted in one edge of the board is a small box compass with needle about three inches long.

The tripod legs are of cherry and are attached to a simple head which has a clamping screw passing through its center, compressing a concealed spring and holding the board to the tripod head and at the same time allowing a motion in azimuth if desired.

The whole forms a very effective apparatus for simple Plane Table work and yet, while not capable of as accurate results as the larger Plane Tables, well supplies a light and portable instrument for topographical work.

THE SOLAR COMPASS.



No. 100.

Price as shown, including leveling screws, clamp and tangent to spindle, and tripod . . . . . $240.00.

The Solar Compass, so ingeniously contrived for readily determining a true meridian, or north or south line, came into general use in the surveys of U. S. public lands, the principal lines of which are required to be run with reference to the true meridian.

The arrangement of its sockets and plates is similar to that of the Surveyors' Transit, except that the sight vanes are attached to the under plate or limb, and this revolves around the upper or vernier plate on which the solar apparatus is placed.

The limb is divided to half degrees, is figured in two rows, as usual, and reads by the two opposite verniers to single minutes.

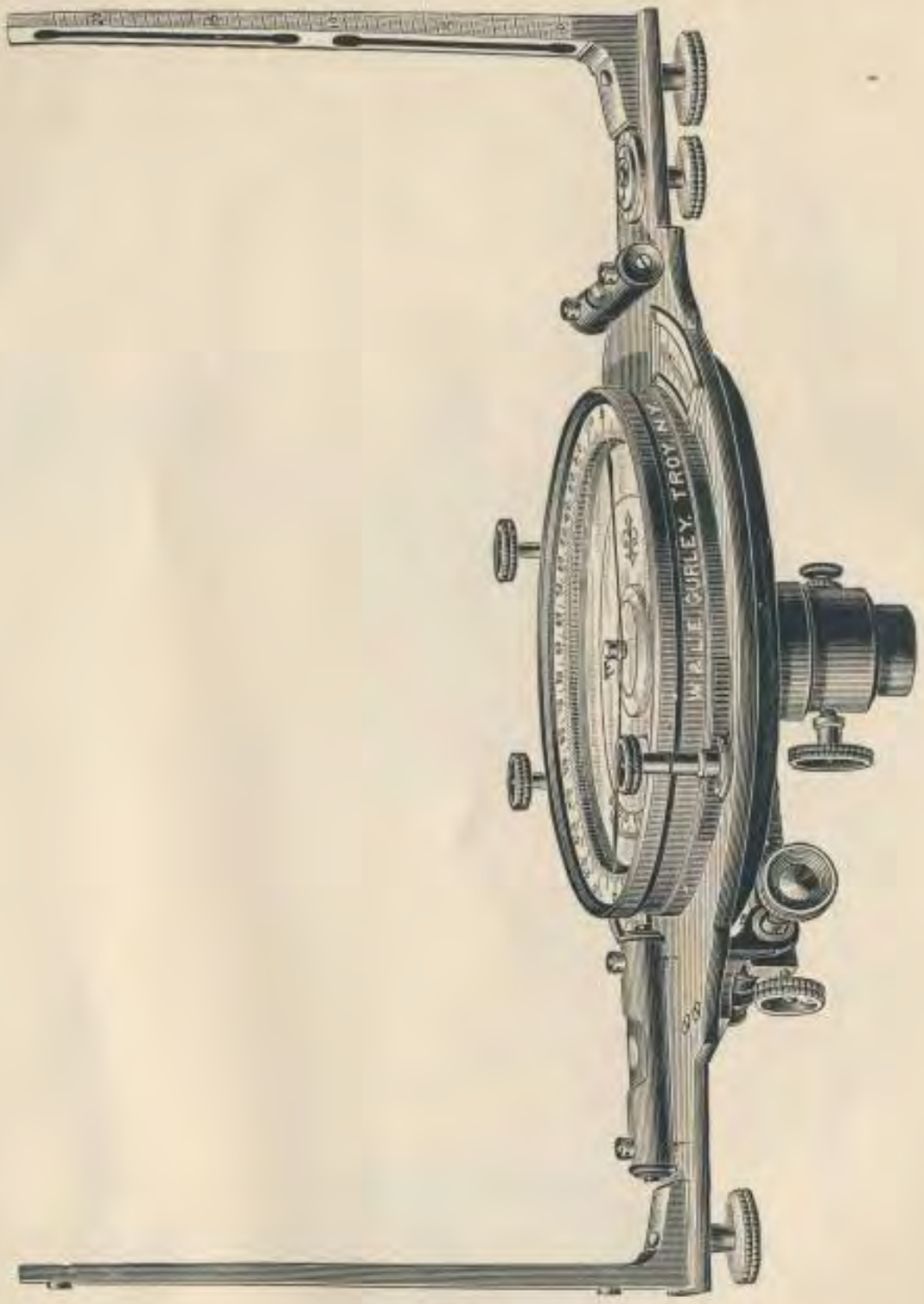
The divisions of the limb and all other arcs of the Solar Compass are made upon solid silver.

The Solar Apparatus is seen in the place of the needle, and in fact operates as its substitute in the field.

It consists mainly of three arcs of circles, by which can be set off the latitude of a place, the declination of the sun, and the hour of the day.

NOTE.—For several years past the U. S. Land Office has required the principal lines of its surveys to be run with a Solar Telescope instrument, and for this purpose our Solar Transits Nos. 5, 7, 8, 16 and 24 have been very generally adopted.

SURVEYORS' COMPASSES.



No. 107.

Railroad Compass, 5½-inch needle. Price, $75.00.

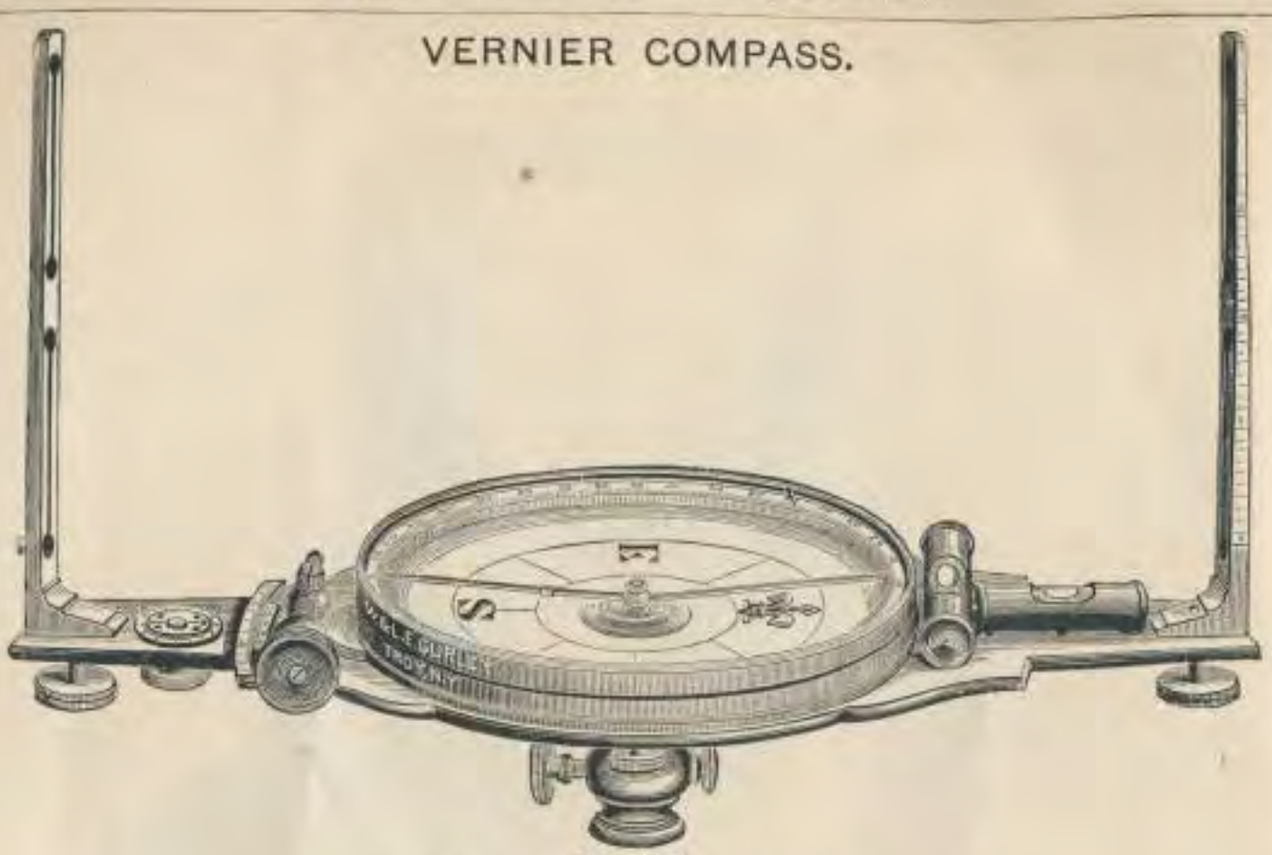
RAILROAD COMPASSES.

The Railroad Compass has the main plate, levels, sights and needle, jacob-staff mountings, brass cover, out-keeper, and vernier for setting off the variation of the needle, of the ordinary Surveyors' Compass, but has also underneath the main plate a divided circle or limb by which horizontal angles to single minutes can be read independently of the needle. The verniers are now placed in front of the observer, and the tangent movement to limb is made like that of our best Transits. In mahogany box, with lock and strap.

PRICES.

No. 105.—Railroad Compass, 5½-inch needle, one vernier to limb	$60 00
No. 106.—Railroad Compass, 5-inch needle, two verniers to limb	70 00
No. 107.—Railroad Compass, 5½-inch needle, two verniers to limb	75 00

VERNIER COMPASS.



No. 112.

Price . . . . . $40.00.

PRICES.

No. 110.—Vernier Compass, 4-inch needle with vernier inside the compass circle, two straight levels, jacob staff mountings, brass cover, out-keeper, vernier under the glass for adding or subtracting the magnetic variation of the needle, sights graduated for taking angles of elevation and depression. In mahogany box with lock, and strap for carrying $30 00
No. 111.—Vernier Compass, same as above, but with 5-inch needle 35 00
No. 112.—Vernier Compass, same as above, but with 6-inch needle and vernier outside, as shown. 40 00

PLAIN COMPASS.

No. 117.

Price . . . . . $35.00.

PRICES.

No. 115.—Plain Compass, 4-inch needle, two straight levels, jacob staff mountings, brass cover, out-keeper, sights graduated for taking angles of elevation and depression. In mahogany box with lock, and strap for carrying $25 00
No. 116.—Plain Compass, same as above, but with 5-inch needle 30 00
No. 117.—Plain Compass, same as above, but with 6-inch needle 35 00

EXTRAS TO COMPASSES.

	Price.	Post.
No. 120.—Compass Tripod	$5 00	$1 50
No. 121.—Patent extension Tripod, furnished with any compass, Nos. 105 to 117	12 00	1 75
No. 122.—Compass Tripod, with leveling screws, and clamp and tangent movement	18 00	
No. 123.—Compass Tripod mountings, without legs	4 00	50
No. 124.—Compound tangent Ball	6 00	25
No. 126.—Leveling adopter, large size	7 00	35

No. 124.

The Price of the leveling adopter, without tripod or ball spindle, is $7.00; with tripod and compound tangent ball, as shown, $18.00.

ADJUSTABLE PLUMB BOBS.

This plummet has a concealed reel, *R*, around which the string is wound by turning the milled head, *K*, on top. The friction upon the reel within will hold the bob at any desired point of the line.

No.	Price.	Post.
350.—10 oz	$2 50	$0 12
354.—30 oz	5 00	35

BRASS PLUMB BOBS (PLAIN).

No.				Price.	Post.
355.—Steel point, screw head,			3 oz.	$1 00	$0 04
356.—	do	do	6 oz.	1 25	07
357.—	do	do	10 oz.	1 50	12
358.—	do	do	14 oz.	2 00	16
359.—	do	do	20 oz.	2 50	23
360.—	do	do	24 oz.	3 00	28
361.—	do	do	32 oz.	3 50	37

THE TELESCOPIC SIGHT.

