BUFF

BUFF & BUFF

INSTRUMENT MFG. CO.

BOSTON
MASSACHUSETTS
U. S. A.

THE
BUFF & BUFF
MANUFACTURING CO.,
INCORPORATED

GEO. L. BUFF . . . . Manager
L. F. BUFF . . . . Treasurer
C. W. BUFF . . Assistant Manager

High Grade Engineering, Surveying, Astronomical and Mining Instruments

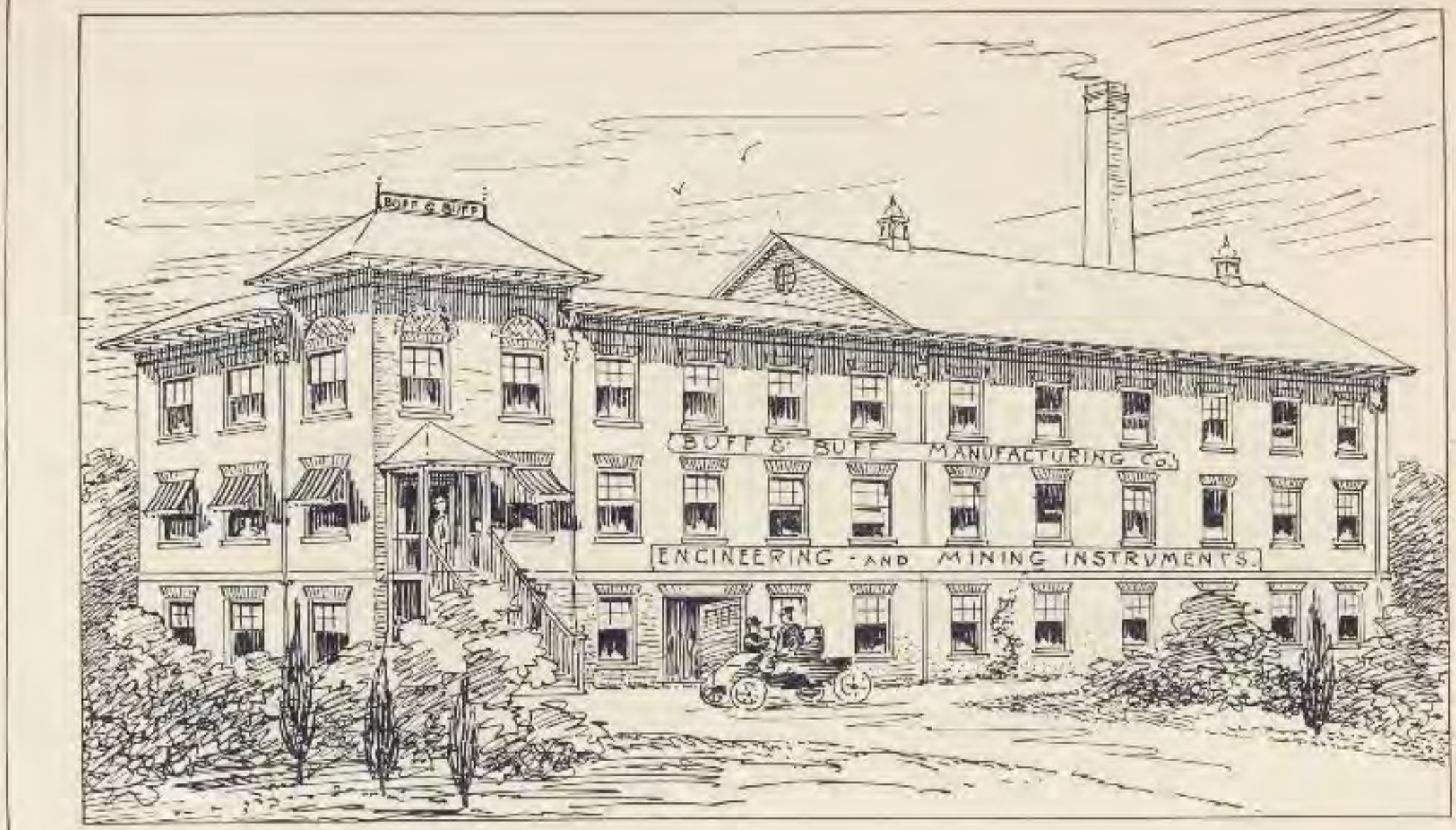
SHOPS AT
JAMAICA PLAIN STATION
BOSTON, MASSACHUSETTS
U.S.A.—1905

City Salesroom
9 PROVINCE COURT
(Near City Hall)

Main Office and Salesroom
JAMAICA PLAIN STATION
Boston, Mass.

G. L Buff

Our present Manager and formerly senior member of
Buff and Berger from 1871 to 1898.



THE MOST PRECISE INSTRUMENT SHOPS IN THE WORLD.

View Looking West, Jamaica Plain Shop.

Like the instrument, the home of the "Buff" is typical of solidity, rigidity and adaptability. Its location, well to the south of Boston, is one of absolute freedom from electrical disturbances.

Where Buff Instruments Originate.

OUR senior manager, Mr. Geo. L. Buff, who supervises the construction and adjustment of each and every instrument which leaves our shops, began the manufacture and incidentally continued the study of Levels and Theodolites with the firm of T. Cook & Son, York, England, in 1858.

Perceiving with his usual prophetic genius that supremacy in instrument making was to cross the Atlantic, he, in 1864, left England and came to America to enter the employ of Stackpole Sons of New York City. At that time they were the best known and most successful instrument makers in America.

Having seen the best in Europe and this country, he, in 1870, went into business for himself. In 1871 he moved his shop to Boston, and established a partnership in order to better incorporate some of his own improved ideas in a transit. Again, in 1898, finding himself still hampered, he dissolved that firm and established the present concern of which today he is manager.

Thus from the best in Europe and America Mr. Buff has selected the best, has added many improvements of his own, all of which have culminated in the supreme result — *"The Buff Precise Transit."*

In the manufacture of the Buff Transit quality alone is considered. We claim for our product the greatest accuracy obtainable, owing to the improved precision machinery which we use, improved methods of construction, and to the accuracy of our new, unrivalled dividing engines. All these are under the exacting and personal supervision of our senior member.

"QUALITY IN ENGINEERING INSTRUMENTS"

OUR MOTTO.

To the Engineering Profession.

AFTER an experience extending over many years in the manufacture of thousands of engineering and astronomical instruments, it seems unnecessary in presenting this catalogue to enlarge upon the success attained. The number produced and the increasing demand speaks for their international popularity and intrinsic worth. We give, therefore, outlines only of the types of construction, the particular features, and brief descriptions of the different styles regularly made.

The illustrations are by half-tones direct from photographs.

We call attention to the abridged nature of this catalogue, since we believe the universal tendency to pad technical literature by voluminous recording of unimportant facts is a real and serious defect, and one which every writer should strive to overcome.

For remarks on adjustments of our instruments, which we trust may be of service to the engineer, see pages 73 and 74.

For convenience in communicating, see cable code, page 111.

For information on repairs, see page 110.

Testimonials.

ORDINARY printed testimonials are of little value. They are easily obtained and are often antiquated or suitably colored. We have scores of letters which would serve as true testimonials, if we were to ask permission to print them. To any one desiring to ascertain the merits of our instruments, we shall be pleased to send the names and addresses of those in his vicinity who have our make, and who will give opinions which will be valuable, because based on experience and unbiased by solicitation.

The "Buff Transit."

THE BUFF TRANSIT is not the product of today nor of a few years, but the crowning results of over forty years' experience in dealing with a very critical clientele. The instrument shows it.

Buff Transits meet with minimum atmospheric resistance for the construction is such as to cut the air — not to obstruct it and collect dust as the standards and forms of most instruments do.

As to dust and its entry into the transit, it is our contention that the better the instrument, the more effectively is the dust excluded. Our instruments are as nearly as possible dust proof.

Buff instruments will withstand a greater degree of heat and moisture without impairment of their accuracy than others, owing to their superior material, precise method of assembling, and final finish.

The density of the metals employed, combined with the superior grade of workmanship in the construction, enables Buff instruments to withstand more severe shocks without disturbing the adjustments than others.

Suffice it to say, therefore: "The best instrument procurable is the cheapest in the end."

By its use, annoying and expensive repetition is avoided.

Characteristics of Our Instruments.

Under this heading we will take up first the four vital parts of the engineers' transit —

A. The CENTRES.

B. The GRADUATIONS.

C. The TELESCOPE.

D. The SPIRIT LEVELS.

And then the secondary ones of —

E. The COMPASS NEEDLE.

F. The GRADIENTER ATTACHMENT.

G. The STADIA.

H. The VARIATION PLATE.

I. The TRIPOD.

K. The PLUMB BOB.

L. The FINAL FINISH OF OUR INSTRUMENTS.

One glance is sufficient. Few words are needed. You have only to know the BUFF & BUFF manufacture to become charmed with the advanced design, the severe conceptions — rigid, bold, ample in bearing. They are not copies — they are original, and thoroughly consistent in their originality. *Lightness combined with strength* of each member, and rare mechanical treatment, at once place them on a plane heretofore hardly approximated.

The Centres.

Next to accuracy of graduations it is important that the centres be true frustrums of accurately circular cones and fitted to retain that theoretical accuracy. They should be constructed of the most suitable metals.

Aluminum bronze containing 90% copper, is extensively applied in our instruments on account of its great tensile strength.

That our centres are accurately conical frustrums, we are convinced by repeated and exhaustive tests, and moreover we are satisfied that they are so in every instrument, because of the methods we employ in turning them — upon what we are pleased to call "dead centre lathes" — being precision lathes without spindles, and merely having a dead head-stock, with immovable centre, and tail-stock centre, between which the work is rotated.

That they are fitted to retain that accuracy, — we take especial pride in stating, — because

1. The long tapers, possible in our instruments, terminating in the broad flanges, are both theoretically and practically the best.

2. These long tapers — theoretically correct — are in practice most carefully and perfectly fitted by the expenditure of much expert labor. Upon the nicety of this fit depends the accuracy and longevity of the entire instrument.

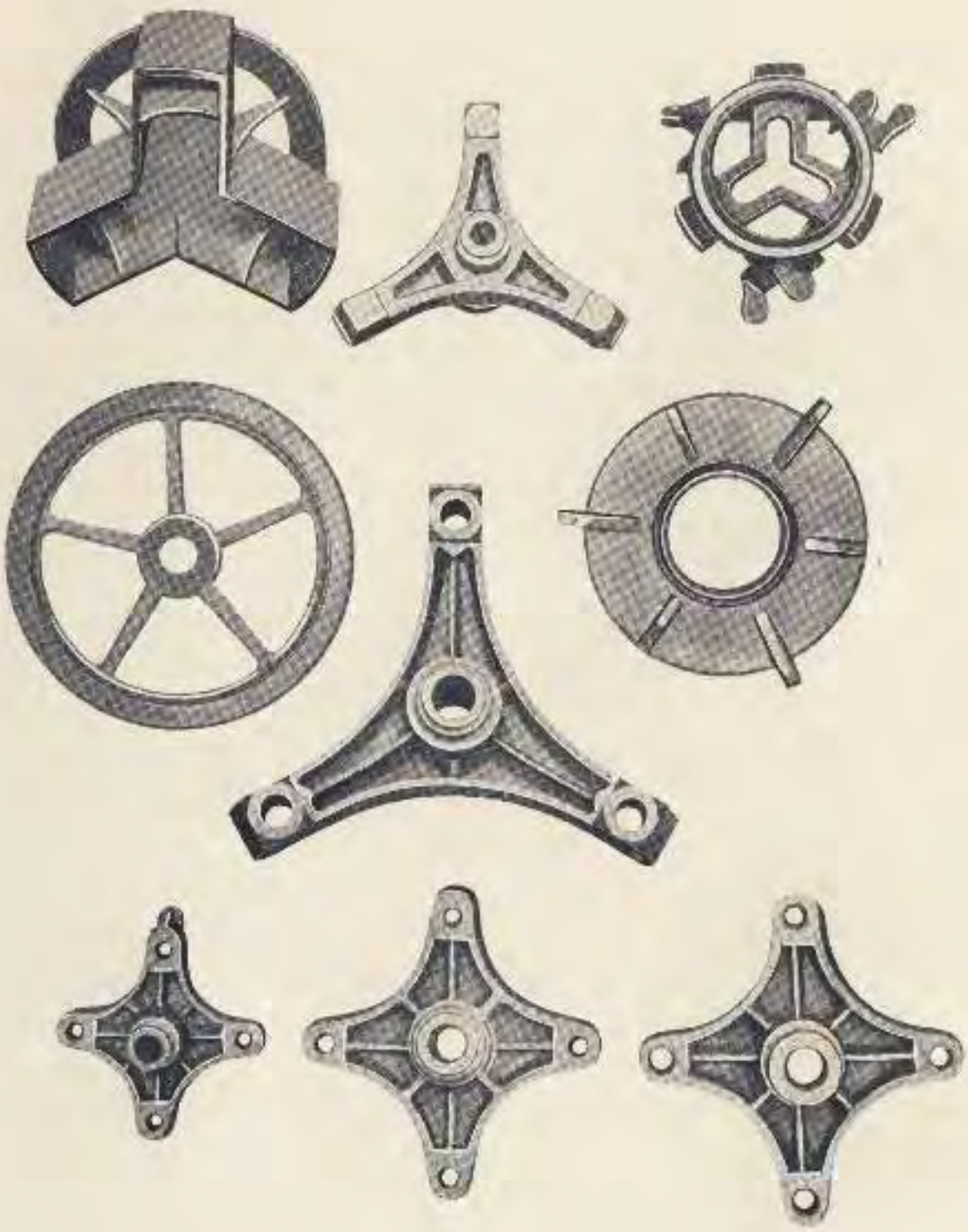
That the different metals employed in their construction are the best for the purpose, — the experience of 50 years dictates. The three widely different compositions of phosphor-bronze, gun-metal, and hard red composition, are the metals chosen for the engineer's transit, since each has for the next respectively, the least co-efficient of friction, and the minimum difference of the co-efficients of expansion and contraction.