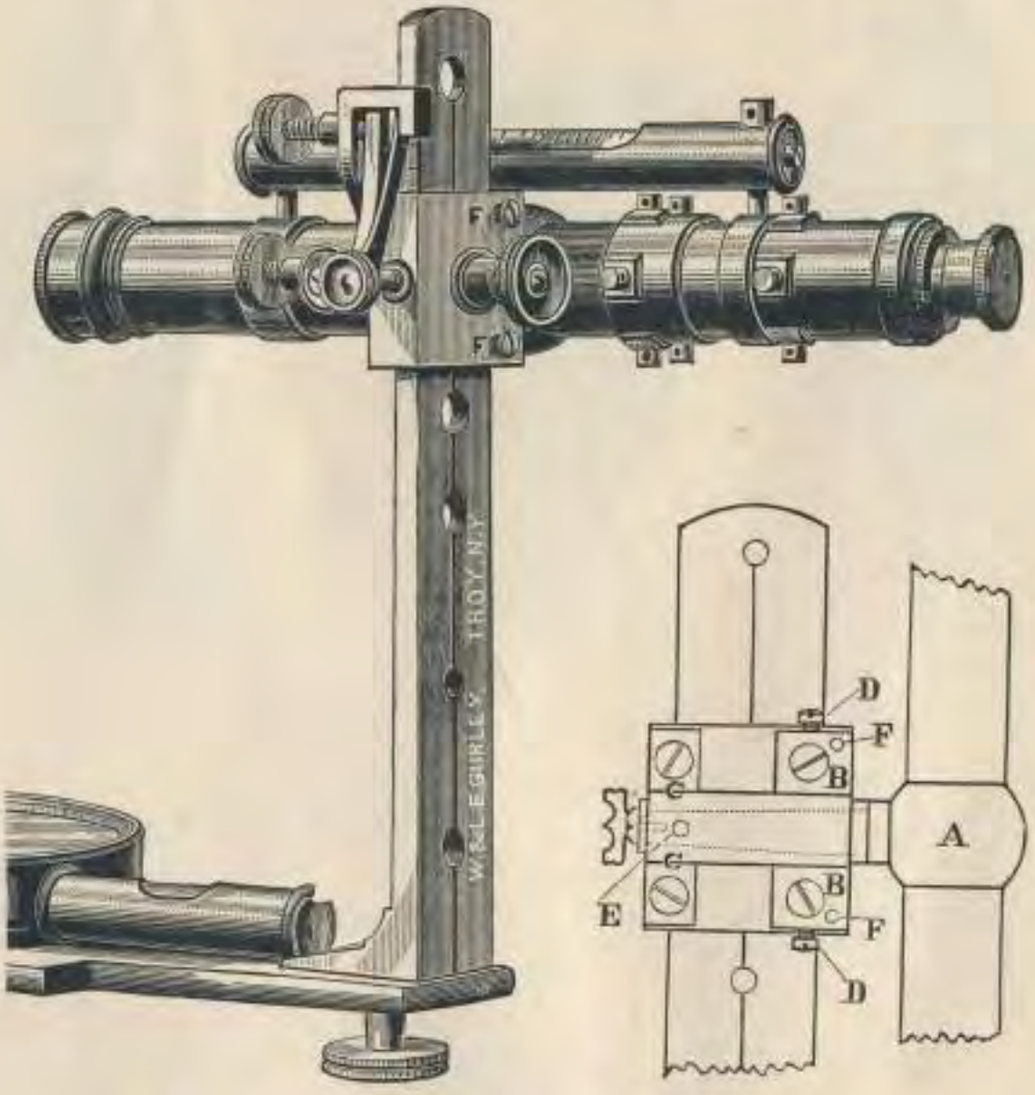
(See Page 36).

This valuable attachment for the Surveyors' Compass consists of a telescope furnished with the usual crosswires, etc., and attached to a movable band, which, as shown in the engraving, can be slipped over the sight of a compass, clamped at any point desired, and put in adjustment by any person who has a screw driver and a steel adjusting pin.

To put this attachment in place, slip the band over the south side of the compass, having (as shown in the cut) the telescope on the right hand and the front clamp screw on the outer surface of the sight; and place the band as low as will allow the telescope to revolve in either direction without striking the compass. This place should be marked by a line across the sight, or still better, a screw or pin on the inner surface of the sight, that the band may be set at the same point in subsequent use.

To fasten the band to the sight, first bring up the clamp-screw in front with a pressure just sufficient to hold the band to its place, then tighten the screw on the left until the band is brought up against the right edge of the sight, and finally touch the front clamp-screw again, when the fastening will be complete.

To put the telescope in focus, turn the end of the eye-piece either back or forth by the thumb and forefinger until by the spiral motion of the tube the cross-wires are brought into distinct view; the object-glass is then moved in either direction by the pinion on the side of the telescope until the object is clearly seen.



Telescope No. 132, with Level, and Clamp and Tangent (Nos. 134 and 135).

Price, as shown $30.00

Telescopic Sight Attachable to Compass Sight. Patented July 9, 1878.

PRICES.

	Price.	Post.
No. 130.—Nine-inch Achromatic Telescope, power about 10 diameters	$12 00	$0.40
No. 131.—Nine-inch Achromatic Telescope, larger diameter of object glass and power about 20 diameters	17 00	.45
No. 132.—Same telescope as No. 131, but furnished with micrometer or stadia wires for measuring distances.	20 00	.50
We add to these TELESCOPIC SIGHTS the following extras, at prices annexed:		
No. 133.—Vertical Circle, Vernier to 5 minutes	5 00	
No. 134.—Level on Telescope	5 00	
No. 135.—Clamp and tangent to Axis of Telescope	5 00	

THE POCKET SOLAR COMPASS.

No. 140 B.

Price as shown . . . . . $105 00.

The Pocket Solar Compass, has a needle 3 inches long, and a limb of 4½ inches diameter, divided to half degrees and reading by its one double vernier horizontal angles to single minutes.

The arrangement of the plates is similar to that of the large Solar Compass, the under plate carrying the sights revolving around the upper or compass plate, to which are attached the solar apparatus, levels, etc.; there is also a clamp and tangent movement to the horizontal limb, and another to the whole instrument about its spindle.

The solar apparatus is attached to the upper plate, and consists of the usual *hour, latitude and declination arcs*, marked respectively *A*, *C*, and *B*, in the cut, with an arm, *FF*, to the last named, carrying the solar lenses and lines as in the larger instruments.

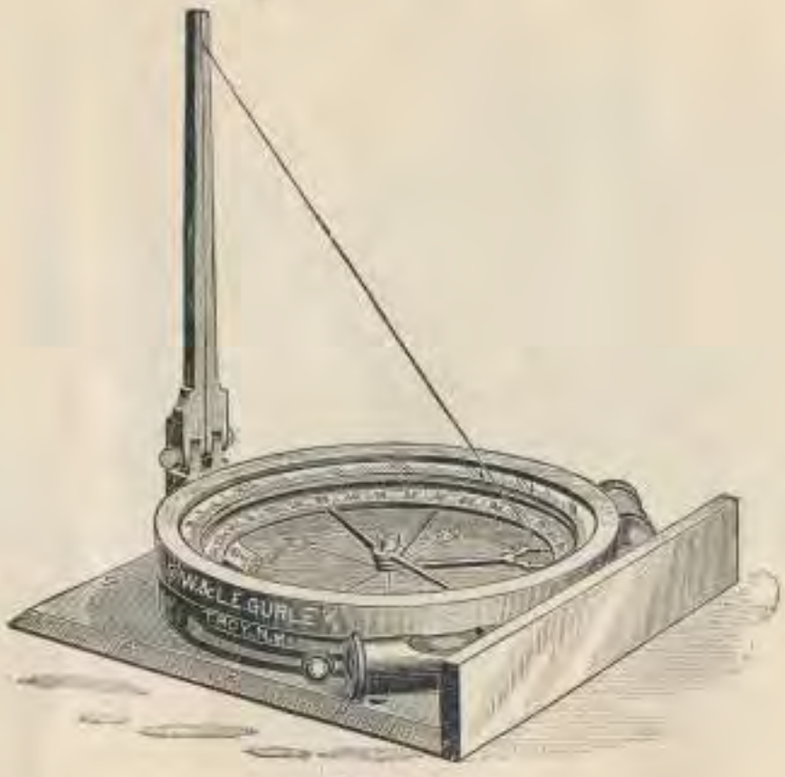
The latitude arc is divided to half degrees, and reads by its vernier to five minutes of a degree. The declination arc is divided to quarter degrees, and reads by its vernier to single minutes of a degree. The hour arc is divided on its inner edge into hours and twelfths, or spaces of five minutes of time, the index of the declination arc above easily enabling one to read to single minutes of time.

PRICES.

	Price.	Post.
No. 140A.—Pocket Solar Compass, with staff mountings and mahogany box	$100 00	$1 25
No. 140B.—Pocket Solar Compass, with Light Tripod.	105 00	2 00
No. 140C.—Pocket Solar Compass, with Light Extension Tripod.	110 00	2 25
No. 140D.—Pocket Solar Compass, with Light Extension Tripod and Leveling Plates	120 00	2 50
No. 141. —Side Telescope and Counterpoise fitted to new Pocket Solar Compass. .	25 00	50
No. 142A.—Leather Case with Shoulder Strap for Pocket Solar Compass	5 00	40
No. 142B.—Leather Case with Shoulder Strap for Pocket Solar Compass with telescope and extras	6 00	60

NOTE.—The tangent movements of the limb and spindle are now made with an opposing spring as shown on page 42.

THE DIAL COMPASS.



No. 148.

This little instrument has a needle two and five-eighths inches long, and with its compass circle is inclosed in a circular box set upon a brass base four inches square, three edges of which are chamfered and divided; one on the W-side of the compass into inches and tenths, the two others into degrees and half degrees, and figured from a center on the southwest corner of the base.

The compass circle is movable in order to set off the variation of the needle, and has a vernier attached to it on the inside, reading a divided arc on the face of the compass to three minutes of a degree.

There is also on the south side of the face an arc of 180°, figured from 0 to 90 on each side of the south or zero line of the face.

A little pendulum with index point hung from the centre pin reads this arc, when the compass is set up vertical on the raised south edge, thus making it a clinometer or slope measurer.

The sight is hinged so as to fold in packing, but when erect makes taut a fine silk thread attached at one end to the sight and at the other to a brass hour-circle above the compass glass, at an angle with the plane of the hour-circle equal to that of the latitude of the place where the compass is used. The hour-circle is divided for any required latitude like that of a sun-dial, the hair serving as a gnomon to give apparent time with the sun.

The Dial Compass is extensively used in this country in regions where there is local attraction and it is desirable to have a simple means of determining the meridian independently of the needle.

This can be easily and quickly done by turning the compass, with dial graduated for the latitude of the place, until the shadow of the string (the compass being held level,) indicates local time on the dial. The line of sight will then be in the meridian.

The needle may then be set to the meridian by laying off the variation, and any deflection of the needle from the true meridian will indicate the presence of veins of magnetic iron ore.

PRICE.

		Post.
No. 148.—Simple Dial Compass, with removable hour arc, graduated for any latitude as ordered, two levels, and clinometer	$16 00	$0 80
Extra hour arcs, graduated for a different latitude, and to fit same compass, each	5 00	05

THE ALUMINUM DIAL COMPASS.

(U. S. Geological Survey Pattern.)

No. 149

Price, as shown. $28.00

We illustrate above an improved form of the Dial Compass, made of aluminum, and differing from our usual pattern in several respects. This new instrument is of the same size and has the same parts as the common Dial Compass, shown on page 38, and in addition has a movable circle graduated on its beveled edge from 0 to 90, and at each quadrant there is a slit cut for sighting.

An extra open sight is also placed upon the clinometer base, to be used when desired in conjunction with the regular sight.

The whole instrument is mounted upon a small ball-spindle and socket with jacob-staff mountings, and is packed in a neat mahogany box.

PLAIN POCKET COMPASS.

NOS. 150 TO 154.

No. 173. *a*

VERNIER POCKET COMPASS.

NOS 155 AND 156.

Price as shown, 3½-inch needle, with tripod, $21.00.
If 4½-inch needle, and tripod, $23.00.

THE VERNIER POCKET COMPASS.

This is a most excellent and portable instrument for preliminary work, having a fine needle, and also a vernier and clamping-nut by which the sights can be placed at an angle with the line of zeros, so as to set off the variation of the needle, as with the Vernier Compass.

The sights are made with a slot in the south vane, and a hair in the north one, for readily finding the object; they also fold down to the compass, when it is packed in the case.

The compass is furnished with jacob-staff mountings; often a very light tripod is ordered for it; it has also two levels, and is neatly packed in a mahogany case.

We make two sizes of the Vernier Pocket Compass having needles of 3½ and 4½ inches respectively; both have the compass circle divided to half degrees; in the 3½-inch size the variation vernier reads to five minutes; in the 4½-inch size the variation is set off to single minutes. When desired, a rack-movement with pinion is supplied, in order to set off the variation more readily.

The 3½-inch compass weighs about 1¾ lbs.; and the 4½-inch compass about 2¾ lbs.

LEVELING ADOPTER.

The appliance shown in No. 173 *a*, for use with the Pocket Compasses, etc., gives, in connection with the ball, a rapid and accurate means of leveling any of the smaller instruments.

POCKET COMPASSES AND EXTRAS.

	Price.	Post.
150.—With folding sights, 2½-inch needle, very serviceable for retracing lines once surveyed	$ 8 00	$0 20
151.—Same as above, with jacob-staff mountings	10 00	30
152.—With 3½-inch needle, and jacob-staff mountings	12 00	50
153.—Same as above, and two levels	13 50	50
154.—Same as 152, but without jacob-staff mountings	10 00	35
155.—Vernier Pocket Compass, with folding sights, staff mountings, two levels, and 3½-inch needle	16 00	60
156.—Same as above, 4½-inch needle	18 00	90
165.—Aluminum Geological Compass, 3-inch needle, folding sights, levels, clinometer and staff mountings	24 00	30
166.—Clinometer Pocket Compass (brass), 3¼-inch needle, folding sights, levels and staff mountings	16 00	50
167.—Leather case with shoulder strap for pocket compasses:		
A.—Size fitted for compasses Nos. 150 and 151	2 00	15
B.— do do Nos. 153 to 155 and 157, 165, 166	3 00	25
C.— do do Nos. 156, 158	4 00	40
D.— do do Nos. 159 A, B, C, D	6 00	60
E.— do do Nos. 160, 161, 162	6 00	60
167.—Leather pouch and strap fitted to receive pocket compasses without wood box:		
F.—Sizes to fit compasses Nos. 150 and 151	1 50	10
G.— do do Nos. 152 to 155	2 00	20
H.— do do Nos. 156 to 158	2 50	20
168.—Tripod for pocket compasses Nos. 140 to 162	5 00	1 00
169.—Tripod for pocket compass, with leveling plates and clamp and tangent	15 00	1 25
170.—Patent extension tripod for pocket compass	10 00	1 25
171.—Tangent movement fitted to spindle of pocket compasses Nos. 151 to 159	5 00	
172.—Rack and pinion movement to vernier of Vernier Pocket Compass	4 00	
173.—Leveling Adopter, small size	5 00	20

RAILROAD POCKET COMPASS.

No. 159.

Price as shown, with tripod . . . . . $45.00.

This instrument is a single vernier Railroad Compass in miniature. The limb is five inches in diameter, and reads to single minutes by the vernier. The needle is 3½-inches long, and its variation can be set off to single minutes. The vernier opening and the clamp and tangent movement are now made like those of the larger Railroad Compass.

The price of this little instrument, with staff mountings only, is $40; with light tripod, $45; and if with extension tripod, $50. If sent by mail add for postage on the Compass, $1.25, and on tripod, $1.00.

RAILROAD POCKET COMPASSES.

No. 159 D.

Price, as shown . . . . . $83.00.

In this style of the Railroad Pocket Compass, the plates are circular, the sights being screwed to the lower one, the compass-circle above, and turning around the lower plate to set off the variation of the needle.

The limb is underneath the compass face, but not shown in the cut, and read by one double vernier under the glass to single minutes.

When the telescope is applied, the sights are placed to one side of the line of zeros, and the telescope is then brought into that line and over the center of the instrument.

No.	PRICES.		Post.
157.	Railroad Pocket Compass, with folding sights, staff mountings, two levels, 3½-inch needle, with limb reading to five minutes	$23 00	$0 75
158.	Railroad Pocket Compass, 4½-inch needle, clamp and tangent to limb, with limb reading to one minute	33 00	1 15
159A.	Railroad Pocket Compass, 4½-inch needle, clamp and tangent to limb, with limb reading to one minute, with clamp and tangent to the main spindle or socket, and fitted with our new telescope sight No. 130, with the extras of level, vertical circle to 5′, and clamp and tangent to axis of telescope. Price, including tripod.	70 00	
159B.	Same as above, but with telescopic sight No. 131	75 00	
159C.	Same as above, but with telescopic sight No. 132	78 00	
159D.	Same as above, but with telescopic sight No. 132, and with leveling adopter .	83 00	

VERNIER POCKET COMPASSES.

WITH TELESCOPIC ATTACHMENT, ETC.

No. 162.

Price, complete as shown . . . . . $63.00.

This engraving shows the attachment of our new TELESCOPIC SIGHT, with the extras of Level, Vertical Circle to 5′, and Clamp and Tangent to axis of telescope, to our 4½-inch needle Vernier Pocket Compass—which has also a clamp and tangent to the main spindle or socket.

The sights in such an arrangement are placed at one side, that the telescope may be directly over the center, and in such case the instrument should have a clamp and tangent movement for spindle, as shown in the figure.

When packed for transportation, the telescope and support are detached from the sights and packed separately in the case.

STAFF MOUNTINGS are always furnished with these compasses, and a light tripod, as shown, is very generally added.

Thus furnished, this light and popular instrument becomes a Transit Compass for ordinary land surveying or reconnoissance, with power to give levels and grades with accuracy sufficient for the common practice of the surveyor.

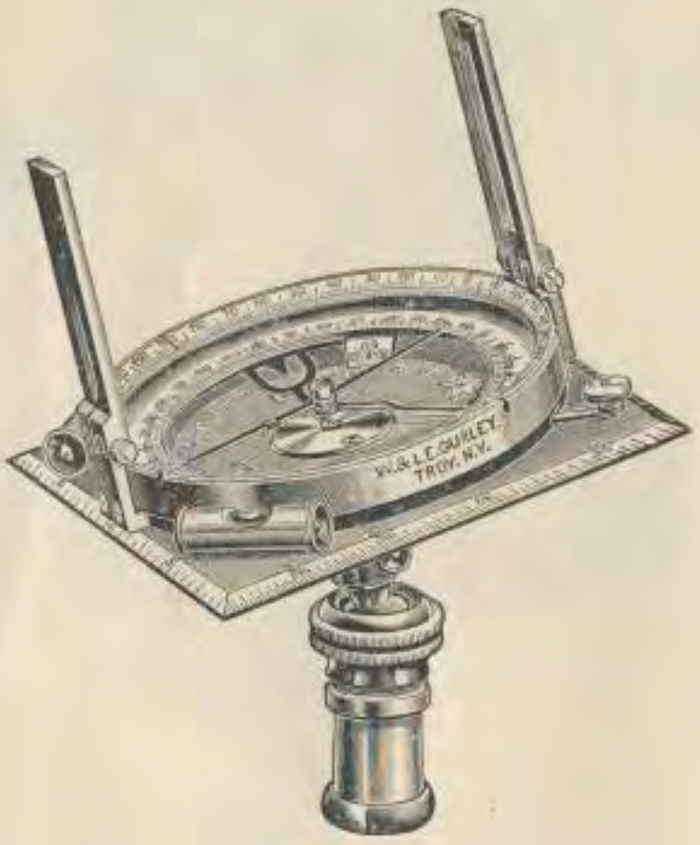
PRICES.

No. 160.—Vernier Pocket Compass, 4½-inch needle, with clamp and tangent to the main spindle or socket, and fitted with our new telescopic sight No. 130, with the extras of level, vertical circle to 5′, and clamp and tangent to axis of telescope. Price, including tripod. $55 00

No. 161.—Same as above, but with telescopic sight No. 131. . . . . 60 00

No. 162.—Same as above, but with telescopic sight No. 132. . . . . 63 00

THE GEOLOGICAL POCKET COMPASS.



No. 165.

Price, as shown . . . . $24.00.

We show here a very popular instrument for topographical work and known as the Geological Pocket Compass.

It is made of aluminum to secure lightness, and has a needle three inches long inclosed with its compass circle in a circular box set upon a base four inches square, the edges of which are beveled and graduated, two of them for a tangent scale, and the other two with scales of eighths and tenths of inches.

The compass circle is made movable and, by a vernier attached to it on the inside, the variation of the needle can be set off to three minutes.

On the south side of the compass face is an arc of 180 degrees, figured on each side of the S or zero line from 0 to 90, the index point—a little pendulum hung from the center pin—indicating on this arc the angle of slope when the compass is placed so that it rests on its south side.

On the outside of the circular box containing the compass circle is a movable circle, beveled and graduated on its upper edge, and figured from 0 to 90, and having at each quadrant a slit cut for sighting. Two folding sights are attached to the edge of the circular box.

The compass is supported on a simple ball-spindle and socket with jacob-staff mountings, and is packed in a neat mahogany box.

THE CLINOMETER POCKET COMPASS.

No. 166.

Price, as shown . . . . . $16.00.

Another form of pocket compass is shown above. It is made of brass and is known as the Clinometer Pocket Compass.

It has a needle 3¼ inches long inclosed with its compass circle in a circular box set upon a base 4¼ inches square.

On one side of this base is erected the rectangular side upon which the compass may be set in determining grades; the small pendulum swinging from the center pin designating by its index the degree of slope upon the graduated arc on the compass face.

Two folding sights are attached to the edge of the circular box and two small levels are placed at right angles to each other upon the base.

The compass is supported upon a simple ball-spindle and socket with jacob-staff mountings and the instrument is packed in a neat mahogany case.

MINERS' COMPASSES OR DIPPING NEEDLES.

For Tracing Veins of Magnetic Iron Ore.

NOS. 178 AND 179.
Price, $12.00.

NOS. 181 AND 182.
Prices, $12.00 and $15.00.

The Dip Compasses, two forms of which are shown, consist essentially of a magnetic needle so suspended as to move readily in a vertical direction, the angle of inclination or "dip" being measured upon the divided rim of a small compass-box.

When in use, the ring or bail is held in the hand—the compass-box by its own weight takes a vertical position—and must also be in the plane of the magnetic meridian.

In this position the needle, when unaffected by the attraction of iron, assumes a horizontal line, as shown by the zeros of the circle. When brought over any mass of iron it dips, and thus detects the presence of iron ores with certainty.

If the Miners' Compass is held horizontally it serves as an ordinary Pocket Compass, and indicates the magnetic meridian in the plane of which it should be held when used to ascertain the dip of the place where the observation is made.

PRICES.

No.		Post.
178.—3-inch needle, glass on both sides, wood box, stop to needle	$12 00	$0 20
179.—3-inch needle, glass on both sides, brass covers, stop to needle	12 00	25
181.—"Norwegian Needle," glass on both sides, brass covers, 3-inch needle, superior article	12 00	30
182.—Same as above, 4-inch needle	15 00	40

NOTE.—No instrument made that will indicate the presence of gold or silver.

PRICES FOR PARTS OF INSTRUMENTS LIABLE TO LOSS OR INJURY.

FOR TRANSITS.

	PRICE.	POST.
Needle and center pin	$2 50	$0 03
Ground glass level vial for plate or standard, each	35	02
do do brass mounted complete, for plate or standard, each	2 00	05
do do for telescope, each	1 35	05
Cap for eye-piece or object-glass, each	75	03
Shade for object-glass	75	03
Clamp screws for horizontal limb, each	75	03
Tangent screw for leveling head	1 50	03
Clamp do do	75	03
Leveling do do each	1 50	05
Eye-piece complete	6 00	05
Object-glass complete	6 00	03
Platinum cross-wires and diaphragm	3 00	05
do stadia do do	5 00	05
Striding, or Adjusting Level	3 00	10

FOR Y LEVELS.

Ground glass level vial	$1 65	$0 10
Cap for eye-piece or object-glass, each	75	03
Clamp screw for leveling head	75	03
Tangent do do	1 50	03
Leveling do do each	1 50	05
Eye-piece complete	6 00	05
Object-glass complete	7 00	04
Platinum cross-wires and diaphragm	3 00	05
do stadia do do	5 00	05

FOR SURVEYORS' COMPASSES.

Needle and center pin	$2 50	$0 02
Plain glass level vials, each	12	03
do do brass mounted complete	1 50	05
Brass cover for compass of our make	1 00	15
Outkeeper	1 00	03
Staff mountings, brass head (without spindle)	2 00	18
do steel point	50	18
Ball-spindle, fitted	1 50	10
Compass sight vanes, each	2 50	15
Clamp screw for spindle or sight vanes	75	03
Tangent screw for moving vernier	1 50	03
Staff mountings complete for pocket compass	$2 50 to 3 50	08

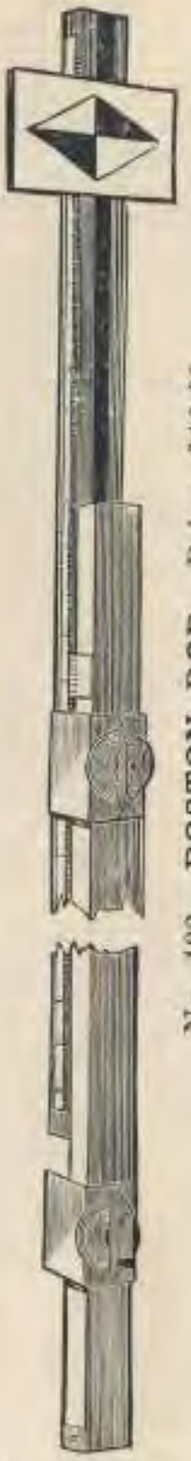
MISCELLANEOUS.

Patent Extension Tripod for Engineers' Transit or Level	$15 00	
Extension legs only, with clamps, do do per set	10 00	
Plain Tripod, do do	10 00	
Plain tripod legs only, do do per set	5 00	
Slit leg tripod, do do	15 00	
Tripod head only, with bolts, do do	5 00	$0 40
Wooden Cap, with brass screw plate, for tripod head	75	10
Ring for tripod legs	10	02
Brass Bolts do each	50	03
Metal Points do do	50	05
Screw drivers, each	20	03
Steel adjusting pins, each	05	01
Brass wrench for center pin	10	01
Glass circle for compass face	25	15
Mahogany case with lock and key and leather strap, fitted complete for Transit or Level	6 00	
do do do do for Compass	5 00	
Regraduating compass circle to half degrees	5 00	
do horizontal limb and verniers of Transit to read to one minute	10 00	
do vertical do do do do	5 00	
Reading microscope	75	02
Plumb-bob for Transit or Level	1 50	12
Target and springs for New York or Philadelphia Rod	5 50	25
Clamp for New York or Philadelphia Rod	2 50	10
Rubber Hood for Transit or Level	1 00	04
Chamois skin, best quality	65	05
Chain handles, each	75	08
Chain tallies, per set of nine	50	05
Clamp screw and band for extension leg	85	05
Leather Case and Shoulder Strap for Engineers' or Surveyors' Transits, price according to size	$8 00 to 10 00	
Leather Case and Shoulder Strap for 15 to 23-inch Y Levels	8 00 to 10 00	
Leather Case and Shoulder Strap for Architect's Level and for 4 to 6-inch Vernier Compasses	$7 00 to 9 00	

LEVELING RODS.

No. 190 B.—**ARCHITECTS' ROD.** Price, $6.00.

No. 191.—**TROY ROD.** Price, $10.00.



No. 192.—**BOSTON ROD.** Price, $16.00.

No. 193.—**PHILADELPHIA ROD.** Price, $16.00.

PRICES.

No. 190A.—Architects' Rod, 5½ ft. closed, sliding to 10 ft., feet, inches and 16ths	$ 6 00
No. 190B.—Architects' Rod, 5½ ft. closed, sliding to 10 ft., feet and 10ths	6 00
No. 191.—Troy Rod, 6½ ft. closed, sliding to 12 ft	10 00
No. 192.—Boston Rod, 6 ft. closed, sliding to 11 ft	16 00
No. 193.—Philadelphia Rod, 7 3-10 ft. closed, sliding to 13 ft.	16 00
No. 194.—Philadelphia Mining Rod, 3 3-10 ft. closed, sliding to 5 ft.	13 00
No. 195.—New York Rod, in two parts, with improved mountings, 6 8-10 ft. closed, sliding to 12 ft	16 00
No. 196.—New York Rod, in three parts, 5 ft. closed, sliding to 13 ft	18 00
No. 197.—New York Rod, in four parts, 5 ft. closed, sliding to 16 ft.	20 00
No. 198.—New York Mining Rod, in two parts, 3 3-10 ft. closed, sliding to 5 3-10 ft.	13 00
No. 199.—Telemeter, or Stadia Rod, 6 ft. folded, unfolding to 12 ft.	12 00
No. 200.—Telescopic Rod, 5 ft. long, sliding to 14 ft	24 00
No. 201.—Cross Section Rod, 10 ft. long, with level vial at each end	10 00
No. 202.—Plain Leveling Rod, in one piece, without target, 10 ft. long, reading to feet and 100ths	6 00

NOTE.—Any of the above Rods with Metric measure, at same price.