For the Wye level centres, — where the presence of iron is not prohibitory, — an option has been recently offered, at a slight additional expense, of a hardened steel centre in a socket of superior annealed charcoal iron.

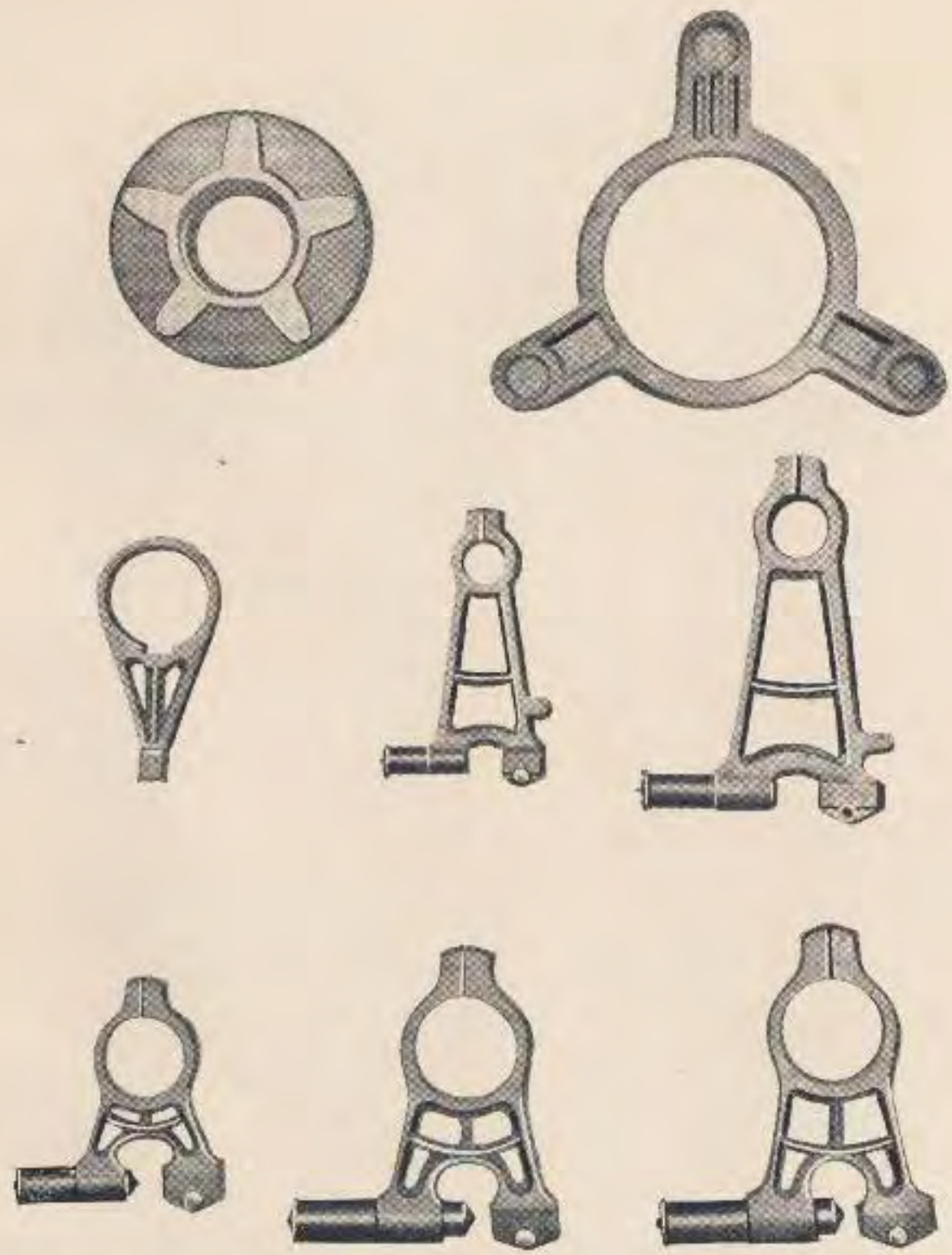
It is unnecessary to say that these metals are the best possible for any centre, — when their presence is not objectionable, — since this combinaton is universally adopted for all large astronomical instruments, and provides: —

1. The minumum co-eff. of expansion of any two metals.
2. The minimum difference of the co-eff. of expansion of each.
3. The minimum co-eff. of friction.

"The workmanship shows great fidelty to detail, while the fits are a revelation in the ethics of finest scientific construction."



In all of our instruments the inside finish is even better than the outside, and the whole is handled in the careful, precise workmanlike manner that alone gives accuracy and permanency to the completed transit. Certainly the ordinary has been forgotten.



Showing some external forms embodying great strength as well as grace of design.

BUFF & BUFF MFG Co
BOSTON

Graduations.

For view of Graduating Engine — See page 86.

FEATURES WHEREIN our graduations excel, are —

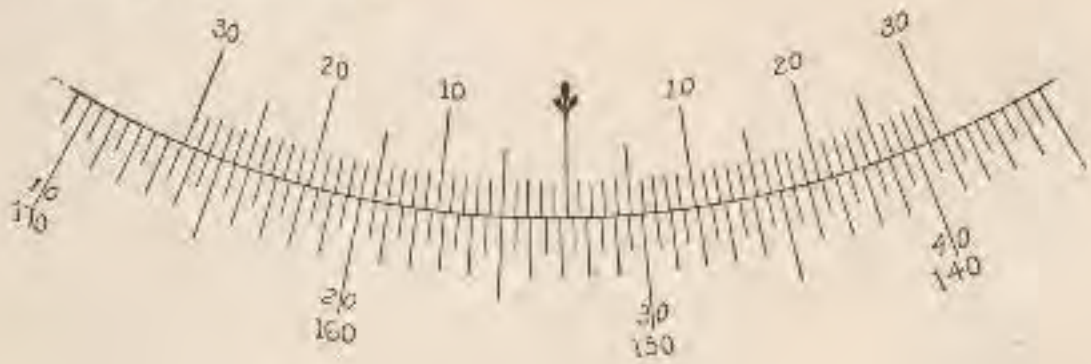
1. The absolute and equi-distant spacing of the division line.
2. The uniform thickness of line at all parts of the circle.
3. The fitting together of the verniers and graduations.

The CORRECTNESS of the SPACING — as performed upon our dividing-engines built by our senior member — we are able to guarantee within $1\frac{1}{2}''$ of arc. This represents an error of less than $\frac{1}{34000}$ part of an inch. Errors smaller than this would be manifestly impossible for human ingenuity to eliminate. since other factors must be taken into consideration, and these are respectively: —

Owing to the precaution exercised — these errors are *virtually* negative.

1. Errors due to temperature changes, though this change be inside of 1° F.
2. Errors due to the personal equation in setting up, levelling and centreing the circle of the transit upon the dividing-engine.

(Compared in sum total with the personal error of manipulation in the field, as usually accounted for in the closest triangulating, these combined errors are infinitesimal *in our graduations.*)



Usual form of Verniers for minutes and 30 sec. graduation.

The UNIFORMITY of the GRADUATION LINE,—as placed upon our circles and verniers,— we deem the special features of our graduations next to spacing. We claim this because: —

1. The delicately poised mechanism, supporting the finely ground cutter, is of such rigid construction.

2. The long experience dictating the proper combination of cutting angles ensures that the cutter is ground to the angles, which will cut the last line equally as wide as the first.

The FINAL FITTING TOGETHER of the GRADUATION and VERNIERS, as performed by ourselves, is guaranteed.

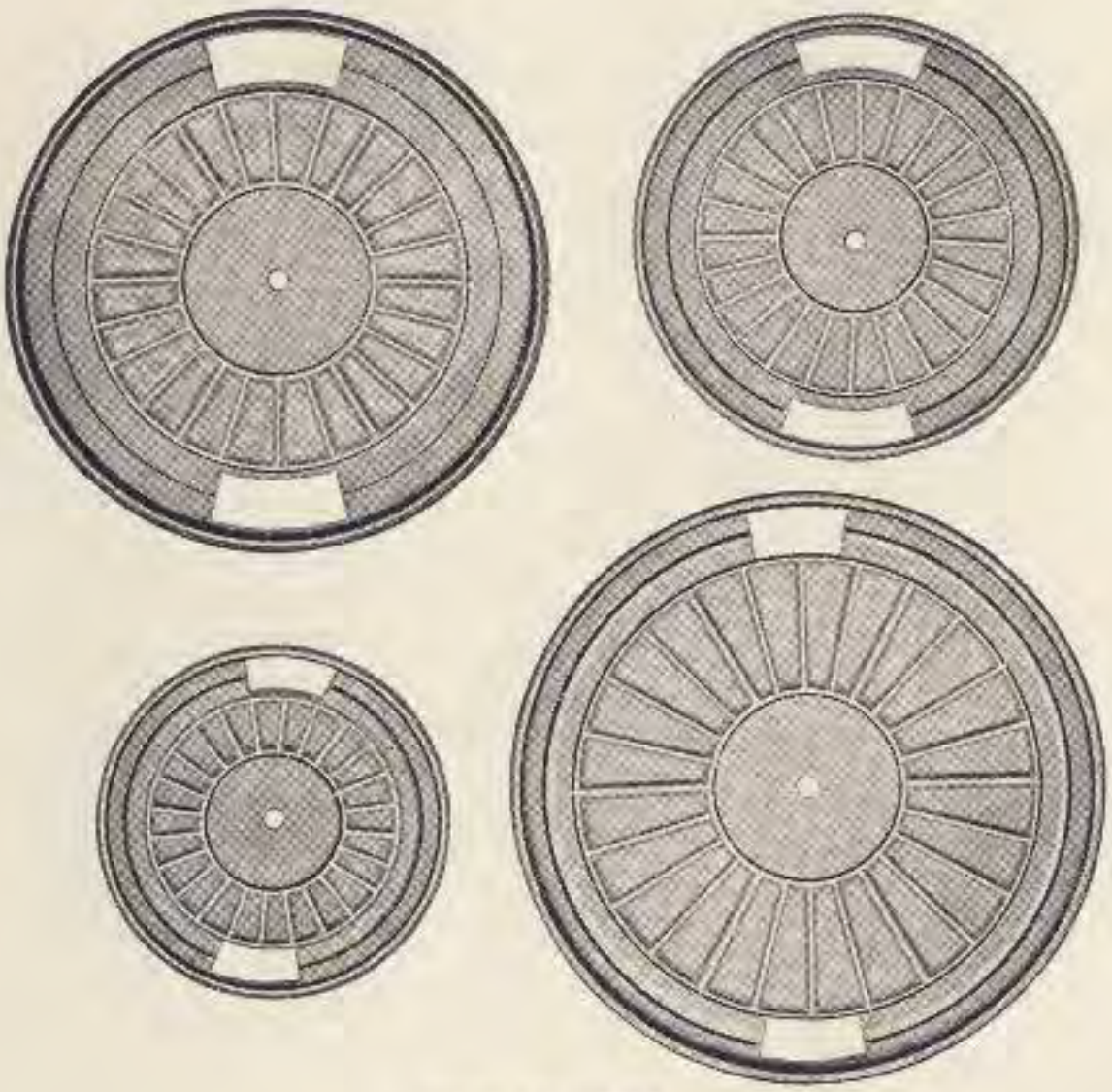
We also graduate in the French Centesimal system.

All graduations are silvered with a dull, frosted finish of peculiar and agreeable whiteness, facilitating rapid reading in the field. If solid silver graduations are specified the same dull finish is given the silver. This is a feature found only in our transits.

REGULAR SIZES OF THE "BUFF" TRANSIT.