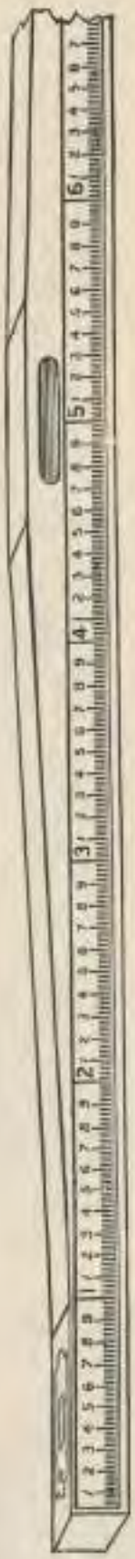
	PRICE.	POST.
205.—Pocket Leveling Rod, 10 feet long, self-reading to feet and 100ths; made of rubber canvas, can be coiled up and carried in pocket; in use it is fastened to a board with thumb tacks	$3 25	$0 15
206.—Pocket Leveling Rod, 12 feet long, self-reading to feet, inches and ⅛-inch	4 00	18
207.—Pocket Leveling Rod, 3½ meters long, divided to centimeters	4 00	18

LEVELING RODS (CONTINUED).

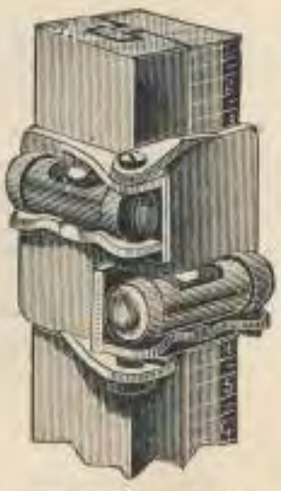
No. 196.—**NEW YORK ROD**, in 3 parts. Patented Oct. 23, 1883. Price, as shown, $18.00.

No. 195.—**NEW YORK ROD**, in 2 parts (usual pattern). Price, $16.00.

No. 200.—**TELESCOPIC ROD.** Price, $24.00.



No. 201.—**CROSS SECTION ROD.** Price, $10.00.



Rod Level as Applied to a Rod.

No. 215.

ROD LEVEL.

Patented Feb. 17, 1885.

Price, $3.00.

WOOD AND IRON FLAG STAFFS, ETC.

These staffs are divided off in feet, which are painted red and white, alternately.

210.—Wood Staff, 6 feet long, with metal shoe		$2 00
211.—Wood Staff, 8 feet long, with metal shoe		2 25
212.—Wood Staff, 10 feet long, with metal shoe		2 50
213.—Aligning or Ranging Pole, 6 feet long, hung in gimbals		4 00
NOTE.—This pole consists of an iron tube, 11-16 of an inch diameter, 6 feet long, and being hung in gimbals always assumes a vertical position.		
214A.—Iron tubular ranging pole, 6 feet long, 13-16-inch diameter		2 75
214B.—Iron tubular ranging pole, 8 feet long, 13-16-inch diameter		3 00
NOTE.—Nos. 210 to 214 divided metrically, at same price.		
215.—Rod Level for plumbing a rod or flag staff	$3 00	$0 10

ODOMETERS.

For Measuring Distances by Revolution of a Carriage Wheel.

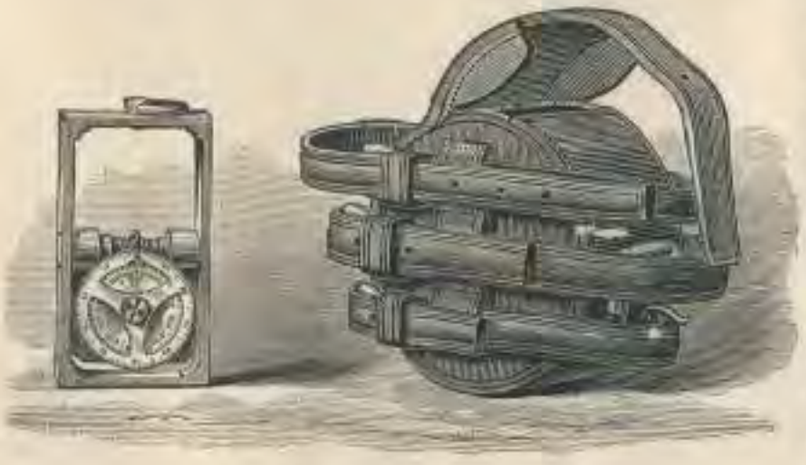
The Odometer is an instrument designed to register the number of revolutions of a wagon wheel of a given circumference, and thus indicate distances in cases where extreme accuracy is not required.

In measuring distances with the odometers shown in Nos. 365 and 366 the carriage should not be driven faster than about eight miles an hour.

No. 365. Price, $10.00.

This Odometer is securely fastened to the spokes of the wheel by three carriage-bolts as shown, there being also a thick leather washer on each side confined between the bottom of the projecting arms, and a metal washer of same shape on the other side of the spokes.

In using this Odometer the reading of the dials must be taken at both ends of the journey, the one subtracted from the other, and the remainder showing the number of turns of the wagon wheel. The circumference of the wheel being given, the distance is obtained by multiplying it by the number of revolutions recorded on the dials.

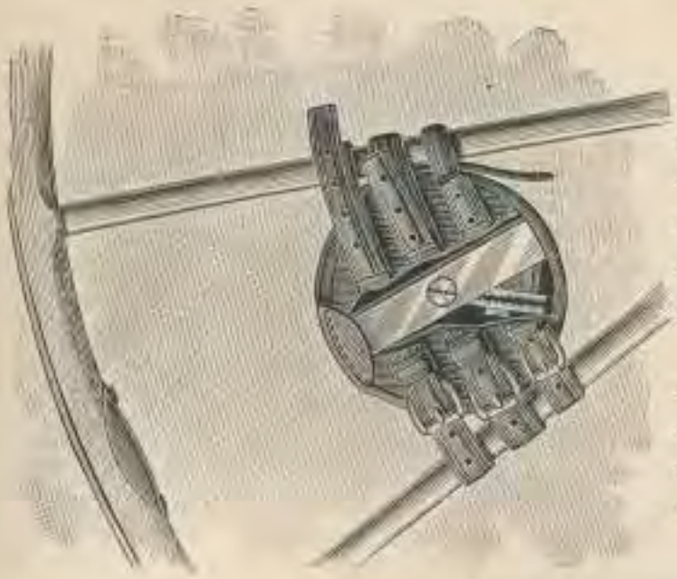


No. 366. Price, $15.00.

The Odometer here shown on the left consists of a square brass pendulum hung within a rectangular frame which revolves with the wheel, while the pendulum remains vertical. Upon the front face of the pendulum are two brass wheels two inches in diameter, the inner surfaces of which are in contact, the edges of both uniting to make a groove corresponding to a worm cut in the middle of a shaft fastened to the sides of the frame.

The front wheel has one hundred teeth, the rear one ninety-nine, and both pitch into and are moved by the worm which turns both wheels, and each will be moved forward one tooth by every turn. When one hundred turns are made the front wheel will have moved completely around, and the index of its zero division will have been carried over one division of the inner wheel.

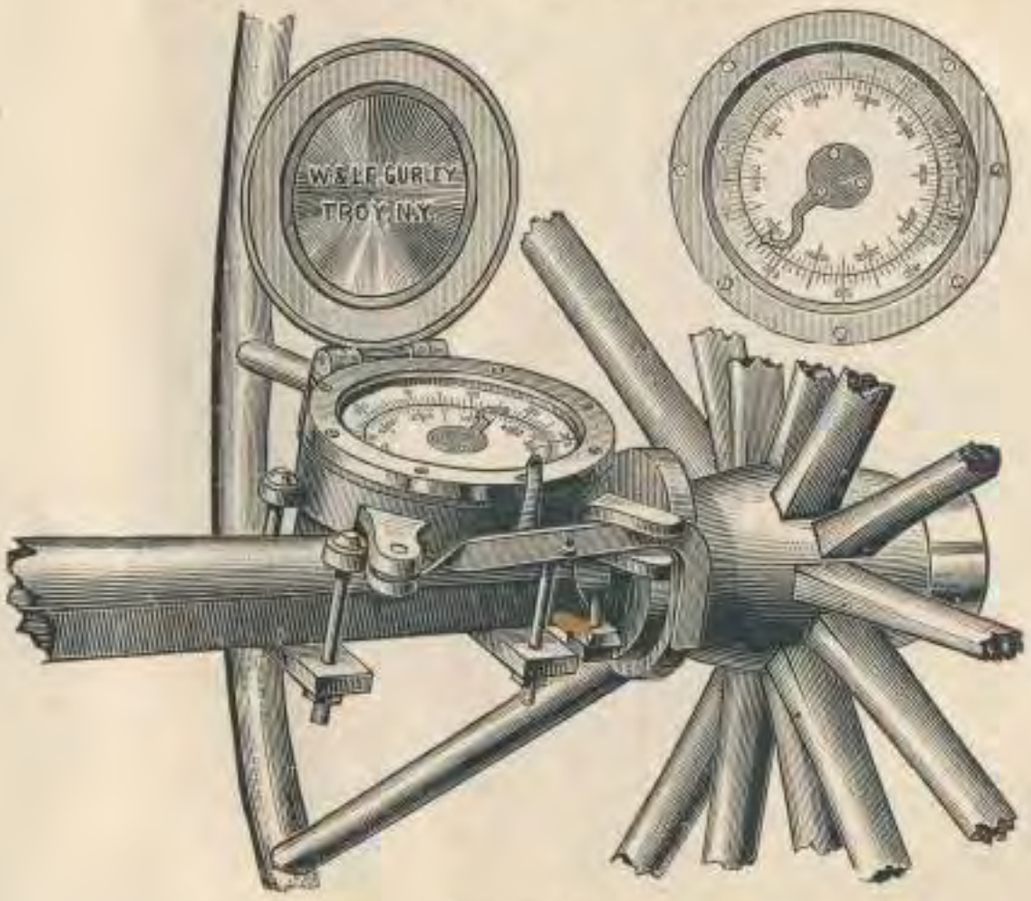
By noting the positions of the indices of both wheels the number of revolutions of the wagon wheel can be obtained up to 9900, when both wheels will be at zero again. The wagon wheel being of a given size, the number of feet traveled can be ascertained by multiplying the perimeter of the wagon wheel by the number of turns made.



The metal case of this odometer is inclosed within a stout leather box as shown. The opening through which the rectangular frame is inserted or removed when the reading of the register is desired is covered with a leather flap secured by a strap and buckle, as shown in the cut.

The Odometer in use is set into a metal case, which is inclosed in a leather cover to which are attached straps for fastening the instrument firmly to the spokes of the wagon wheel as shown.

POSITIVE MOTION ODOMETER.



No. 367

Price. $20.00

This Odometer as represented, for counting the revolutions of a carriage wheel, is of the most substantial construction.

The wheel work is contained in a solid metal case, with glass covering the face of the dial.

On the chamfered surface are 100 divisions, which are figured in tens and read by an index carried forward one space on the dial by every upward movement of a steel lever shown underneath.

A wheel with 99 divisions upon it revolves under the index, immediately beneath the divided edge of the dial and is carried forward a single division on the dial by every complete revolution of the index; the wheel is numbered from 0 to 9900.

This Odometer is intended to be fastened to the axle of a wagon by the bolts as shown, a cam on the hub of the wheel giving the upward motion to the steel lever above described.

The form of the odometer secures entire accuracy in recording the revolutions of the wheel either slow or fast, and has been adopted in the Topographical surveys of the United States as superior to any other.

CURRENT METER.

This instrument, now so generally used to ascertain the velocities of currents in harbors, rivers and smaller streams, is shown below at *A* in its best and most substantial form.