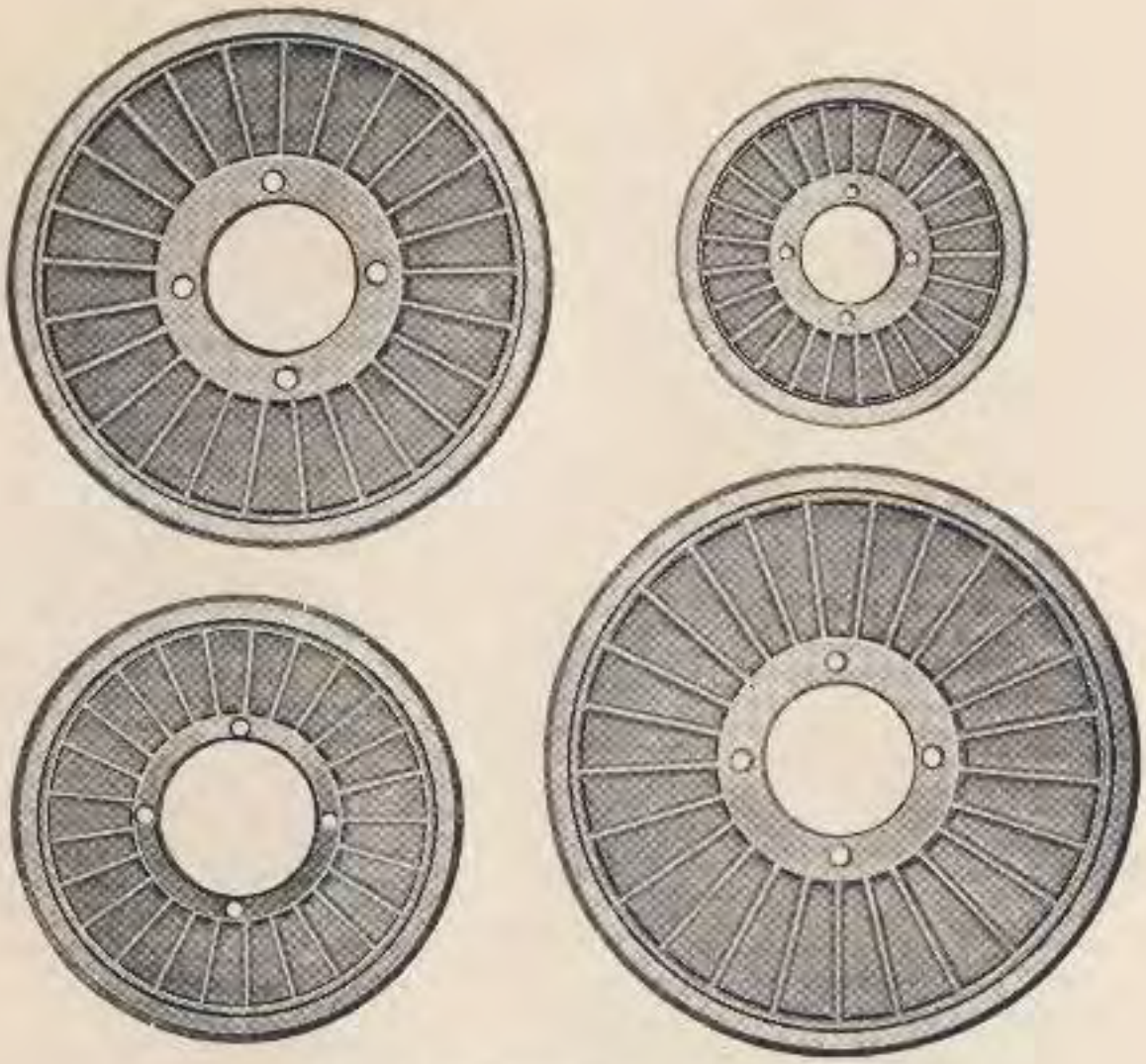
	Weight.	Dia. of Graduation.	Length Needle.	Power Erecting Telescope.	Power Inverting Telescope.
No. 1	14 lbs.	6¼ in.	4⅛ in.	26.5	29.
No. 1½	12½ lbs.	6¼ in.	4½ in.	22.5	25.
No. 2	10 lbs.	5⅛ in.	3⅞ in.	22.5	25.
No. 3	7 lbs.	4⅛ in.	3¼ in.	18.	21.
No. 4	5 lbs.	4 in.	2⅜ in.	17.	20.

Sizes and diameters of the different transits are measured at the edge of graduation.



THE PLATES.

To which are attached the verniers which read off the circular graduations.



THE HORIZONTAL CIRCLES.

Showing uniformity of ribbing.

RAPID TRANSIT TUNNEL EXCAVATION, NEW YORK CITY.

By Permission Leslie's Weekly, May, 1900

Telescope.

The telescope of an engineer's transit is an important part of the foundation on which success or failure to a great extent depends. Any transit, however perfect its other vital parts may be, or however carefully it is constructed, or however finely it is finished, if defective so far as its telescope is concerned, will be a source of annoyance to the engineer who is compelled to decipher its work.

In adapting our form of telescope to the re-calculated system of lenses and diaphragms of the different styles of instrument, we have been governed by the other factors that go to make that particular instrument, such as the fineness of graduations and sensitiveness of spirit level, thus obtaining that harmonious whole in which every element is consistent with the other.

To accomplish this, we have greatly improved the entire lens system by instituting somewhat longer focus objectives, giving:

1. Much more satisfactory working combination.
2. Vastly improved illumination.
3. Slightly greater power.
4. Flatter and sharper defined field.

Additional points secured in our telescopes:

5. Reversibility at both ends.
6. Perfect balance in all positions.

The power we chose for each of the several transit telescopes is that one by which the slightest motion of either vernier or bubbles is easily noticeable by movement of the cross wires in the field of view. A higher power is useless, and can only result in decreased illumination. A lower power, on the other hand, does not develop the maximum capacities of the other dependent features of a first-class instrument.

In our terrestrial (erecting) telescope, for the regular No. 1 size transit, we obtain a power of 26.5 diameters with 1¼-inch aperture objective.

In the 18-inch Engineer's Wye Level, with the larger objective of 1⅜-inch and the greatly increased available focal depth, a power of 36 diameters is obtained.

The eye-piece for all terrestrial mountings is constructed of that combination of four lenses giving an unsurpassed large field which has all possible illumination,

since full size diaphragms are used (no attempt being made, as is common with other makers, to cut the diaphragm down at the expense of light) to gain definition. This, of course, necessitates the very finest workmanship on the eye-piece lenses.

For the astronomical telescope we have adopted an admirable eyepiece which is a modification of the Kellner. It is modified insomuch as a somewhat longer working focus is obtained which in field practice prevents the engineer from any chance breaking of the cross-wires when setting in focus.

To obtain this it is necessary to make the field lens a double one, making three lenses altogether in the eye-piece.

For large flat field with the full aperture admitting the full quota of light, this modified Kellner is unsurpassed.

In conclusion, the factors aiding us greatly in the matter of good glasses in our telescope are:

1. That every eye-piece and objective, before being accepted by us, is tested on a special apparatus and compared with known and standard glasses of excellent and tried qualities, and to this standard each must conform.

2. That both eye-pieces and objectives are made by one and the same celebrated Continental makers, who know no peer for quality or price.

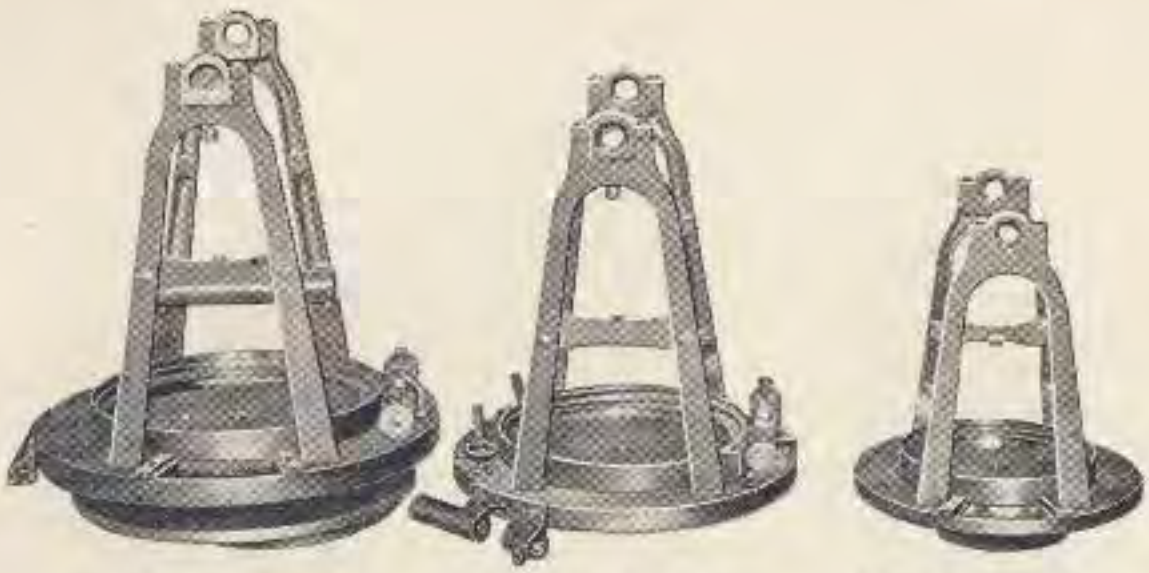
It is hardly necessary to state that nothing but the purest Jena glass of a suitable refractive index is used in our lenses.

All of our telescopes are provided with a centre point on top of axle to permit centreing of instrument from above.

SPECIAL.

A true and valuable improvement on our telescope (one that is typical of our endeavor to simplify and not merely adopt subterfuges), is the precise fit of our focussing slide into the main telescope tube. By development from the start, and by the use of improved machines in boring out and fitting, we obtain the great precision in permanent collimation so desirable. To ensure a correct line of collimation for all distances, many devices have been made that work fairly well for a year or so but fail when gummed by oil or clogged by dust or by uneven wear, owing to the original defects. The true and accurate fit of the inner slide into the outer tube throughout its length can alone satisfy the requirements of mechanical perfection in *perfect and permanent alignment*. The use of aluminum in top and solar telescopes, we cannot favor, since the very few ounces saved in weight do not offset the inaccuracies and lack of permanency of such construction.

The non-friction construction of our tubes excels, and the final step taken by us to ensure minimum wear, embodies a complete change in the choice of material. With this perfect wearing quality guaranteed, together with the perfect fit throughout its entire length, the accuracy of the telescope will not be affected by years of steady use.



No. 1—6¾ inch. No. 2—5⅝ inch. No. 3—4½ inch.
Showing the relative size of the standards which swing the respective telescopes.

Spirit Levels.

BUBBLES.

In thoroughly developing the method of producing the spirit levels for our instrument, it has been our aim to obtain much more uniform and reliable results than were formerly customary.

In consequence we have constructed new machines, which are automatic grinding, and produce truer curves than could be ground by hand on lathe arbors.

Carefully testing and marking each bubble, we separate them into groups of definite sensitiveness, from which, according to the type of instrument, we select the preferred sensitometer number.

Incidentally, the method of grinding is precisely the reverse of hand work, and also eliminates that objectionable heat of the hand from grinding with an arbor on the lathe. This heating plays a very important part in the accuracy of the vials and is accountable for the inaccuracies heretofore experienced.

In addition to the regular grades of sensitiveness we are prepared to furnish guaranteed spirit levels ranging down from ½ second (for the finest levelling instrument) to 120 seconds, and also for astronomical uses.

The Compass.

The compass circle in all our instruments is graduated to half degrees on its upper surface, and is figured from 0 to 90 on each side of North and South.

The graduation and inside face of compass are heavily silvered.

On the south end of the needle, a fine coil of silver wire is wound to equalize the attraction due to dip. As the dip of the negative needle varies, we make the correction on the needle dependent upon the locality to which the instrument is to be shipped. The variation of the dip is taken from the government charts published each year.

The needle and its form, as made by us, play quite an important part in the accuracy which we claim for our compass. Long experience has developed the form (as in pen sketch) with jewel bearing on delicate hardened steel pivot.

Special Swedish magnet steel only is used, treated also by our special process.

The Improved Gradienter Attachment.

As applied by us the gradienter attachment is guaranteed accurate within one-tenth of one per cent. This approximates the average of what can be expected of the stadia.

Thus, with equivalent accuracy, it has the several advantages of running definite grade lines with the minimum work, and of measuring horizontal distance, difference of level and vertical angles.