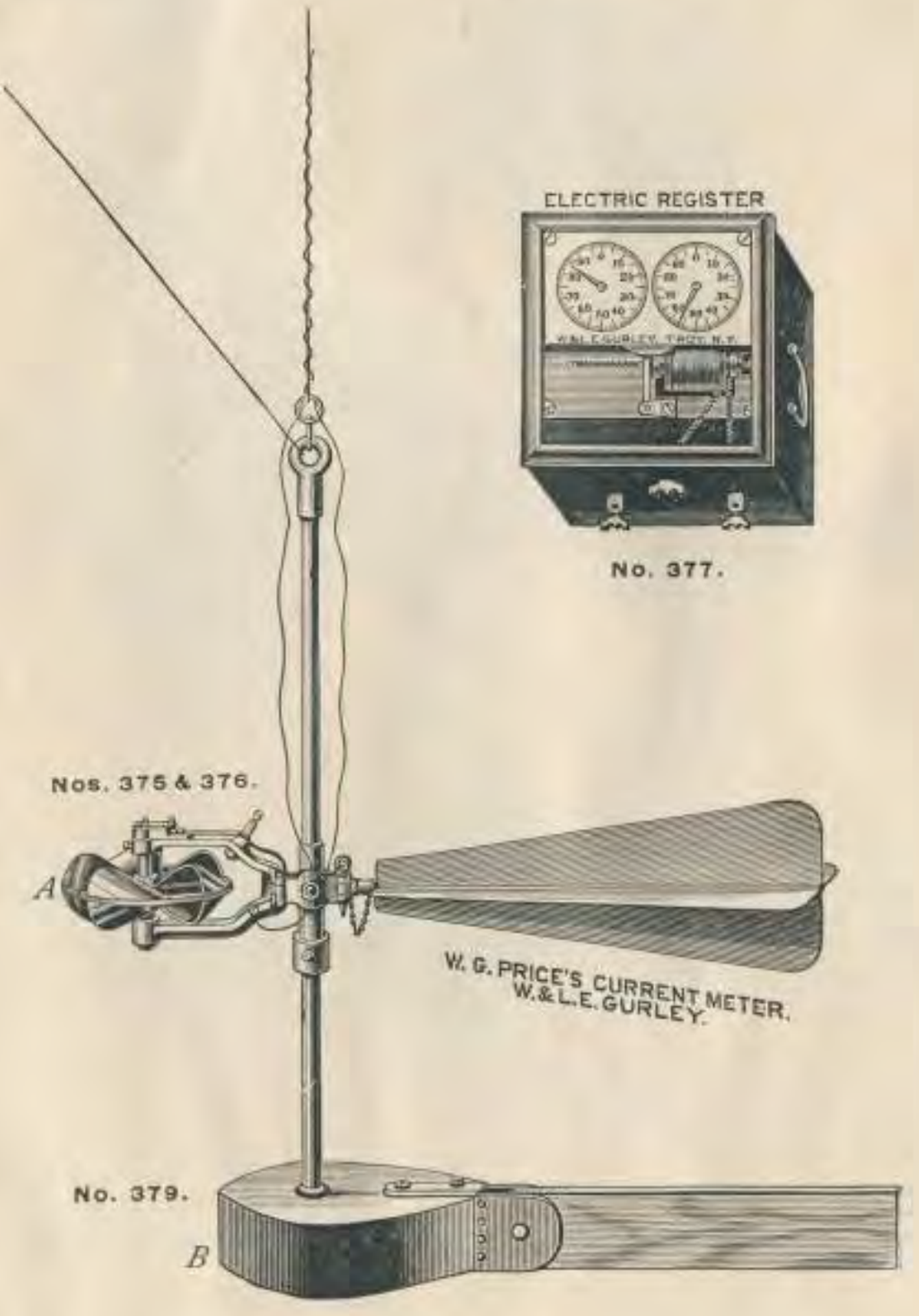
The wheel of this meter carries five conical buckets, as shown, so arranged as to feel the force of the slightest current and cause the wheel to revolve.

The ends of the axis of the wheel revolve in bearings contained in air chambers of metal, which protect them from the water and any gritty matter it may contain, and the friction is thus reduced to a minimum and made a constant quantity.

The form of the wheel and buckets is such as to insure great strength, and thus resist injury from driftwood, etc., while, at the same time, it is not liable to obstruction from floating leaves and grass.

The Price Meter is the result of six years' experience in measuring the velocity of water in the Ohio and Mississippi Rivers by different methods, while the inventor was in the employ of the U. S. Engineer Corps.

It is used by the U. S. Engineer Corps, the U. S. Coast and Geodetic Survey, and by hydraulic engineers in different parts of the country.



We make two sizes of this meter. The larger size is intended for deep water and harbor surveying, where great strength is required, and usually the weight is to be employed; the smaller one is designed for use in smaller rivers and streams, and is used either with or without the weight.

The weight *B* is of lead, and weighs about sixty pounds; it has a rudder of wood, as shown, secured to the weight by brass cheek pieces which are also securely fastened to the weight by sockets cast into the lead. The rudder can be set at any angle with the weight, or turned up parallel with the rod, for convenience in transportation.

The weight *B* is only used where the meter is employed in deep water and harbor surveying, where the currents are very strong. In shallower waters the meter is suspended upon a rod of wood or metal, and this may be in one piece or formed of several short rods screwed together.

No. 385.

ELECTRIC REGISTER.

The number of revolutions of the meter-wheel is recorded by an electric register (No. 377) actuated by a battery of two or three cells.

The electric register is inclosed in a mahogany case showing two dials under a glass face, and has an electro-magnet which, when the circuit is made, moves a lever at the end of which is a pawl carrying forward a rachet-wheel one tooth at every break of the current.

BOYDEN'S HOOK GAUGE.

So called from the name of its inventor, is used in determining the depth of water flowing over weirs, etc.

As represented, it has a frame of wood, three feet long and four inches wide, in a rectangular groove of which another piece is made to slide, carrying a metallic scale divided to feet and hundredths, and figured from zero to two feet and two-tenths, as shown.

Connected with the scale is a brass screw passing through a socket, fastened to another shorter sliding piece, shown above, which can be clamped at any point on the frame, and the scale with hook moved in either direction by the milled head nut.

There is also a vernier attached to the frame, and movable under the screw-heads which secure it, in order to adjust its zero to correspond with the point of the hook. The vernier reads the scale to thousandths of a foot.

The hook is of brass, and has a sharp point which, when raised to the surface of the water at rest, indicates its precise level.

Price . . . . . $25.00.

PRICES.

No. 375.—Deep Water and Harbor Meter	$100 00
No. 376.—River and Smaller Stream Meter	100 00
No. 377.—Electric Register	50 00
No. 379. Lead weight, 60 lbs. and connections (to use with Harbor Meter No. 375)	15 00
No. 380.—Brass tubing, jointed in 4-ft. lengths, and graduated in feet and tenths (to use with Meter No. 376 and without lead weight) per foot	1 25
No. 381.—Battery, 3 cells, in case	7 00
No. 382.—Insulated connecting wires for Battery, per foot	02
No. 385.—Boyden's Hook Gauge	25 00

CHAINS AND TAPES.

PARTIAL LIST.

CHAINS.

No.								Price.	Post.
220.—	66 feet,	100 links,	with oval rings,	No.	8	refined iron wire		$4 00	$1 40
221.—	66 do	100 do	do	do	10	do		3 50	1 00
222.—	33 do	50 do	do	do	8	do		2 50	74
223.—	33 do	50 do	do	do	10	do		2 25	55
225.—100	do	100 do	do	do	10	best steel wire		8 50	1 25
227.—	50 do	50 do	do	do	10	do		4 75	70
229.—	66 do	100 do	do	do	10	do		7 00	1 00
231.—	33 do	50 do	do	do	10	do		4 00	55

STEEL BRAZED CHAINS.

No.							Price.	Post.
235.—100	feet,	100 links,	No. 12	steel,	spring temper,	brazed links and rings	$11 00	$0 90
236.—	66 do	100	do	do	do	do do	10 00	70
237.—	50 do	50	do	do	do	do do	6 00	50
238.—	33 do	50	do	do	do	do do	5 50	35

Our steel brazed chains displace the ordinary chains wherever they are tried on account of superior lightness and strength. They are practically the only chains now used in railroad construction.

SPANISH VARA AND FRENCH METRE CHAINS.

FOR USE IN TEXAS, MEXICO, SOUTH AMERICA AND CUBA.

No.								Price.	Post.
240.—10	varas or 10	metres,	50	links,	No.	10	refined iron wire	$2 25	$0 55
241.—20	do	20	do	100	do	10	do	3 50	1 00
244.—10	do	10	do	50	do	10	best steel wire	4 00	55
245.—20	do	20	do	100	do	10	do	7 00	1 00
248.—10	do	10	do	50	do	brazed links and rings,	No. 12 steel wire tempered.	5 50	35
249.—20	varas or 20	metres,	100	links,	brazed links and rings,	No. 12	steel wire tempered.	10 00	70

Parties ordering chains, Nos. 240 to 249, must state whether vara or metre chains are wanted.

NOTE.—Steel snaps to make full chains into "half chains," no extra charge if ordered with the chain.

GRUMMAN PATENT STEEL CHAINS.

No.										Price.	Post.
260.—	66 feet,	No. 15	tempered steel wire,	100	links,	weight	1¼ lbs.,	with 10	extra links.	$9 00	$0 26
261.—	33 do	do	do	50	do		¾ lb.,	do 5	do	5 00	18
262.—100	do	do	do	200	do		2 lbs.,	do 15	do	11 00	38
263.—	50 do	do	do	100	do		1 lb.,	do 10	do	6 00	22
268.—	50 feet,	No. 18	tempered steel wire,	100	links,	with attachments of spring-balance, level, and thermometer, for very accurate measurements; weight, ¾ lb.				15 00	18
271.—Spring-balance to use with chains Nos. 260 to 263										2 00	06

MARKING PINS.

No.			Price.	Post.
275.—Set of 11	Pins,	iron wire, No. 4	$1 50	$0 40
276.—	do	steel wire, No. 6	2 00	32
277.—	do	brass wire, No. 4	3 00	40
278.—	do	steel wire, No. 6, weighted near point	3 00	1 10
279.—	do	steel wire, No. 10, very light, with leather case	2 00	12
280.—Timber scribes or Marking irons, each			1 25	05

METALLIC TAPE MEASURES.

Made of linen thread, interwoven with fine brass wire. They are ⅜-inch wide and in substantial leather cases.

No.								Price.	Post.
285.—Metallic tape,	33	feet long,	in 10ths or 12ths,	and	links	on	reverse side	$2 10	$0 10
287.—	do	50	do	do	do	do	do	2 50	15
288.—	do	66	do	do	do	do	do	3 00	18
292.—	do	100	do	do	do	do	do	4 20	25

NOTE.—We can furnish metallic tapes with metric or vara measure on reverse side instead of links at an extra cost of one cent per foot.

STANDARD STEEL TAPE MEASURES.

All steel, ⅜-inch wide; the most accurate, durable and portable measures, in substantial leather cases.

No.								Price.	Post.
302.—Steel Tape,	25	feet	long,	in	10ths or 12ths,	and	links on reverse side	$4 50	$0 08
303.— do	33	do	do	do	do	do	do	5 20	10
305.— do	50	do	do	do	do	do	do	7 00	12
306.— do	66	do	do	do	do	do	do	9 00	15
308.— do	100	do	do	do	do	do	do	12 80	25

EXCELSIOR STEEL TAPES.

Excelsior steel tape, ½-inch wide, on brass frame with handle, handy in rolling up or unrolling the tape, very good to be used in mines.

No.								Price.	Post.
310.—Steel Tape,	50	feet	long,	in	10ths or 12ths,	and	links on reverse side	$7 20	$0 20
311.— do	100	do	do	do	do	do	do	12 75	35
312.— do	50	do	in	12ths,	and	metres	on reverse side	8 40	20
313.— do	100	do	do	do	do	do	do	15 40	35

POCKET STEEL TAPE MEASURES.

No.	Price.	Post.
315.—Pocket Steel Tapes, in German silver cases, with spring and stop, divided in 10ths or 12ths of feet, 3 feet long	$1 25	$0 03
317.—Pocket Steel Tapes, in German silver cases, with spring and stop, divided in 10ths or 12ths of feet, 5 feet long	1 60	04
318.—Pocket Steel Tapes, in German silver cases, with spring and stop, divided in 10ths or 12ths of feet, 6 feet long	1 75	04
320.—Pocket Steel Tapes, in German silver cases, with spring and stop, divided in 10ths or 12ths of feet, 12 feet long	3 00	06

These pocket tapes, with divisions to centimeters and millimeters on the other side 5 cents per foot extra.

PAINE'S PATENT STANDARD STEEL TAPES.

Of steel ribbon ¼-inch wide.

No.								Price.	Post.
325.—Steel Tape,	in	leather	case,	33	feet	long,	10ths or 12ths, and links on reverse side	$5 50	$0 10
326.— do		do		50	do	do	do do	8 00	15
327.— do		do		66	do	do	do do	10 00	20
329.— do		do		100	do	do	do do	15 00	25
331.— do	in	metal	case,	33	do	do	do do	4 50	10
332.— do		do		50	do	do	do do	6 00	15
333.— do		do		66	do	do	do do	8 00	20
335.— do		do		100	do	do	do do	12 00	25

Tapes Nos. 325 to 335, with metric or vara measure on reverse side instead of links, at an extra cost of 3 cents per foot.

STEEL RIBBON CHAIN TAPES.

¼-Inch Wide, with Handles and Reel.

No.						Price.	Post.
345.—Steel Ribbon,	33	feet	long,	graduated	each link	$3 50	$0 15
346.— do	50	do	do	do	each foot	4 00	20
347.— do	66	do	do	do	each link	4 50	30
348.— do	100	do	do	do	each foot	5 00	35

The 50 and 100 feet tapes have the first foot graduated to tenths.

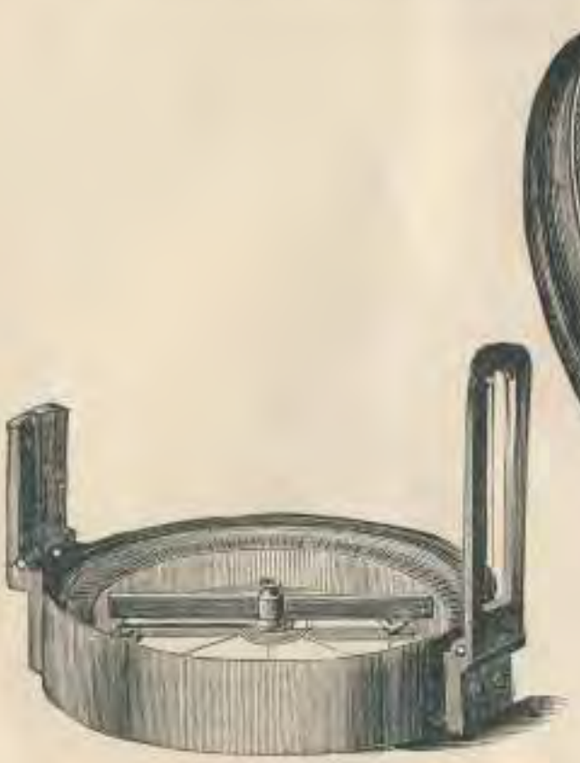
Longer tapes to order. For each additional 100 feet, with an extra graduation at each 10 feet, add $2.00. Thus, a steel ribbon 500 feet long will cost $5.00 + $8.00 = $13.00.