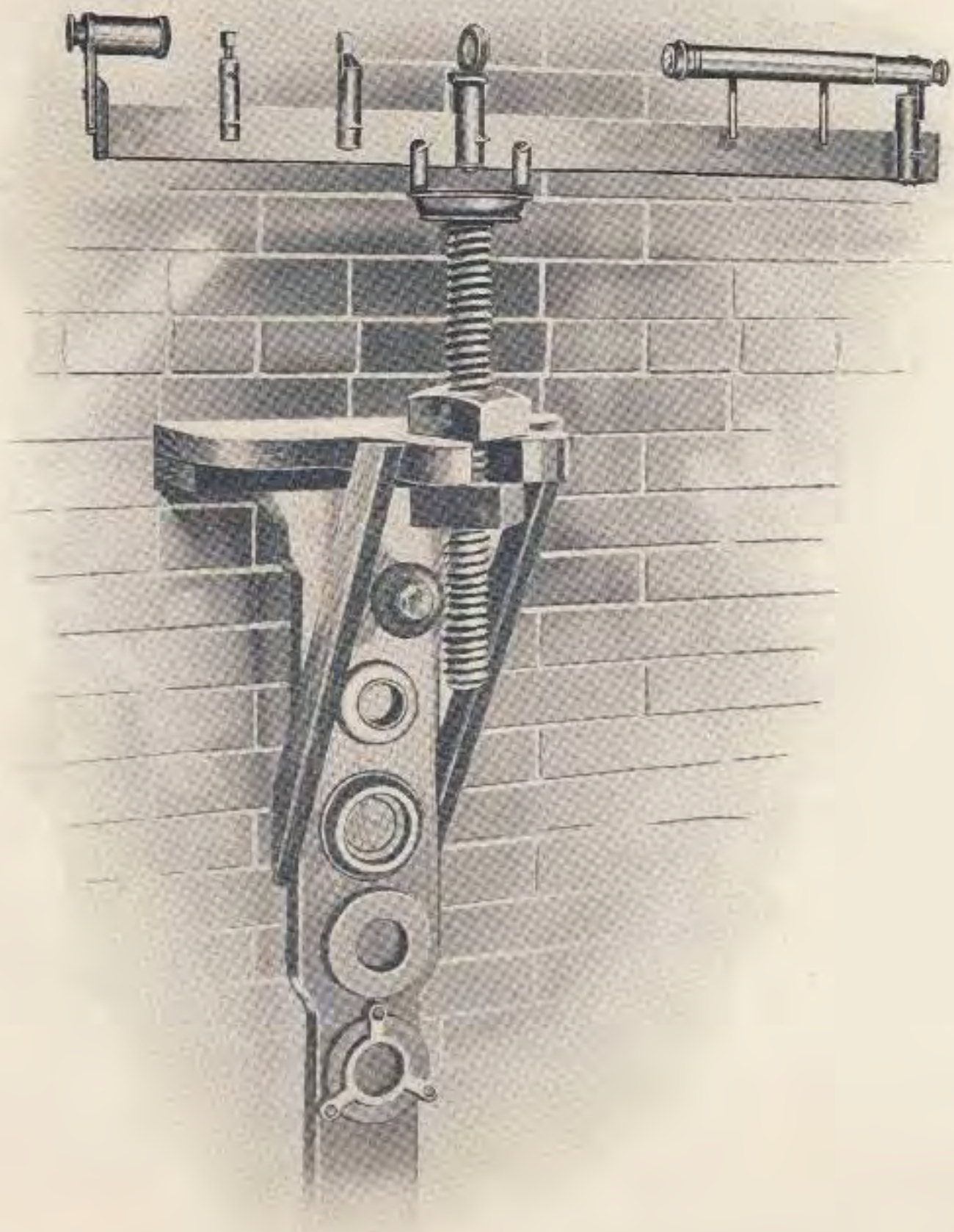
The attachment is certainly quite worthy a place on the complete engineer's transit.

As made by us, the gradienter dial is graduated so that two complete revolutions subtend one foot at one hundred feet. Or, in other words, if moved through two revolutions and sighting on a levelling rod at any distance, the difference of readings, multiplied by one hundred will give the actual distance in feet from the centre of instrument.

The setting of a grade would be even simpler, for in that case the reading of the gradienter screw is taken with level-bubble standing in centre of tube. The necessary revolutions of the screw from zero position would then be twice the grade in feet per hundred.

On the No. 3 and No. 4 sizes of transit, we have also perfected the gradienter attachment, but on these instruments the value of the graduation on the screw dial is for one revolution, one foot in one hundred feet, and for distance work the difference of rod readings, subtended by one revolution of the screw, would be multiplied by one hundred to obtain the distance in feet.

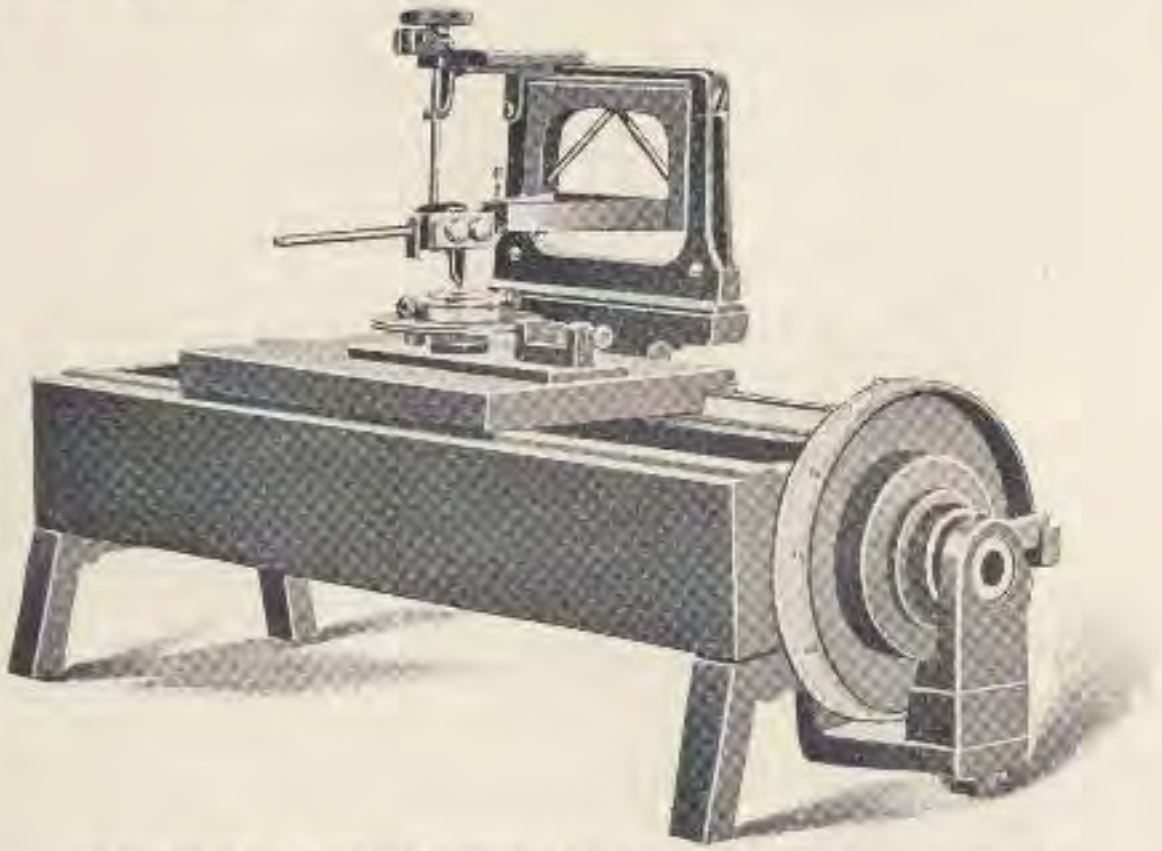
For railroad and general surveying it forms a valuable part of an engineer's equipment and can be employed in many problems.



FOCAL LENGTH APPARATUS — For Measuring Objection.

The Stadia.

In advocating the stadia wires in addition to the gradienter attachment, we claim that one is fully equal to the other in accuracy of construction. The superiority of the stadia lies in the permanency of the stadia wires under all conditions, and this is due to simplicity. With the gradienter, any resultant errors, owing to neglect to guard against backlash of the screw, may be of such frequent occurrence, that the entire attachment will not be valued at its proper worth, simply because not given proper manipulation.



THE BUFF LONGITUDINAL GRADUATING MACHINE.

Reading to $\frac{1}{20000}$ part of an inch. For marking diaphragm for insertion of stadia wires.

In ruling the diaphragm, for the insertion of the fixed stadia, the objective, with which the stadia is used, is very carefully measured for its mean focal length on our special Focal-length Apparatus. Having this value, in hundreths of an inch, the dependent value in fifty-thousandths of an inch is ruled off by the delicate drafting cutter in our diaphragm ruling apparatus.

This ruled diaphragm is then inserted under our special microscopic stand with the variable micrometer feed screw adjustments, and the proper thickness of spider's web is selected, cleansed, stretched and accurately placed in the tiny grooves previously ruled.

We say, proper thickness of spider web because we are governed by the magnifying power of the respective telescope and select the diameter of web that fulfills the proper requirements.

The diameter of an ordinary spider web is .001 inch.

Diameter of web as ordinarily used by other makers, .0002-.0003.

Diameter of minimum web for telescopes of our make, .0001 inch and less for finer astronomical instruments.

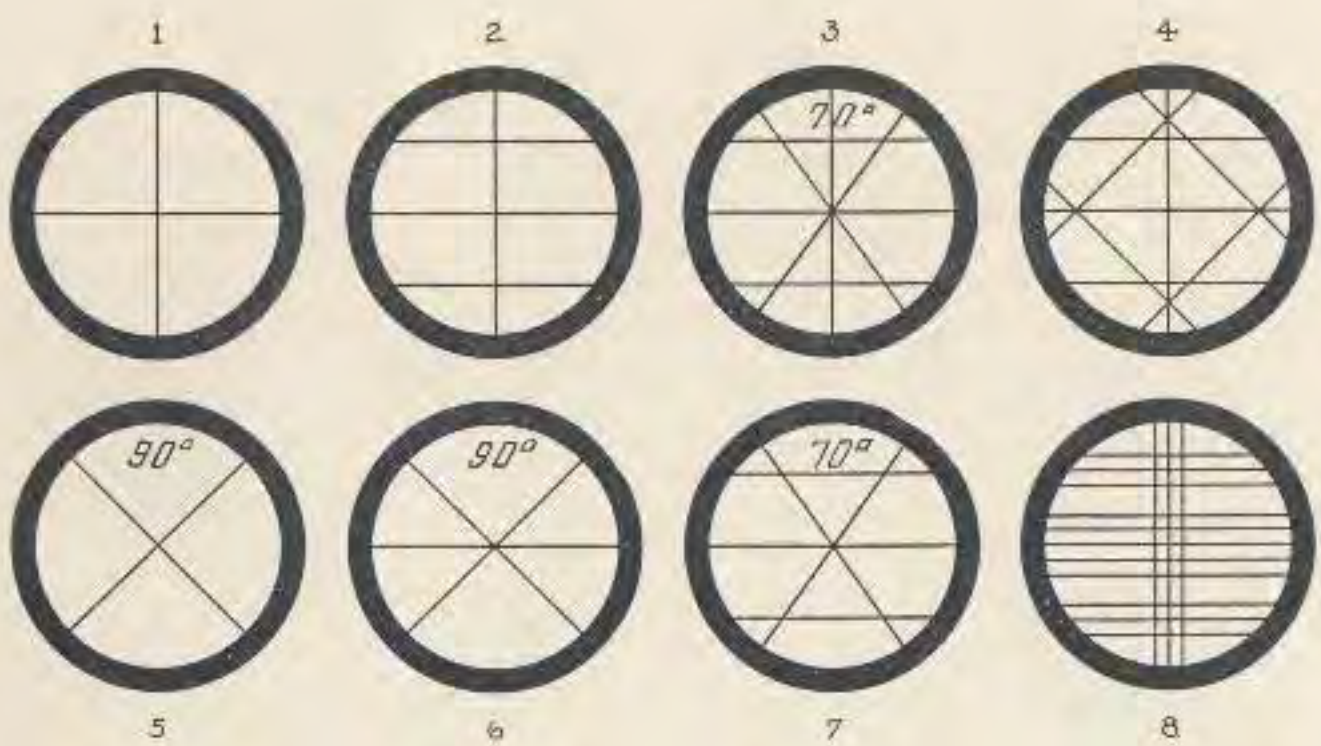
The cost of inserting the stadia in any of our new telescopes is $3.00.

For the adjustable stadia wire the charge is $10.00. This form we do not recommend strongly since it is liable to derangement.

The constant, which is to be added to all stadia measurements can be accurately assumed as 1.5 times the focal length of the object-glass (with our system of lenses). Its individual value is supplied with every instrument.

Diaphragms on next page show best arrangements for all cases of engineering and surveying practice.

Special arrangements can be supplied if specified.



Nos. 1, 5 and 6 are furnished as equipment.

2.	Stadia and cross wires	$3.00
3.	" " mining wires	4.00
4.	" " solar wires	7.00
7.	Triangulation	4.00
8.	Stella observation	6.00

No. 2 EXTENSION TRIPOD.

The Variation Plate.

It is well-known that the magnetic North varies in almost all parts of the world, and also that the deviation is constantly on the increase or decline in a series of years.

To avoid the confusion arising from adding or subtracting the error to each reading we make an additional movable graduated ring, called the variation plate. It will readily be seen that the engineer, having such an arrangement, can pick up old lines on farm surveys, etc., with much ease, provided the variation giving the time meridian is set off by means of the milled head adjusting screw, East or West as the case may warrant.

The cost of this attachment as applied to our instrument is $10.00.

Special U. S. chart for the current year of the magnetic variations, is mailed post free for 50 cents.

Tripod.

Our latest form of split-leg tripod for our regular instruments, as recently designed, we construct entirely of fine-grained white-ash. The advantages of white ash are the straighter and closer grain and the better and more durable finish permissible.

The iron shoe provided on our regular tripods is of improved and superior design as has been found necessary by field work. It embraces a projecting spur for the boot of suitable size to admit of easily pushing the leg to a firm bearing in the earth.

The bell-metal head holding the three legs together at the top, is a single casting which is strengthened by curved and powerful ribs adding grace and increasing the rigidity.

The finish on our tripod is of the most approved type, being three coats of hard shellac, which are each rubbed down and dressed in oil, thus procuring an almost indestructible, permanent finish.

Our levels and transits both fit the same tripod, which in both cases is of equal length.

Plumb-Bob.

Similar to several other insignificant, yet important details when assembled into the whole, is the accuracy of our plumb-bob. This depends upon carefulness in making and the design permitting an unobstructed view of the point.

The care in the making produces a bob that will, when suspended and rotated, swing truly on a theoretical centre.

This is obtained by having centre of gravity low, fitting hole in top accurately to size of plumb string, and finishing carefully.
It excels in the following points:

1. Accuracy due to careful work.
2. Design and proportion permitting a low centre of gravity and an unobstructed view of the point.
3. Thoroughness of construction from hardest bell-metal and a point of hardened and tempered tool steel.

Finish.

The finish of our instruments may be divided into three types of one class, since all finishes are of the best grade.

A. Bright Finish — which is the usual finish and embraces polished surfaces throughout.

B. Bronze Finish — which is the handsome, dark-polished finish most suitable for mining work.

C Cloth Finish — which resembles a covering as of cloth and can be applied to any or all parts of the instruments as desired.

Our bright finish is of the pleasing lacquer color, so unique and characteristic of our instruments. It is not a glaring finish, but is bright enough to throw off all objectional heat rays. It is a most permanent finish.

The bronze finish is upon the same finely polished surface, but burnt a delicate brown with acid, and finely lacquered with white lacquer to preserve the rich tone of the brown. This one is suitable for mining work since it throws no reflections, adding thus materially to the manipulation and speed.

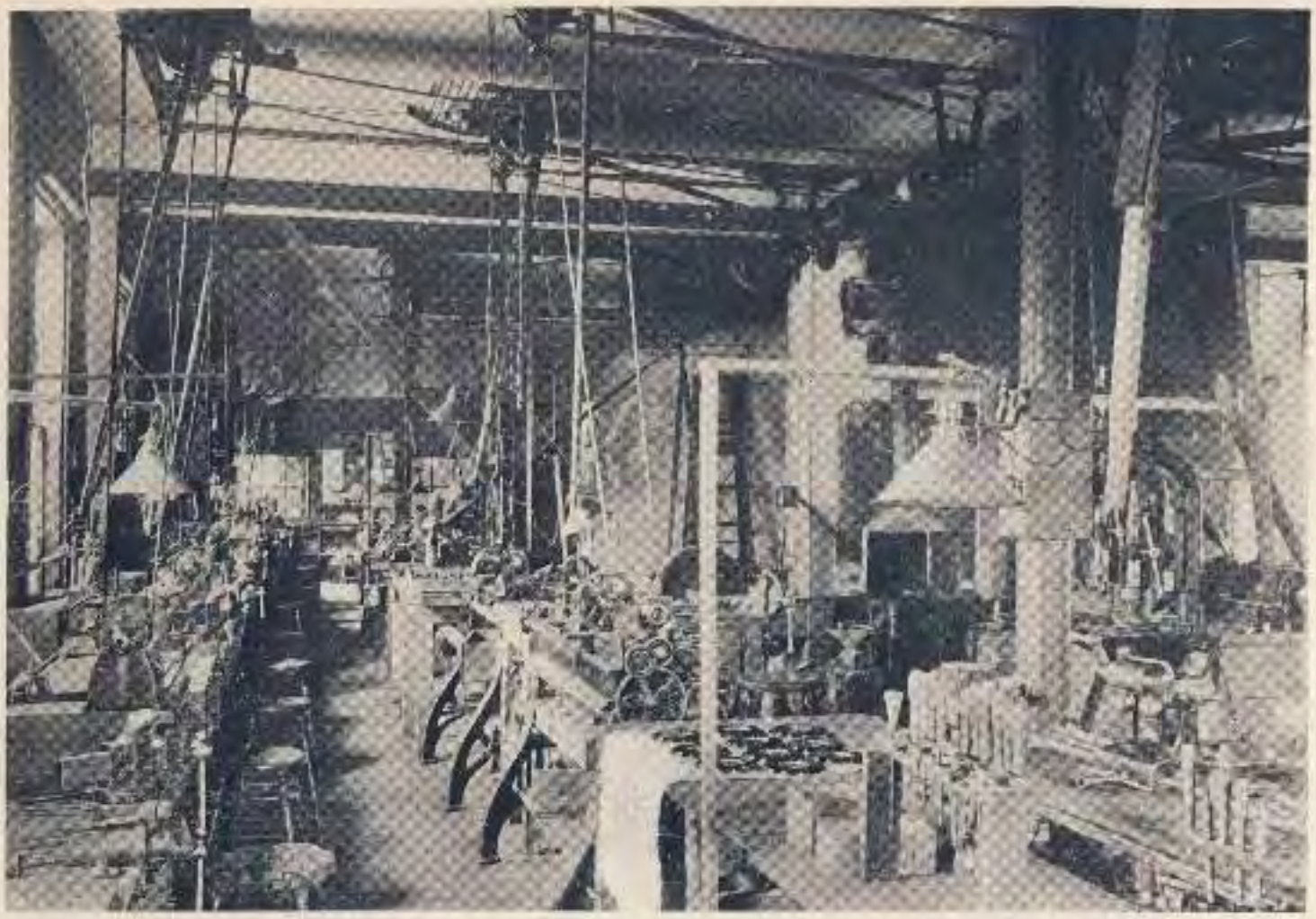
Cloth finish, so called, because to the touch it resembles cloth, is not cloth but merely a finely prepared material of the requisite color, greenish brown, of which three separate coats are applied with japan. Contrary to belief it is a durable finish, for the reason that it is so firmly baked. This style is much desired for astronomical instruments, on account of the equable temperature possible. Since the necessity of finely polishing these surfaces to be cloth-finished is thereby unnecessary, the cost of thus finishing is lower than the two preceding styles. It is quite the equal of the bright finish and superior to the bronze in durability. Its freedom from ill effects of sudden changes in temperature, and also its cheap and ready restoration strongly advance its claims to recognition.

OPTIONAL ARRANGEMENT OF VERNIERS AT 30° TO LINE OF SIGHT.

Showing new arrangement whereby we use full length of plate bubble and also provide ample protection.

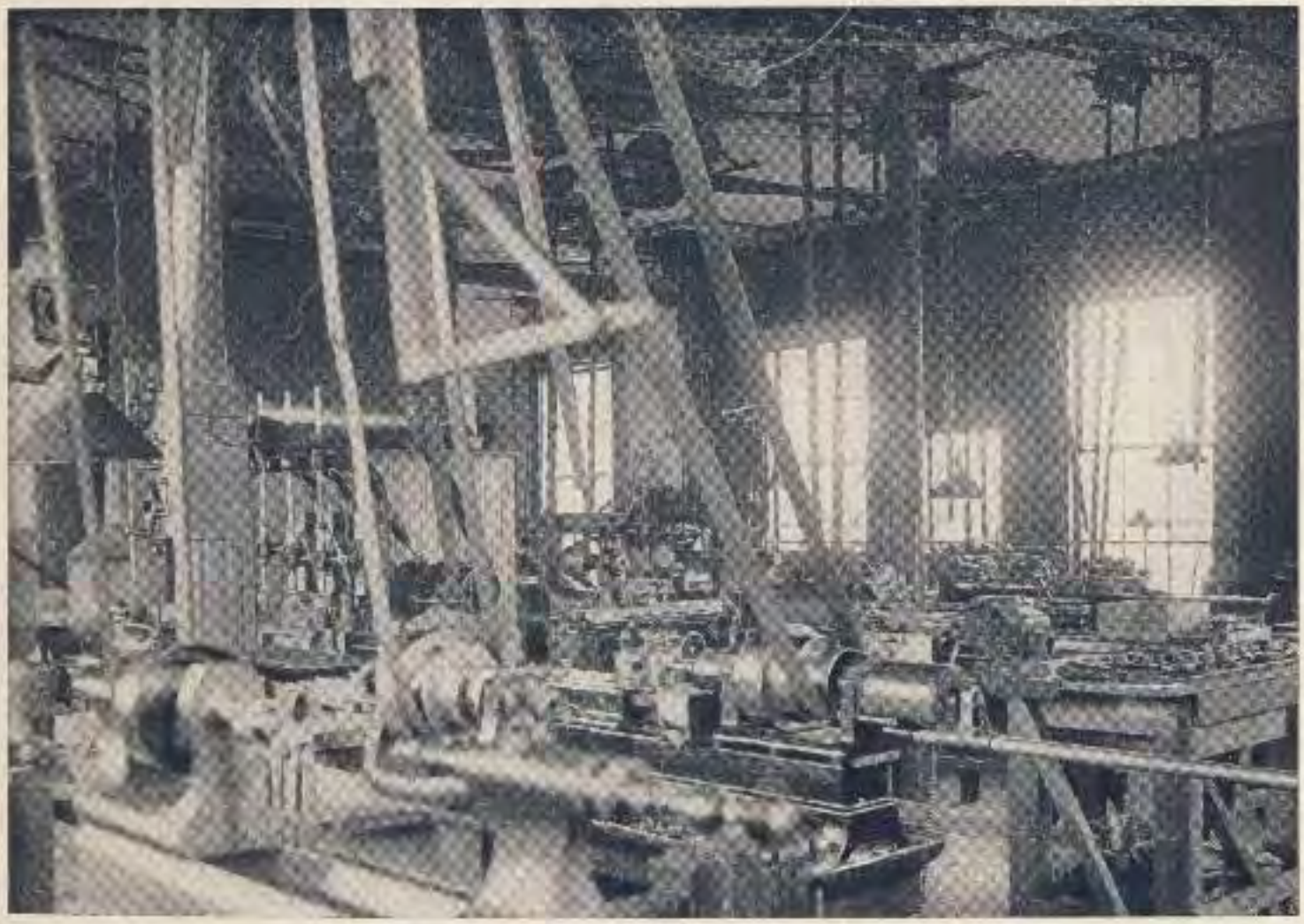
Design Patented Nov. 13, 1900. Patented Feb. 3, 1903

The advantages and disadvantages of the verniers at 30° to line of sight are several, and should be carefully weighed in view of the future requirements of the work to be performed.



CIRCLES, CENTRES AND PARTS DEPARTMENT — Second Floor.