No.							Price.
349A.—Steel Ribbon,	200	feet	long,	with	handles	and substantial reel	$11 00
349B.— do	300	do	do	do	do	do	14 00
349C.— do	500	do	do	do	do	do	20 00

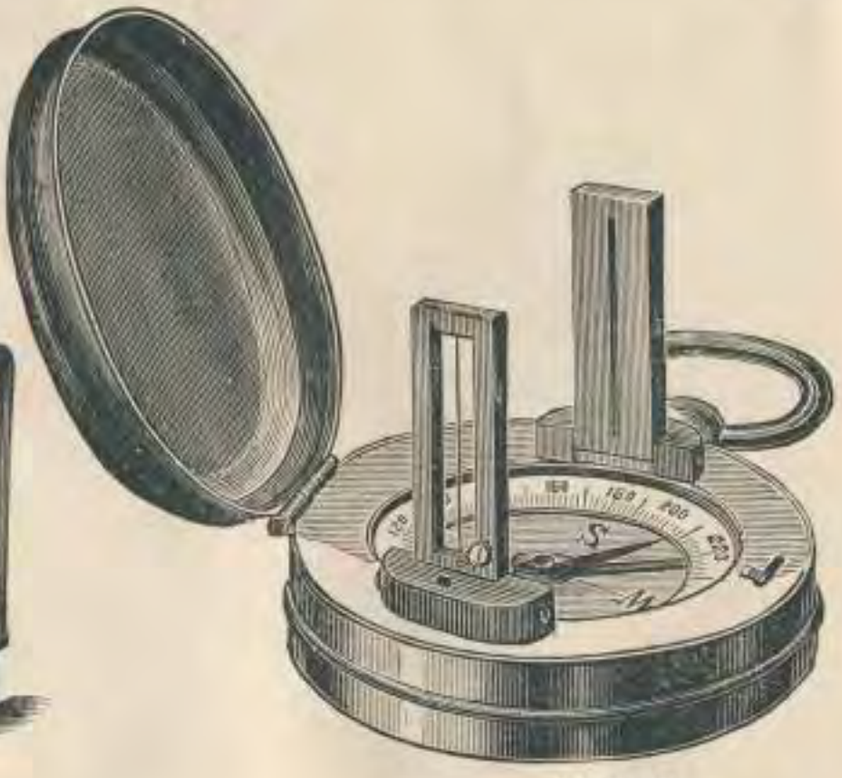
Tapes Nos. 349A, B and C are graduated at each five feet the entire length, and are mounted on a mahogany reel of solid sides and swivel handles.

COMMON POCKET COMPASSES.

No.		Price.	Post.
1143.	Mahogany Case, 3 inches square, stop to needle	$2 25	$0 05
1143.A	Government pattern, Mahogany Case, 3 inches square, raised ring, superior needle, with stop, Gurley, maker	3 50	05
1145.	Brass, round, watch pattern, stop, agate center, 2 inch	1 25	04
1147.	Brass, round, with cover 2 inches diameter, stop and agate centre to needle	1 50	04
1148.	Brass, round, watch pattern, stop, agate center, 1½ inch, with hinged cover	1 50	03
1151.	Pocket compass, watch pattern, gilt, stem stop, bar needle, 1½ inches in diameter	5 00	04
1152.	Pocket Compass, watch pattern, with hinged cover, spring catch and stop to needle in joint of cover, 1½ inches in diameter	3 50	05
1154A.	Military Pocket Compass, 1⅞ inches diameter, heavy case with hinged cover, bar needle with agate center and stop to needle	5 00	15
1154B.	Same as No. 1154A, but 2⅛ inches diameter	5 75	15



No. 1156.



No. 1158.

No.		Price.	Post.
1156A.	Pocket Compass, 2⅛ inches diameter, with cover, folding sights, bar needle with agate center and stop to needle in joint of sight	$5 00	$0 20
1156B.	Same as No. 1156A, but 3¼ inches diameter and superior	7 50	20

As Sight Compass.

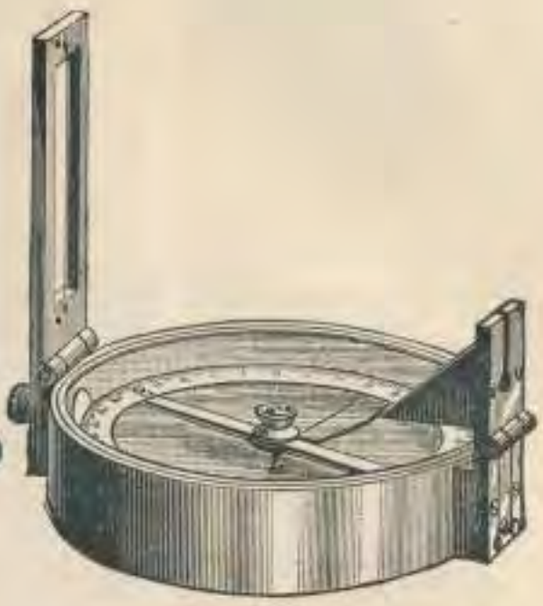
No. 1157.

As Clinometer.

COMMON POCKET COMPASSES (CONTINUED).

No.		Price.	Post.
1157 A.	Clinometer-Compass, 2½ inches diameter, graduated to one degree, bar needle with agate center and stop, pivoted sights, cover and Morocco case	$7 50	$0 20
1157 B.	Same as 1157 A, but 3 inches diameter	9 50	20
1158.	Pocket Compass, hunting case, raised ring, stop to needle, folding sights, 2¾ inches in diameter	7 00	10
1159 A.	Geological Compass, of brass, 2¾ inches diameter, with pendulum for ascertaining the angle of dip in rocks	4 00	05

No. 1161.



No. 1162.

No.		Price.	Post.
1161.	Prismatic Azimuth Compass, 2 inches diameter, hinged cover, floating dial with stop, folding prism	$15 00	$0 15
1162.	Prismatic Azimuth Compass, 3 inches diameter, with cover, floating dial with stop, folding prism and sight, and leather sling case	17 50	25

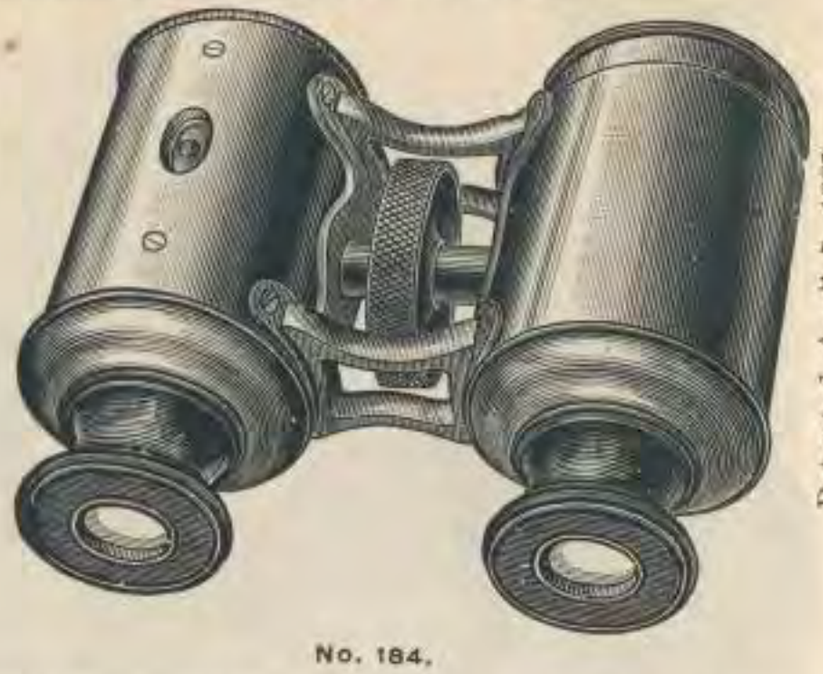
MISCELLANEOUS.

No.		Price.	Post.
1163.	Pocket Alt-Azimuth, with Telescope, for travelers and military surveyors. Altitudes, azimuths, compass bearings, clinometer degrees and levels are all obtained by this instrument. Size, 6½x2½x1⅛ in case	$50 00	$0 30
1164 A.	Pocket Sextant, divided to ½ degrees, with vernier to 1 minute, telescope, sun glasses, reading glass, tangent screw, etc. In metal case, 3 inches diameter	42 50	40
1164 B.	Sextant of gun metal, open frame, four inches radius, arc of 150 degrees, graduated on silver to 15 minutes, with vernier reading to 15 seconds, clamp and tangent and magnifier, one terrestrial and one celestial telescopes, two mirrors, six sun glasses; all in mahogany box	45 00	75
1165.	Surveyors' Cross—for right angles	3 00	30
1167.	Surveyor's Cross—with vertical axis divided to one degree and vernier to 3 minutes—with magnetic compass, 2½-inch needle	12 00	45
1168.	Rectangular Prism, for right angles, in Morocco case	5 00	05
1169.	Artificial Horizon, with black glass plane mounted in brass frame with three leveling screws, and sensitive level vial	16 00	25
1170.	Pedometer, watch form, registers distance walked up to 12 miles by each 1-5 mile	4 50	05
1171.	Pedometer, watch form, registers distance walked up to 50 miles by each 80 yards	5 00	05
1172.	Passometer, or Step Counter, watch form, registers each step	6 50	05

NEW TELESCOPIC HAND LEVELS.

Patented Nov. 30, 1886.

No. 183.



No. 184.

Patented April 5, 1887.

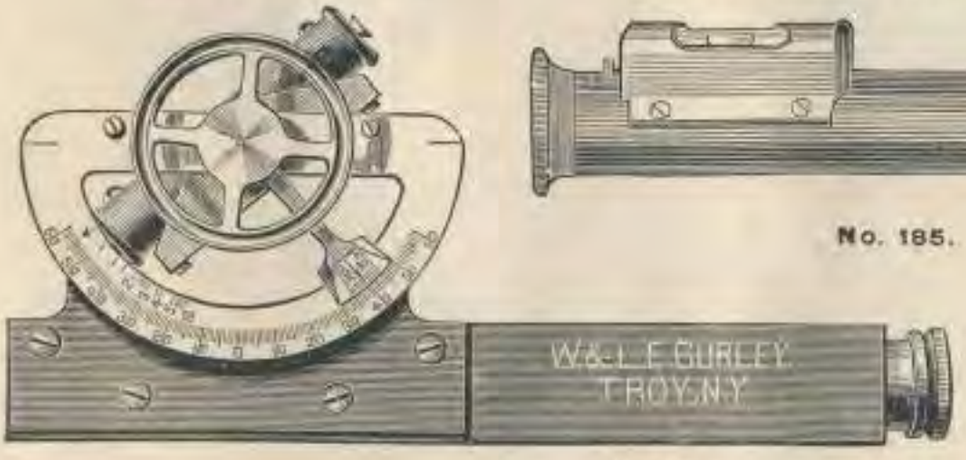
The cuts above shown represent two forms of a telescopic hand level just devised by us, in which, besides the ordinary lenses of an opera glass, are included a reflecting prism, level vial, and cross wire.

When the monocular hand level is held truly horizontal, the observer will see the object through the larger concave segment of the eye lense, and at the same time note through the small convex segment the position of the cross wire bisecting the bubble upon the surface of the object to which the level is directed.

The use of the binocular hand level gives a clearer view of an object than is possible with a single tube, there being now no light lost by the interference of the prism and level vial.

	Price.	Post.
No. 183.—Monocular Hand Level, in case	$12 00	$0 15
No. 184.—Binocular Hand Level, in case	15 00	30

THE ABNEY LEVEL AND CLINOMETER.



No. 187.

LOCKE'S HAND LEVEL.

No. 185.

The Abney Level is an English modification of that shown in No. 185, combining with it an excellent clinometer as represented in the cut.

Here, when the level is brought to the center by setting the vernier arm to zero on the divided arc, the bubble is seen through the eye end and the level ascertained precisely as with the Locke's Level. And the main tube being square it can be applied to any surface, the inclination of which may be ascertained by bringing the level bubble into its center, and reading off the angle to five minutes, by the vernier and arc.

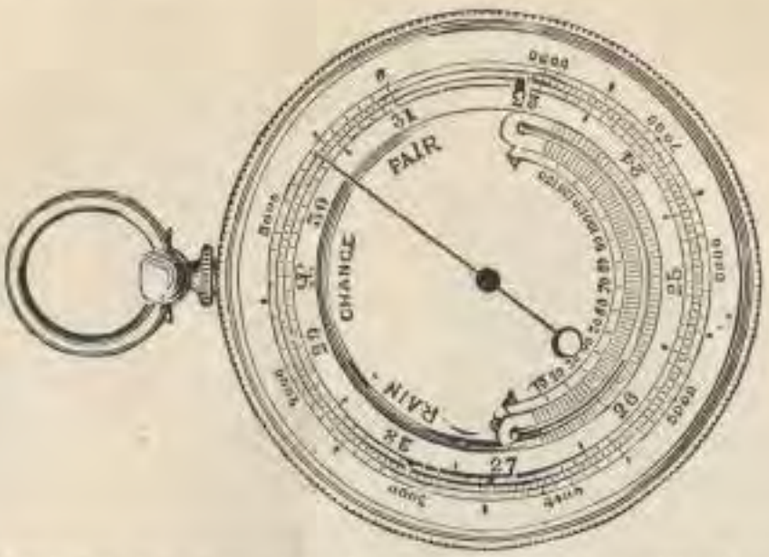
The inner and shorter arc indicates the lines of different degrees of slope, the left-hand edge of the vernier being applied to the lines and the bubble brought into the center as usual.

	Price.	Post.
No. 185.—Locke's Hand Level, bronze, in case	$9 00	$0 12
No. 186.— do do nickel plated, in case	10 00	15
No. 187.—Abney Level, an improved "Locke's Hand Level," giving angles of elevation, and is also divided for slopes, as 1 to 1, 2 to 1, etc., in case	15 00	15
No. 187A.—Ditto, and with compass and staff socket attached	18 00	20

ANEROID BAROMETERS.

For Ascertaining Heights, Differences of Level, Meteorological Changes, Approach of Storms, etc.

No.					Price.	Post.
1270.—Mountain Aneroid Barometers, compensated for temperature, with brass cases and silvered dial, in Morocco cases, accompanied by a handbook of instructions. These instruments are of very great service to the engineer and tourist, as well as to the scientific observer, and are rapidly coming into general use.						
A.—Pocket Aneroid, 2-inch diameter, altitude scale to 8,000 feet					$18 00	$0 10
B.—	Pocket Aneroid, 2-inch diameter, altitude scale to 10,000 feet				19 00	10
C.—	Pocket Aneroid, 2-inch diameter, altitude scale to 16,000 feet				20 00	10
E.—	Pocket Aneroid, 2-inch diameter, altitude scale to 16,000 feet, and thermometer				22 00	10



H.—Pocket Aneroid, 2¾-inch diameter, altitude scale to 10,000 feet, with thermometer, and opposite side with pocket compass					28 00	20
J.—	do	do	do	16,000 feet, with thermometer and pocket compass	30 00	20
K.—Pocket Aneroid, 2¾-inch diameter, altitude scale to 3,000 feet					19 00	18
L.—	do	do	do	5,000 feet	18 00	18
N.—	do	do	do	10,000 feet	19 00	18
O.—	do	do	do	16,000 feet	20 00	18
P.—	do	do	do	20,000 feet	22 00	18
Q.—	do	do	do	10,000 ft, and thermometer	21 00	18
R.—	do	do	do	16,000 ft, and thermometer	24 00	18
1275.—Metric Pocket Aneroid, 2¾ inches diameter, altitude scale to 3,000 meters reading to 10 meters, and pressure scale reading to 10 millimeters					30 00	18
1276.—	do	do	do	altitude scale to 5,000 meters, reading to 20 meters, and pressure scale reading to 20 millimeters	22 00	18
1278.—Plain Aneroid, no altitude scale, 5-inch diameter, with thermometer and open face, to show mechanism, for parlor use					15 00	65
1279.—	do	but 6¼-inch diameter, and with two thermometers reading to Fahrenheit and Centigrade scales			18 00	

SURVEYING AND MINING ANEROIDS.

1280.—Surveying Aneroid, 3-inch diameter, compensated for temperature, silvered metal dial, with vernier and magnifier, in leather sling case, with altitude scale to					6,000 feet	40 00	40
1281.—	do	do	do	do	10,000 feet	43 00	40
1282.—Mining Aneroid, 3-inch diameter, but arranged to register 2,000 feet below sea-level to 4,000 feet above						40 00	40
1285.—Surveying Aneroid, 3-inch diameter, compensated for temperature, silvered metal dial, with vernier and magnifier, in leather sling case, with altitude scale to 5,000 feet						45 00	1 00
1286.—	do	do	do	do	10,000 feet	47 00	1 00
1287.—	do	do	do	do	15,000 feet	50 00	1 00
1288.—	do	do	do	do	20,000 feet	52 00	1 00

The Surveying and Mining Aneroid has been constructed especially for the use of Surveyors and Engineers, for ascertaining slight variations in gradients, levels, etc., and from its extreme sensitiveness will be found of considerable utility in Mining and Surveying work generally.

The Vernier Scale is moved by a rack-work adjustment, and a magnifying lens which rotates on the outer circumference of the instrument facilitates the reading of minute quantities.

NOTE.—The barometers described above are the most desirable styles. We can, however, furnish any of the styles mentioned in the catalogues of other dealers at their list price.

A treatise on the Aneroid Barometer; its construction and use. Illustrated 50

ANEMOMETERS.

For Measuring the Pressure and Velocity of Currents of Air in Coal Mines and Ventilators, Flues, etc., of Public Buildings.

"BIRAMS."—For ascertaining the velocity and volume of currents of air in mines, tunnels, etc., by means of a light fan, the revolutions of which are recorded on a dial in the center of the instrument.

This instrument placed in the passage of a mine registers automatically the rate at which the air is traveling through it, and a simple observation will detect any slackening of the current arising from obstruction of the ways, or want of attention at the ventilating furnace, or fan wheel.

Suppose the observation of one minute gives:

Second Reading	5,525
First Reading	5,225
	300
Add correction, say	30
	330

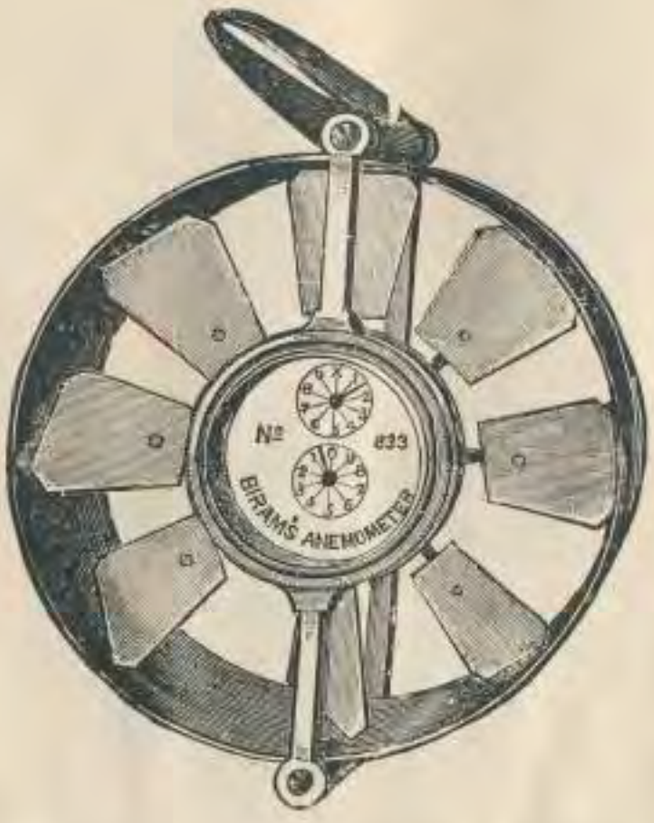
Size of passage in feet, $10 \times 5 = 50$, and multiplied by $330 = 16{,}500$ feet per minute.

The correction added above is the value of the constant friction, which must be found for each machine by actual experiment.

TO FIND THE VELOCITY OF THE AIR IN THE PASSAGE.

Proceed thus:—Suppose the Anemometer indicates 330 feet per minute. $330 \div 88 = 3.75$ or $3\frac{3}{4}$ miles per hour, 88 being 1-60th of a mile.

To ascertain the force of the air-current, multiply the square of the velocity of the air in feet per second by .0023.



No.		Price.	Post.
1292.	—Biram's Anemometer, 3 in. diam., reading to 1,000 feet, with disconnector . .	$20 00	$0 30
1293.	—Biram's Anemometer, 4 in. diam., reading to 1,000 feet, with disconnector . .	22 00	40
1294.	—Biram's Anemometer, 6 in. diam., reading to 1,000 feet, with disconnector . .	24 00	50
1295.	—Biram's Anemometer, 6 in. diam., reading to 100,000 feet, with disconnector . .	26 00	50
1296.	—Biram's Anemometer, 6 in. diam., reading to 10,000,000 feet, with disconnector	26 00	50
1297.	—Watch Anemometer, small and sensitive, in hunting case, reading to 1,000 feet	26 00	15

MARINE AND FIELD GLASSES.

(PARTIAL LIST.)

The power and sharpness of definition of a field glass depends upon the diameter of the object glass; the greater the diameter the higher the power, and more clearly distant objects are seen.

These glasses are designated and priced according to the diameter of the object glasses in French lines, eleven lines being equal to one inch.

No.		Price.	Post.
1300.	—Six Lens Achromatic Field Glass, metal body, covered with Morocco, sun-shade to extend over the object glasses, and leather case, with strap.		
	A.—Body 4¾ inches long; object-glasses 21 lines in diameter	$7 00	$0 30
	C.— do 6¼ do do 26 do	9 00	40
1301.	—U. S. Army Signal Service Six Lens Achromatic Marine or Field Glass, metal body, covered with Turkey Morocco, sun shades to extend over the object glasses, and heavy leather case, with strap.		
	A.—Body 5⅝ inches long; object-glasses 21 lines in diameter	13 00	35
	B.— do 5⅞ do do 24 do	14 00	40

1302.	—Bardou's U. S. Army Signal Service Marine or Field Glass, six lenses, achromatic object-glasses, metal body, covered with Turkey Morocco, sun-shades to extend over the object-glasses, and heavy leather case, with strap; very superior.		
	A.—Body 6 inches long when adjusted, object-glasses 21 lines in diameter	$16 00	$0 40
	C.— do 7½ do do do 26 do	20 00	60
1303.	—Bardou's U. S. Army Signal Service Marine or Field Glass, six lenses, achromatic object-glasses, body covered with Turkey Morocco, with hinge adjustment for different widths of eyes, sun-shade to extend over the object-glasses, in fine leather case, with strap.		
	B.—Body 6¾ inches long when adjusted, object-glasses 24 lines in diameter	20 00	55
	C.— do 7½ do do do 26 do	22 00	60
1304.	—**Binocular Telescope.** This form of Marine and Field Glass has great power and wonderful optical qualities. It is one of the best instruments for yachting, deer stalking, military service and general field use. It is furnished with screw shades, a strong cole-leather case, with strap.		
	A.—Body 9 inches long; object-glasses 10 lines in diameter, power 12 diameters	35 00	50
	B.— do 9½ do do 16 do do 16 do	45 00	75
	D.— do 5¼ do do 8 do do 10 do	30 00	65
1305.	—**Ranchman's Glass.** Six-Lens Achromatic Field Glass, metal body, covered with Morocco, sun-shades to extend over the object-glasses, in fine leather case with strap. A superior glass.		
	Body 6¾ inches long, object-glasses 26 lines in diameter	18 00	50
1306.	—**Panergetic Glass.** Six-lens Achromatic Field-Glass, aluminum body (weight 9 ounces) covered with Morocco. Fine leather case and strap. This is a new style and a superior glass.		
	Body 4 inches long, object-glasses 21 lines diameter	25 00	25

NOTE.—We also have constantly on hand a full and choice assortment of plain and fancy Opera Glasses of best make. Sizes from 11 to 19 lines diameter. Prices from $3.00 to $25.00 each.

ACHROMATIC TELESCOPES.

1325.

No.		Price.	Post.
1325.	Telescope, wood body, 3 draws, 15 inches drawn out, 6 inches shut, object-glass 1 inch in diameter, power 13 times.	$2 50	$0 15
1326.	Telescope, wood body, 3 draws, 16 inches drawn out, 6 inches shut, object glass 1⅛ inches in diameter, power 16 times.	3 50	20
1327.	Telescope, wood body, 3 draws, 23 inches drawn out, 8 inches shut, object-glass 1⅜ inches in diameter, power 20 times.	4 75	25
1328.	Telescope, wood body, 3 draws, 30 inches drawn out, 10 inches shut, object-glass 1⅝ inches in diameter, power 25 times	7 00	35
1329.	Telescope, wood body, 4 draws, 37 inches drawn out, 11 inches shut, object-glass 1⅞ inches in diameter, power 35 times.	12 00	60
1330.	Telescope, wood body, 4 draws, 42 inches drawn out, 11½ inches shut, object-glass 2⅛ inches in diameter, power 40 times.	20 00	80
1331.	Telescope, wood body, 4 draws, 48 inches drawn out, 13½ inches shut, object-glass 2⅜ inches in diameter, power 50 times.	30 00	1 25

TOURISTS' GLASSES.

1341.	Tourists' Achromatic Spy-glass with brass body covered with black Turkey Morocco, 3 draws, 17 inches long when drawn out, 6 inches long when shut up, object glass 1¼ inches diameter, sun-shade to slip beyond the object-glass, heavy leather caps to cover both the eye-glass and object-glass, strong leather strap to sling over the shoulder. Power 20 times.	$8 00	$0 15
1342.	Same as No. 1341, but is 21 inches long when drawn out, 7 inches long when shut up, object-glass 1⅝ inches diameter. Power 25 times	11 00	25
1343.	Same as No. 1341, but is 24 inches long when drawn out, 9 inches long when shut up, object-glass 1¾ inches diameter. Power 30 times	14 00	35
1344.	Signal Service Spy-glass, same as No. 1341, but has 4 draws, and is 30 inches long when drawn out, 10 inches long when shut up, object-glass 2 inches diameter. Power 35 times	20 00	50
1345.	Rifle spy-glass, 10¾ inches long, body covered with black leather, achromatic object-glass ½ inch in diameter. Power 10 times	2 50	10
1350.	Wooden tripod stand, with vertical and horizontal motion, upon which to place a spy-glass. An exceedingly useful article, as a glass of much power cannot be held in the hand with sufficient steadiness to produce the best effect.	5 00	85
1351.	Brass Clamp with Gimlet Screw, to fasten a spy-glass to a post or tree, three sizes to fit any of the foregoing spy-glasses	$1 50 to 3 50	05

ASTRONOMICAL TELESCOPES.