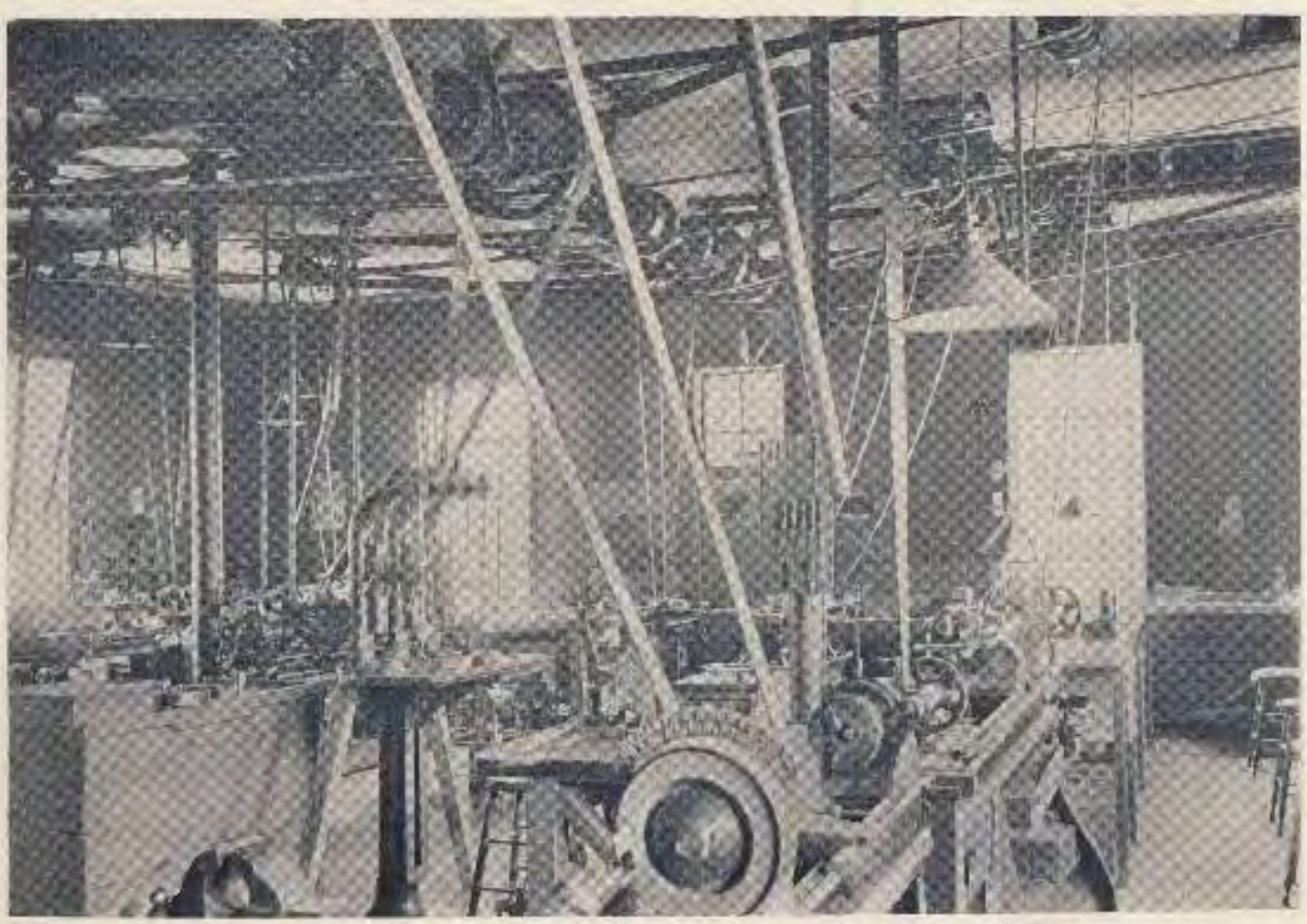
ADVANCED IDEAS IN OUR



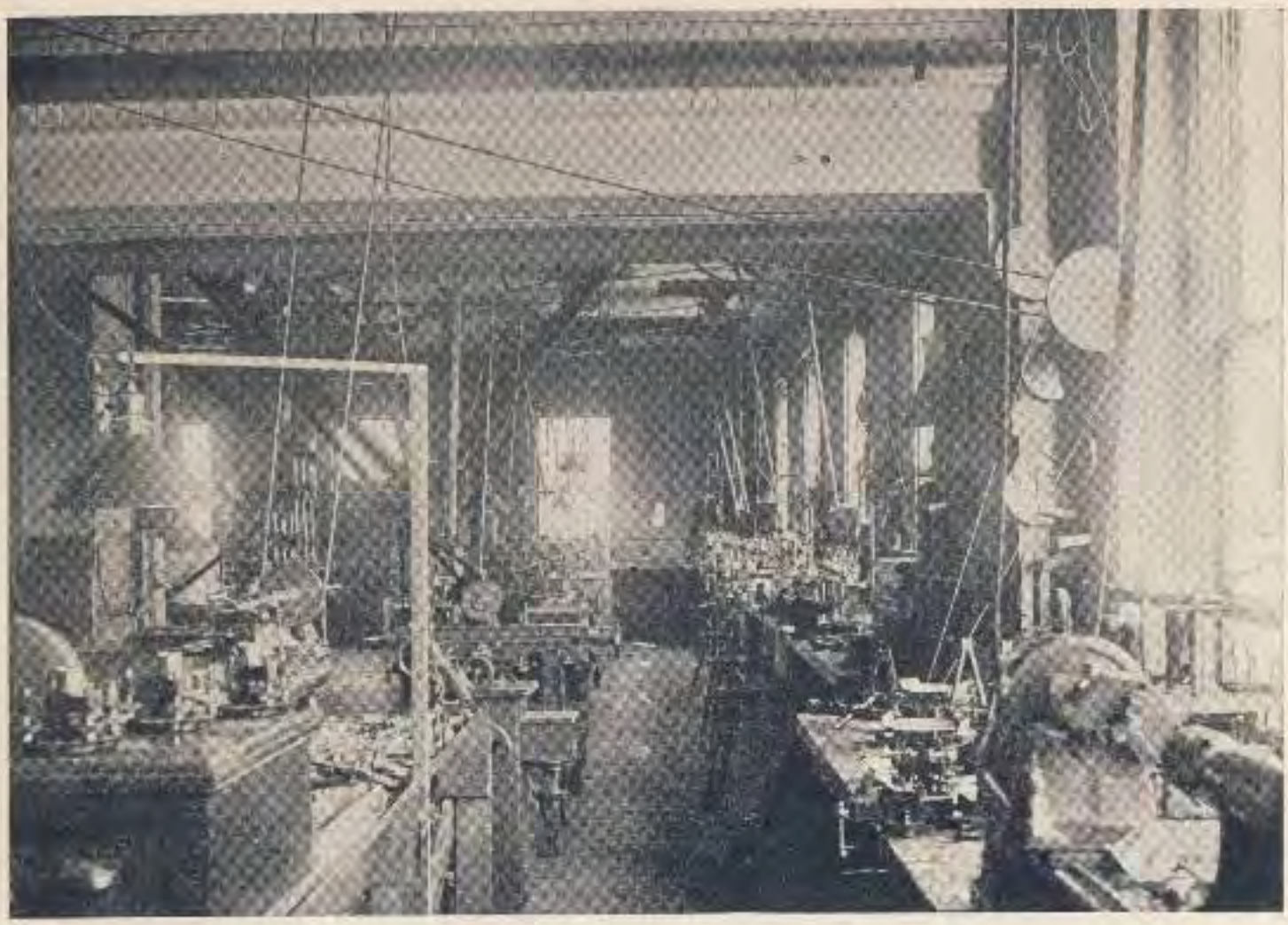
MACHINE AND MILLING DEPARTMENT — North Side, Second Floor.

SOUTH SIDE OF TELESCOPE AND LENS SHOP — Third Floor.

INSTRUMENT SHOPS.



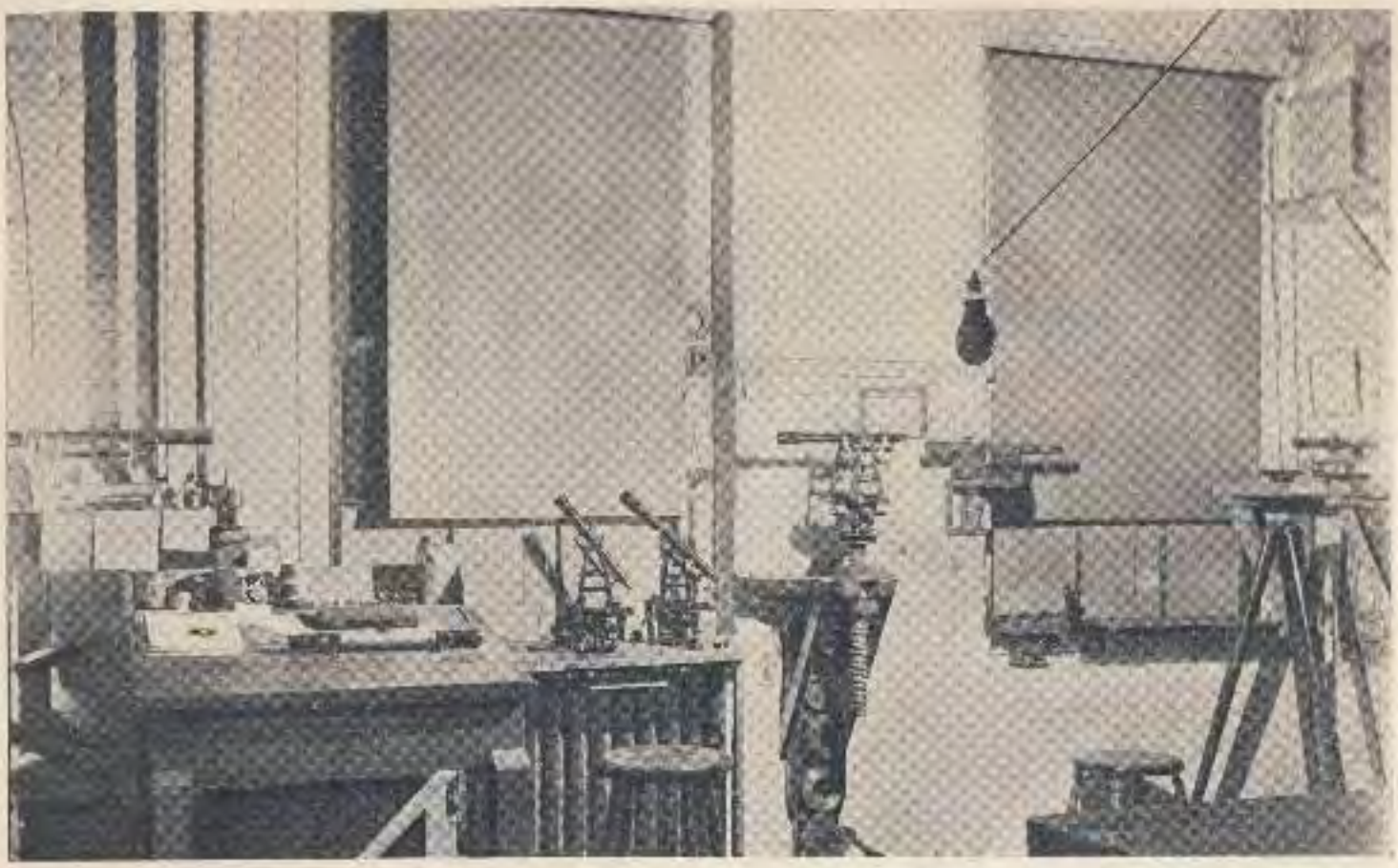
PRECISION GRINDING ROOMS — Third Floor.



ASSEMBLING ROOM — Second Floor.

The "BUFF" TRANSIT is
Buff & Buff Mfg. Co. specialize

NORTH END OF GENERAL OFFICE.



ADJUSTING ROOM.

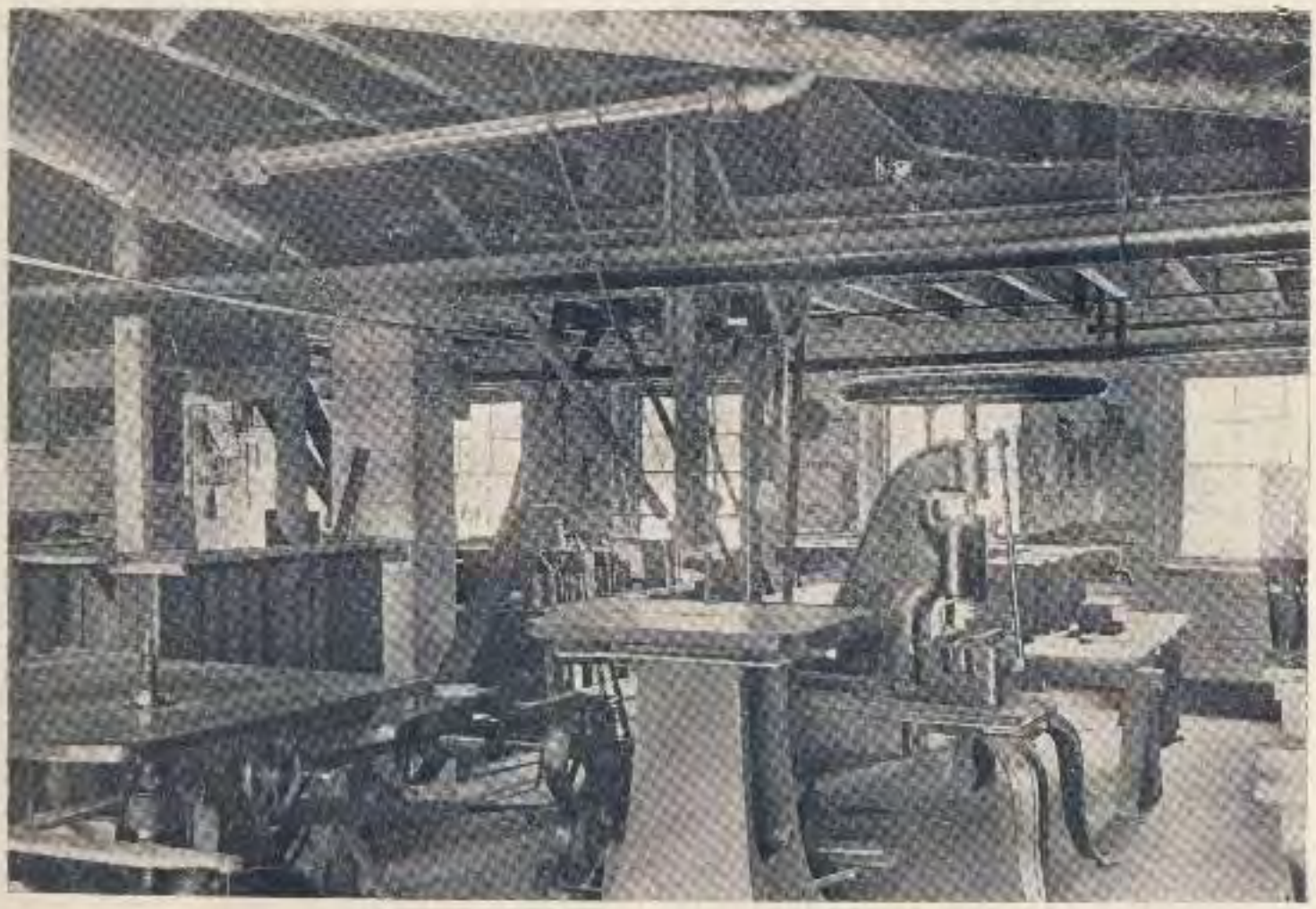
the instrument on which The
at their Jamaica Plain shops.

FINISHED STOCK ROOM No. 3.

CABINET MAKERS SHOP — First Floor.

Other Departments

GRADUATING — EXPERIMENTAL — SHIPPING —



MOULDING AND WOOD WORKING — First Floor.

REPAIR DEPARTMENT.

Not Shown.

POWER PLANT — VARNISH ROOM — STOCK ROOMS.

SECRETARY'S OFFICE.

The "Buff Precise Transit."

The "Buff" Precise Transit has behind it an unparalelled history of years of uninterrupted success, which demonstrates beyond cavil the correctness of the design and the accuracies of construction.

It is the foundation of our large and growing business, and it is because of the completeness with which it has always fulfilled our most sanguine expectations that we are always encouraged to extend our facilities for the manufacture of new types and in larger numbers.

The "Buff" instrument has kept pace with the growth of business in this country, showing that it covers a field peculiarly its own, and has inherent advantages that cannot be outweighed.

Consequently, we not only continue to build "Buff" instruments with the same scrupulous care, but are to-day building them better in every point where the experience with transits of this particular type has indicated that improvement was possible. Incidentally, this instrument comes more nearly than any other to being purely elementary in design and grace of finish. That it has thrived for so many years, suggests the possession of tangible merit, easily discernible by those whose good sense enables them to discriminate between a superior and an average transit.