1355.	Astronomical Telescope. Polished brass body, 35 inches long, mounted on firm tripod stand, achromatic object-glass 2¾ inches in diameter, one terrestrial eye-piece, rack and pinion for adjusting the focus. Power 50 times	$65 00
1356.	Astronomical Telescope. Same as No. 1355, with one terrestrial eye-piece giving power of 50 times and one celestial eye-piece giving power of 100 times	70 00
1357.	Astronomical Telescope. Body of brass, 35 inches long, has rack and pinion focusing, achromatic object-glass 2½ inches in diameter, terrestrial eye-piece, power 40 times, celestial eye-piece, with black sun-glass, power 80 times, firm tripod stand of walnut, having horizontal and vertical movements, walnut case with lock and key for receiving the body and eye-glass.	70 00
1358.	Astronomical Telescope. Same as No. 1357, but with body 40 inches long, achromatic object-glass 3 inches in diameter, terrestrial eye-piece, power 55 times, celestial eye-piece, with black sun-glass, power 110 times, with walnut case.	100 00

DRAWING INSTRUMENTS (IN CASES.)

PARTIAL LIST.

CASES OF BRASS DRAWING INSTRUMENTS.

No.		Price.	Post.
530.	Rosewood Box, containing pair of 6-inch Dividers, with pen and pencil points and lengthening-bar, pair of 4½-inch plain Dividers, Drawing Pen, pair of 3½-inch Dividers with pen and pencil points, Brass Protractor, Horn Protractor, Wood Rule	$2 00	$0 15
533.	Rosewood Box, containing pair of 6-inch needle-point Dividers, with pen and pencil points and lengthening-bar, pair of 4½-inch plain Dividers, pair of 3½-inch needle-point Dividers, with pen and pencil points, Drawing Pen, Brass Protractor, Horn Protractor, Wood Rule, with lock and key and the instruments set in a tray so that colors, etc., may be put below	3 00	25
534.	Rosewood Box, containing pair of 6-inch needle-point Dividers, with pen and pencil points and lengthening-bar, Drawing Pen, pair 4½-inch plain Dividers, Brass Protractor, Horn Protractor, pair of 3½-inch needle-point Dividers with pen and pencil points, Spring Bow Pen with needle-point, Wood Rule, with lock and key and the instruments set in a tray so that colors, etc., may be put below	4 00	25
535.	Same as No. 534, with addition of a pair Proportional Dividers; has no brass Protractor, but has wood triangle and irregular curve	6 00	30

CASES OF FINE GERMAN-SILVER INSTRUMENTS.

No.		Price.	Post.
582.	Morocco Box, with pair of 5½-inch needle-point Dividers with pen and pencil points, pair of 5-inch plain Dividers, Drawing Pen	$3 50	$0 10
583.	Same as No. 582, with addition of steel points to Dividers and lengthening-bar	5 00	12
586.	Morocco box, with pair of 5½-inch Dividers with pen, pencil, needle-point and lengthening-bar, pair of 5-inch plain Dividers, Spring-Bow Pen, Drawing Pen	6 50	15
587.	Morocco Box, with pair of 5½-inch Dividers with pen, pencil, needle-point and lengthening-bar, pair of 5-inch plain Dividers, pair of 4-inch Dividers with pen, pencil and needle-point, two Drawing Pens	9 75	15
588.	Same as No. 587, with addition of Spring-Bow Pen	11 00	18
590.	Mahogany Box, with lock and key and tray, containing 5½-inch Dividers with pen, pencil, needle-point and lengthening-bar, Pair of 5-inch plain Dividers, Pair of 5-inch hair-spring Dividers, Pair of 4-inch Dividers with pen, pencil and needle-points, Spring Bow Pen with needle-point, 2 drawing-pens, German Silver or Rubber Square, German Silver Protractor.	16 00	45
591.	Mahogany Box, with lock and key and tray, containing pair of 6-inch Dividers with pen, pencil, needle-point and lengthening-bar, Pair 5-inch hair-spring Dividers, Pair of 4-inch Needle-Point Dividers, with pen and pencil points, Pair of Proportional Dividers, Three Drawing Pens, Bow Pen, Horn Protractor, Wood Curve and 2 Wood Triangles, Ivory Protractor Scale	21 00	50
592.	Mahogany box, with lock and key and tray, containing pair of 6-inch Dividers with pen, pencil, needle-point and lengthening-bar, Pair 5-inch hair-spring Dividers, Pair of 4-inch Dividers with needle-point, pen and pencil points, Pair Proportional Dividers, Bow Pen, 3 Drawing Pens, Beam Compass, 8-inch Horn Protractor, Ivory Protractor Scale, 1 Wood Curve and 2 Wood Triangles	29 00	75
593.	Mahogany box, with lock and key and tray, containing pair of 6-inch Dividers with pen, pencil, needle-point and lengthening-bar, Pair 5-inch plain Dividers, pair 5-inch hair-spring Dividers, Pair 4-inch Dividers with pen, pencil and needle-point, Bow Pen, 2 Drawing Pens, 1 Red Ink Pen, 1 Road Pen, Protractor, pair Proportional Dividers, Triangle and 12-inch Triangular Scale, Beam Compass	30 00	1 00

PROTRACTORS.

No.							Price.	Post.
620.—German Silver Protractor, 5½ inches diameter, half circle, half degrees, with arm, and vernier reading to three minutes							$11 00	$0 10
621.—German Silver Protractor, 3 inches diameter, half circle, quarter degrees, with arm, and vernier reading to one minute							14 00	15
630.—Railroad Curve Protractor, of Horn, 8 inches diameter, having laid off on it twenty-three curves from half degree to eight degrees, with scale of 400 feet to the inch							1 50	05
631.—Horn Protractor, 5 inches diameter, whole circle, half degrees							1 00	05
636.—	do	6	do	half circle,	do		30	03
638.—	do	8	do	do	do		55	05
640.—Brass Protractor,	4	do		do	do		25	03
641.—	do	5	do	do	do		50	05
644.—German Silver Protractor, 5 inches diameter, half circle, half degrees							85	05
645.—	do	do	6	do	do	do	1 00	07

DUFFIELD'S PATENT PROTRACTORS.

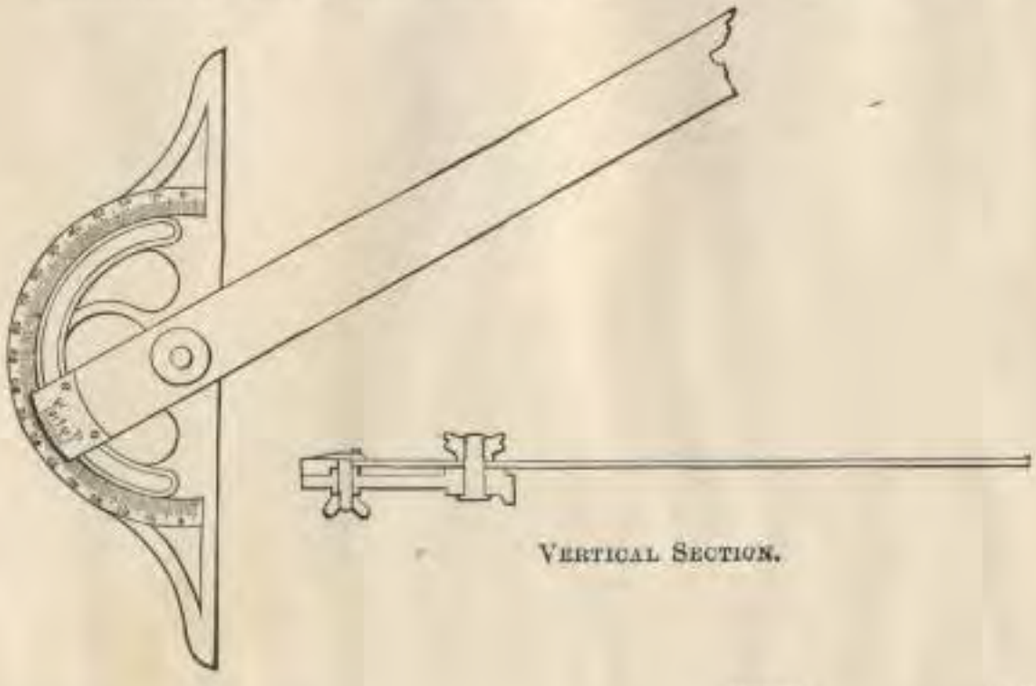
Made of transparent celluloid, and with two parallel scales of twenty parts to the inch to enable the zero line to be set parallel to meridian lines drawn on the paper.

No. 626.

626.—Protractor, 6 inches diameter, half circle, half degrees							$3 00	$0 05
627.—	do	9	do	do	do		3 50	10
628.—	do	12	do	do	quarter degrees		4 00	15

NEW LIMB PROTRACTORS,

BRONZE HEAD, STEEL BLADE, VERNIER TO ONE MINUTE.



Vertical Section.

No.						Price.		Price.	Post.
665.—Protractor, blade 24 inches long						Plain, $8 00	Nickel-plated, $8 75	$0 60	
666.—	do	do	30	do		do 8 75	do 9 65	70	
667.—	do	do	36	do		do 9 50	do 10 50	80	
668.—	do	do	42	do		do 10 25	do 11 35	90	

PLOTTING SCALES.

No.		Price.	Post.
675.	Ivory Rectangular Protractor, 6 inches long, 1¾ inches wide, with scales as follows: front side divided around edges from 0 to 180 degrees in single degrees, scales of ¼, ½, ¾ and 1 inch to the foot, and scale of chords. Reverse side scales of 30, 35, 40, 45, 50 and 60 parts to the inch, scale of chords and diagonal scale of inches and 1-100ths	$1 25	$0 05
677.	Ivory Rectangular Protractor, 6 inches long by 2 inches wide, with scales as follows: front side, the edge divided in single degrees from 0 to 180 degrees, scales of ⅛, ¼, ⅜, ½, ⅝, ¾, ⅞, 1, 1⅛, 1¼ inches to the foot, scale of chords, and line of 40 parts lower edge. On the reverse side, scales of 20, 25, 30, 35, 40, 45, 50, 55, 60 parts to the inch, diagonal scale of 1-100ths	3 25	06
678.	Ivory Rectangular Protractor, same as No. 677, but has the Protractor divided in ½ degrees	4 00	06
700.	Boxwood Protractor, 6 inches long, 1¾ inches wide, whole degrees, with scales of ¼, ½, ¾, 1 inch, scale of chords, and diagonal scale	40	03
703.	Flat Boxwood Scale, 12 inches divided ⅛, ¼, ½, 1 or ⅜, ¾, 1½, 3 in. to the foot, each	75	05
706.	Boxwood Chain Scales, 12 inches long, graduated on two edges with either 10 and 50, or 20 and 40, or 30 and 60 parts to the inch	75	05
712.	Boxwood Scale, 12 inches long, with scales as follows: 1-16, ⅛, 3-16, ¼, ⅜, ½, ⅝, ¾, ⅞, 1, 1¼, 1½, 1¾, 2, 2½ and 3 inches to the foot, the first division of each scale subdivided into 12 parts, each	1 00	05
713.	Same as No. 712, but with the first division of each scale subdivided into 10 parts, each	1 00	05
719.	Flat Metallic Chain Scale, 12 inches long, graduated on two beveled edges, 10 and 20 or 20 and 40 parts to the inch, each	3 00	10
719H.	— do 30 centimetres long, divided to millimetres	3 00	10
722.	Triangular Scale of Boxwood, 12 inches long, graduated 10, 20, 30, 40, 50 and 60 to the inch	1 50	05
728.	Triangular Scale of Boxwood, 12 inches long, graduated 3-32, 3-16, ⅛, ¼, ⅜, ½, ¾, 1, 1½ and 3 inches to the foot, and 16ths of inches	1 50	05
730.	Metallic Triangular Scale, 12 inches, graduated same No. 722	3 00	08
732.	— do do do do do No. 728	3 00	08
749.	Triangular Boxwood Scale, metric measure, 30 centimetres long	2 00	05

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1087.	Two Feet, four Fold, boxwood, brass bound, with draughting scales	60	05
1088.	Two Feet, four Fold, boxwood, inside edges beveled, with draughting scales	65	03
1091.	One Foot, four Fold, ivory, German-Silver mounted, graduated in 8ths, 10ths, 12ths, 16ths of inches, and 100ths of a foot on edges	1 50	03
1092.	One Foot, four Fold, ivory, graduated in 8ths, 10ths, 12ths, 16ths of inches, and 100ths of a foot, with German-silver edges, bound	1 75	04
1093A.	One Foot, four Fold, ivory, Caliper, graduated in 8ths, 10ths, 12ths, and 16ths inches	2 00	04
1093B.	One Foot, Four fold, ivory, Caliper, graduated in 8ths, 10ths, 12ths, and 16ths of inches, with German-silver edges, bound	2 50	05
1094.	Two Feet, four Fold, ivory, German-silver mounted, with 8ths, 10ths, and 16ths inches, and ⅛, ¼, ¾ and 1 inch draughting scales	3 25	08
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	The Slide Rule Manual, by Wm. Cox	50	

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404.—Hair-spring Dividers, German Silver, 5½-inch	do	do	2 50	03
406.—Plain Dividers, German Silver, 5-inch	do	do	1 75	03
408.—Drawing Compass, German Silver, 4-inch, with pen, pencil and needle-point	do	do	5 00	04
436.—Small Steel Bow Pen, with needle-point	do	do	2 50	02
443.—Drawing Pen, with joint, 5¼ inches long	do	do	1 40	02
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544.—Hair-spring Dividers, German Silver, steel joints, turned cheeks, 5-in.	do		1 50	03
547.—Dividers, German Silver, needle-point, with pen and pencil-point, 4-in.	do		2 50	04
548.— do do do pen, lengthening bar, do 6-in.	do		3 00	08
557.—Bow Spacer, all steel, ivory or metal handle	do		1 10	02
558.—Bow Pen, all steel, ivory or metal handle	do		1 40	02
559.—Bow Pencil, all steel, ivory or metal handle	do		1 40	02
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804.— do do 36 do do 3.00 do			3 75	30
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838.— do do do 36-inch			50	20
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917.— do do do do do 9-inch			40	08
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