With an unusually skilled force, comprising men especially belonging to the instrument makers of the world, we stand in a position to offer our customers the best possible.

ITS ECONOMY.

In point of economy the "Buff" Precise Transit is unequalled by any other transit made.

We know that it is the only single instrument, which is adapted to wide variety of use.

We know that it will always accomodate itself to adverse circumstances and offer up clear work at all times with its more powerful telescope.

We know that it will preserve its adjustments unimpaired for a longer time owing to the rare skill with which its centres are constructed of the toughest metals.

We want you to see the instruments. To see them is to come in contact with an affirmative argument that gives emphasis and reality to the claims we make for them. *Where words fail, inspection speaks. The recollection of quality remains long after price is forgotten.*

SPECIFICATIONS, — No. 1 Bubble Transit.

Graduation, 6¼ inch diameter, with two double opposite verniers to minutes, placed at either 90° or 30° to line of sight. Two rows of opposite inclined figures 0°-360°. Graduations silvered and covered by pure crystal plate glass.

Telescope, erecting or inverting, is balanced and reverses at either end; 12 inches long, 1¼ inch aperture, with power of 26.5 dia. improved eye-piece, unsurpassed large clear field. Centre point is provided on top of telescope to permit of accurate centreing from above. Adjustment for vertical plane, and line of collimation correct for all distances.

Sensitive level bubble, 6 inches long.

Improved lower and upper spring tangent clamps.

Shifting centre with ¾ inch adjustment.

Spirit levels truly ground by special machine, rated and sensitive.

Standards are cloth-finished.

Long taper centres with broad flanges.

Compass needle is 4½ inches long and of accepted form.

Compass graduation is silvered and figured with a single row 0-90 on each side of N. and S.

Tripod improved; split leg with wing-nuts.

The mahogany instrument box is provided with strap, lock and hooks, and contains plumb-bob, pocket magnifier, sun-shade, wrench, screw-driver, adjusting pins, etc.

No. 1. Plain Transit weighs 14 lbs. Stiff leg tripod, 7½ lbs.

EXTRAS TO NO. 1 SIZE TRANSIT.

Graduation, horizontal circle, solid silver		$10.00
" " " reading to 30″		10.00
" " " " " 20″		20.00
" " " " " 10″		30.00
" vertical circle, solid silver		5.00
" " " reading to 30″		5.00
Ground glass shades to verniers		3.00
Standards finished and polished bright (like telescope)		5.00
Improved gradienter attachment		5.00
Reversion level, for levelling with telescope reversed, (See p. 43)		12.50
Fixed stadia wires, guaranteed 1 ft. in 100 feet		3.00
Variation plate and ring		10.00
Short Focus lens attachment. No. 1 lens, $8.00; No. 2 lens, $8.00		16.00
Dust caps to levelling screws		3.00
Silk waterproof bag to cover instrument		1.00
Superfine watch oil, per bottle		.25
Extra extension tripod	9½ lbs.	16.00
Extra regular tripod	7½ lbs.	16.00
Reflector shade for cross wires		4.00

The transit, as illustrated, represents the highest perfection of the instrument makers' art. Accuracy, quality, finish and equitable price have obtained for it exclusive use on the largest works in progress at the present time.

The sensitiveness of the spirit level attachment is equivalent to that of many wye levels, and allows of high accuracy in levelling up to 200 feet sights.

THE BUFF "PRECISE" TRANSIT.

Patented Nov. 6, 1900; Nov. 13, 1900; Feb. 3, 1903.

No. 1 a.

Price, as in cut, $210.00.

Code-Word—THEODITE.

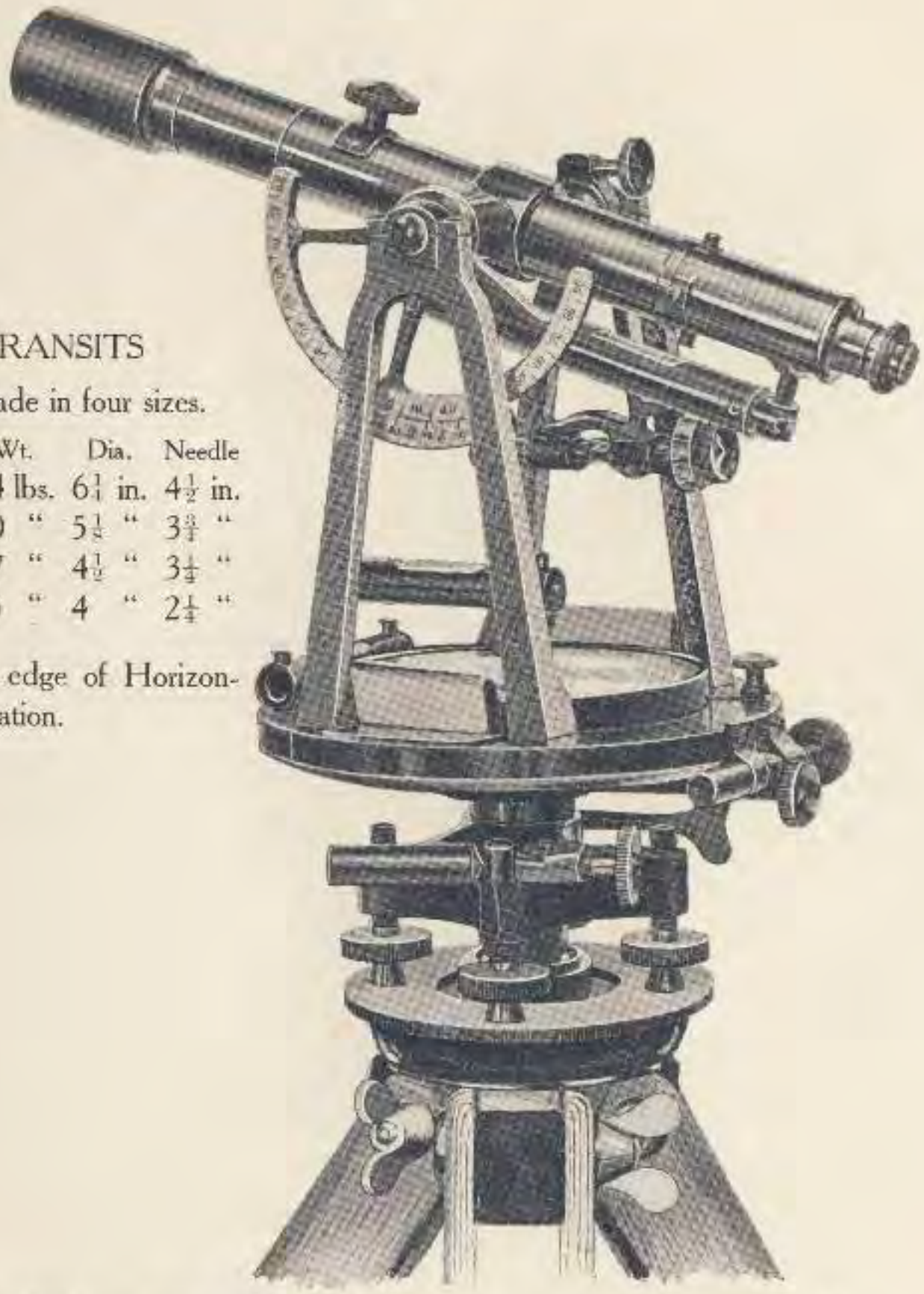
Plain Transit, without bubble and clamp, $180.00.

Code-Word—THEOCAT.

THE BUFF "PRECISE" TRANSIT.

(Design Patented.)

No. 1 b.



TRANSITS

Are made in four sizes.

	Wt.	Dia.	Needle
No. 1,	14 lbs.	6¼ in.	4½ in.
" 2,	10 "	5⅛ "	3¾ "
" 3,	7 "	4½ "	3¼ "
" 4,	5 "	4 "	2¼ "

Dia. at edge of Horizontal Graduation.

Price (without gradienter), $225.00. For specifications see page 35.

Code-Word—THEODAS. See page 111 for code.

THE BUFF "PRECISE" TRANSIT.

(Design Patented.)

No. 1 c.

Price *without gradienter,* $234.00.

5″ full circle reading to minutes is protected by aluminum guard.

Code-Word — THEODUSE. See Code Page 111.

THE PENNSYLVANIA "PRECISE."

No. 1 p.

Price $210.00. For specifications see page 35. Can also be equipped with 2½ inch compass of type as shown on page 52. Price extra $20.00.

Code-Word — THEOPENN. See Code Page 111.

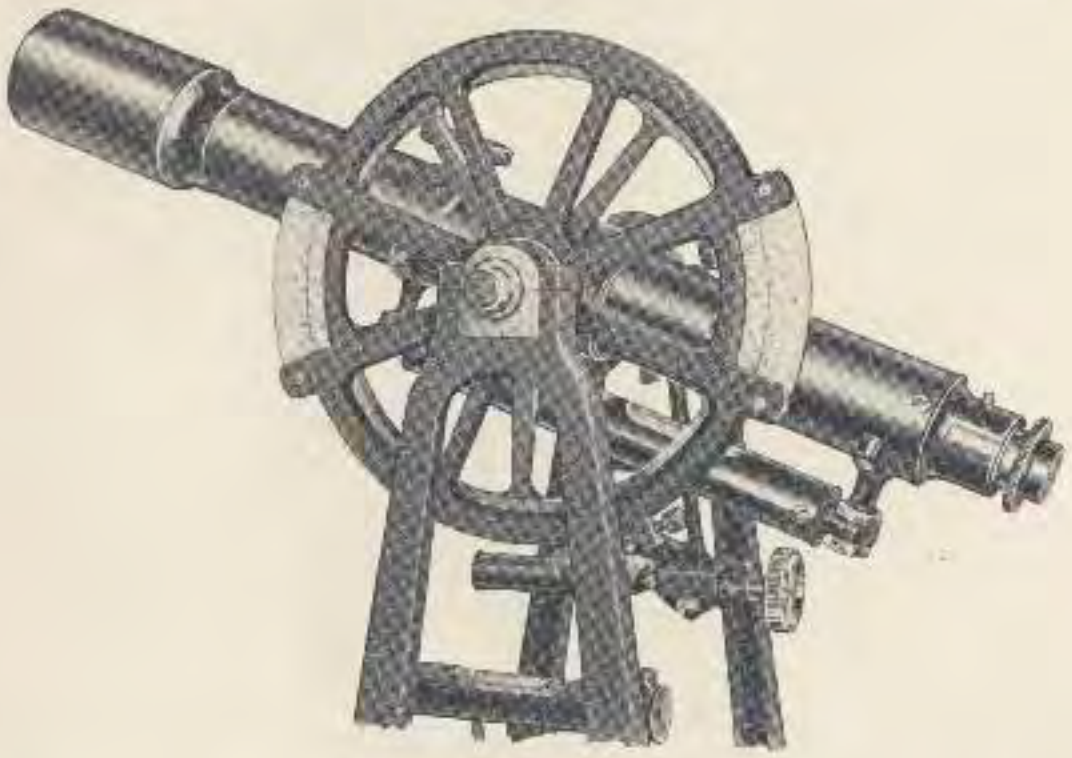
BUFF & BUFF MFG Co
BOSTON

THE "UNIVERSITY" PRECISE.
No. 1 s.

Price $220.00. Striding level $20.00. Full vertical circle and vernier reading to minutes, $20.00.

Code-Word — THEOPENNSY. See Code Page 111.

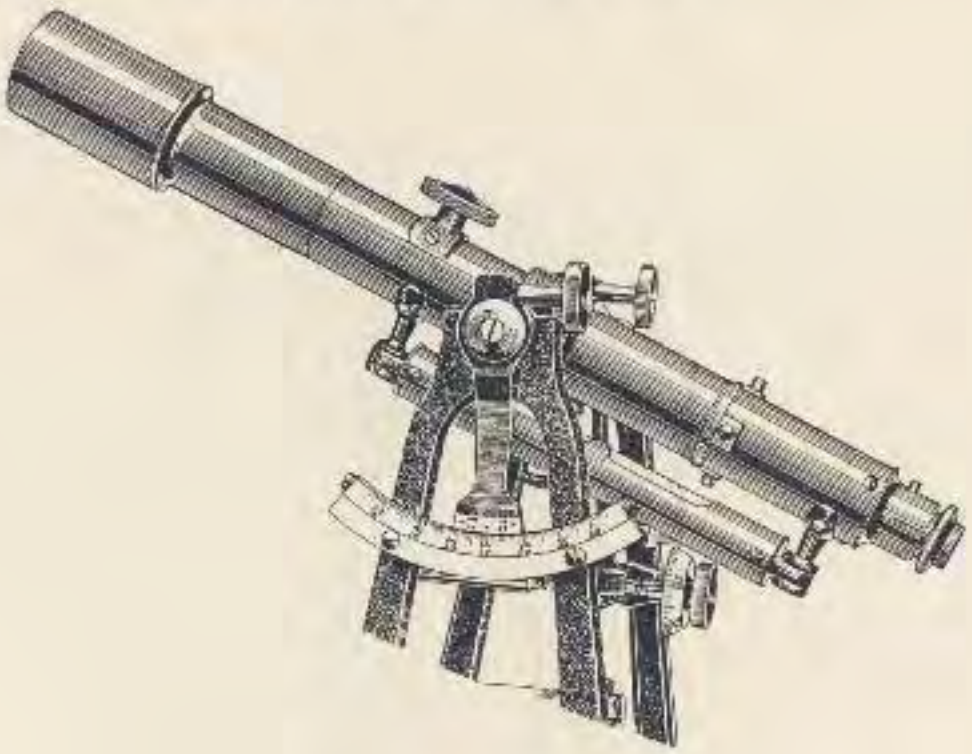
DOUBLE OPPOSITE VERNIER ATTACHMENT.



This arrangement is provided with adjusting screws to set zero of vernier.

Price, complete with guard	$20.00
Reading-glasses for both verniers	10.00
Graduation reading to 30″	10.00

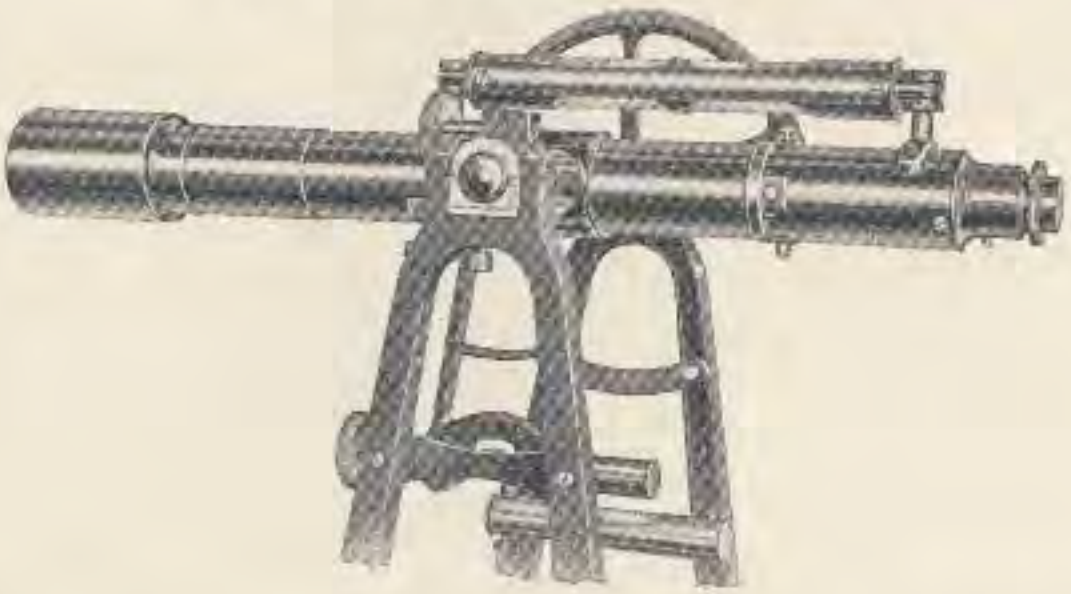
PHILADELPHIA ARC.



Optional with regular form of arc, page 38.

REVERSION LEVEL.

For Levelling with Telescope Reversed.

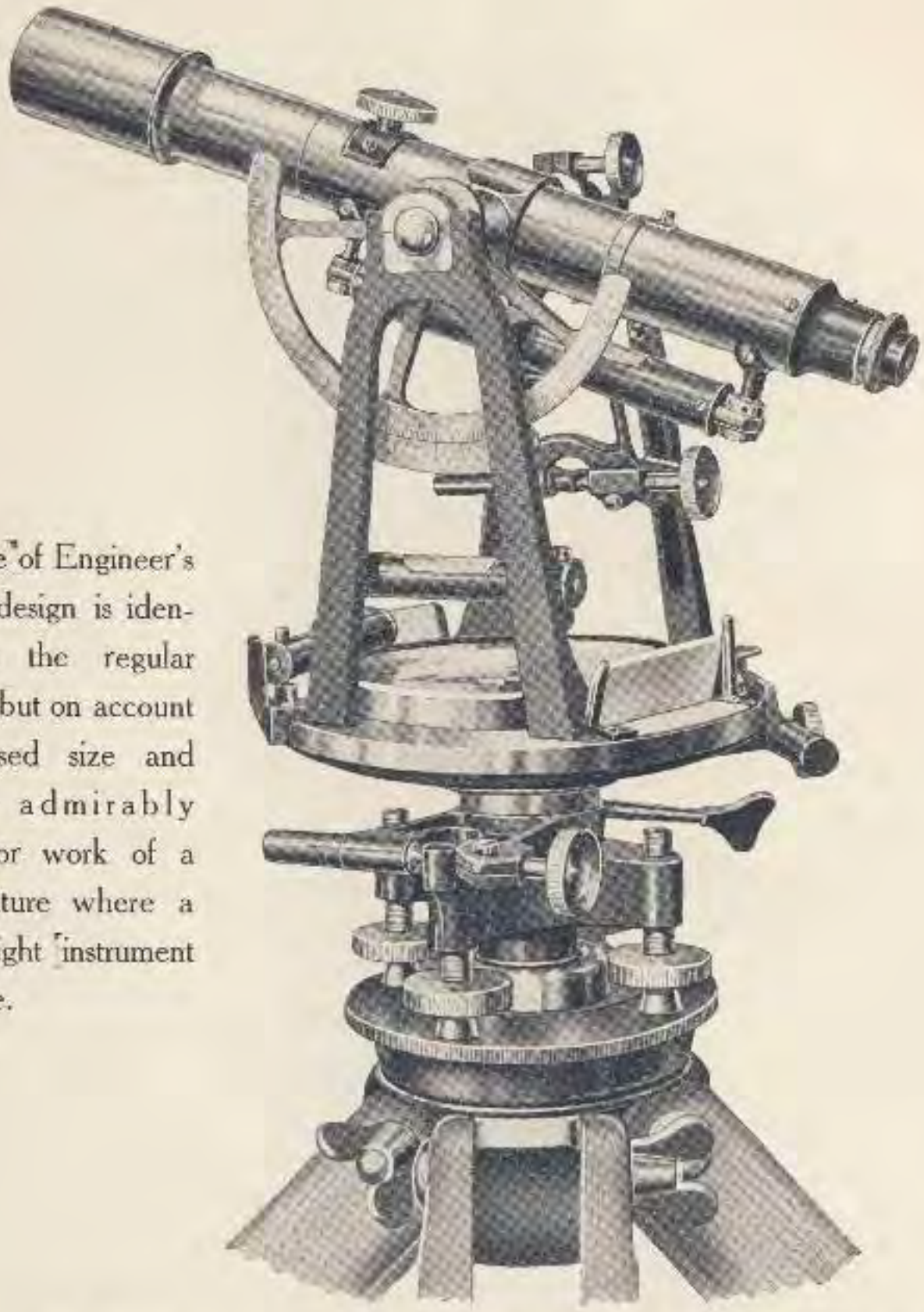


A guard is provided with this level to protect the under side of the vial when not in use.

Price, complete when ordered on any of our new transits .	$12.50
Price, on Wye Level	15.00

NO. 2 BUFF ENGINEER'S TRANSIT.

No. 2 b.



This size of Engineer's Transit in design is identical with the regular larger size, but on account of decreased size and weight is admirably adapted for work of a reliable nature where a lighter weight instrument is desirable.

Price without gradienter . $225.00 and per specifications on next page.

Code-Word — TRANDATE.

See page 57 for No. 2 Transit with full vertical circle.

SPECIFICATIONS.

Graduation, 5⅛ inch diameter with two double opposite verniers to minutes, placed at either 30° or 90° to line of sight. Two rows of figures 0-360 inclined. Graduations are silvered and covered by pure crystal plate glass. Vertical arc 5 inch diameter and reading to minutes by double vernier.

Telescope, erecting or inverting, is perfectly balanced, and reverses at both ends. Length is 10¾ inches with aperture of 1¼ inch, and power of 22.5 dia. Eye-piece gives sharply defined field of improved illumination.

Sensitive level bubble to telescope, 5½ inches long with clamp.

Adjustment for vertical plane of telescope and line of collimation is correct for all distances.

Improved lower and upper spring tangent clamps and shifting centre with ⅝ inch adjustment.

Standards are cloth finished.

Long taper centres with wide flanges.

Compass needle 3¾ inches long and of preferred form.

Tripod improved, split-leg form with thumb-nuts.

Mahogany case is fitted with strap, lock and hooks, and contains plumb-bob, pocket magnifier, sun-shade, wrench, screw-driver, etc.

Option. Aluminum tripod head, reduces weight 1½ lbs.

EXTRAS TO NO. 2 SIZE OF ENGINEERS' TRANSIT.

Graduation, horizontal circle, solid silver,	$10.00
" " " reading to 30″	10.00
" " " " " 20″	20.00
Edge graduation for vertical circle, 5 inch dia. (See p. 56)	10.00
Graduation, vertical circle, solid silver	5.00
" " " reading to 30″	5.00
Standards finished bright or bronzed	5.00
Extra extension tripod, weight 9½ lbs.	16.00
Ground glass shades to vernier	3.00
Gradienter attachment	5.00
Stadia wires, fixed	3.00
Variation plate and ring	10.00
Silk waterproof bag to cover instrument	1.00
Superfine watch oil, to lubricate centres	.25
Reflector shade for cross wires	4.00
Short Focus lens attachment	16.00

No. 3 "BUFF" ENGINEER'S TRANSIT.

(Design Patented.)

No. 3 b.

The difference of one-half inch in the diameter of the No. 3 and No. 4 is slight, but the difference on the graduation is more noticeable. Ordinarily a 30″ silver graduation on the No. 3 can be read without a pocket magnifier, whereas on the No. 4 it cannot. This pronounced advantage of the No. 3 is equal in value to an increase of three-quarters of an inch in the length of needle. In design the No. 3 is symmetrical, and all parts have been carefully tested. In our transits particular stress is laid on securing equal angles of elevation and depression for the telescope. This important feature permits sighting very close to instrument plumb-bob.

Price	$215.00
Without Bubble and Arc to Telescope	175.00

Code-Word—TRIO.

SPECIFICATIONS.

No. 3 b.

Graduations, 4½ inch diameter with two double opposite verniers to minutes, placed at 90° or 30° to line of sight. Two rows opposite inclined figures 0-360. Graduations are silvered and covered by pure plate glass.

Telescope, erecting or inverting, is balanced and reverses at both ends, 8 inches long with 1⅛ inch aperture and power of 20. Improved eye-piece gives large clear field. Level attachment includes bubble 4 inches long fixed to telescope, and with clamp and tangent adjustment. Vertical arc with double reading vernier is graduated to single minutes.

Line of collimation correct for all distances.

Shifting centres.

Standards are cloth finished.

Tripod has extension legs, or our improved stiff legs if ordered.

Compass magnetic needle is 3¼ inches long and graduations are silvered with one row of figures 0-90.

The mahogany instrument case is equipped with lock, strap and hooks, and contains plumb-bob, pocket magnifier, sun-shade, wrench, screw-driver, adjusting pins, etc.

Weight of No. 3 transit, 6 pounds.

The No. 4 Buff

No. 4 b.

Price $215.00

Weight of No. 4 transit, 5 pounds.
Weight of extension tripod, 6 pounds.
Code-Word — RECON.

No. 4 Transit.

SPECIFICATIONS.

Graduation, 4 inches diameter. Telescope power, 18 inches diameter. Compass needle 2¾ inches long. All other specifications are identical with those for the No. 3 size. The compactness of the No. 4 peculiarly adapts it for explorers and for reconnaissance surveys. It makes the neatest set on the market.

See next page for list of extras — No. 3 and No. 4 transits.

EXTRAS TO NO. 3 AND 4 SIZE TRANSITS.

Graduation, horizontal circle, solid silver	$10.00
" " " reading to 30″	10.00
" vertical circle, solid silver	5.00
Ground glass shades to vernier	5.00
Standards, hand polished and finished bright or bronze	5.00
Gradienter attachment, improved, guaranteed accurate	5.00
Stadia wires, fixed, 1 ft. to 100 ft.	3.00
Two reading glasses to Hor. circle	4.00
Aluminum guard for circle, as in mountain transit	4.00
Prism, attachable to eye-piece	8.00
Prism, attachable to eye-piece, pivoted combination	12.00
Leather cover over case, sole leather, with carrying straps, 9.00 to	12.00
Leather cover for extension tripod	8.50
Detachable side-telescope with counterpoise	35.00
Detachable top telescope with counterpoise	45.00
Silk bag to cover transit, and bottle of superfine watch oil	1.25
Striding level to complete transit	15.00
Variation plate and ring	10.00
Reflector shade for illuminating cross wires	4.00
For this instrument made with U shaped standards, cast in one piece, without compass, thus gaining great tranverse stiffness, add $10.00 to cost	
Short Focus lens attachment, No. 1, $8.00; No. 2, $8.00	16.00

We prefer to make these instruments with inverting eye-pieces, knowing that thereby the greater satisfaction will be obtained. If a detachable side-telescope is ordered, it should be on the instrument having the U shaped standards.

For the use of explorers and reconnaissance surveyors, needing additional power, we offer in No. 3 transit, an instrument that can be used with the greatest satisfaction and accuracy in results, and that also has long been asked for by a great many engineers.

"Buff" Mining Transits.

The noticeable advancement that has taken place in the design and efficiency of the small and medium sized engineers' transit, during the past few years in particular, is easily traced to the increased demand for a superior mining transit of higher power and greater accuracy.

The elements entering into the design and construction to obtain these ends with absolute rigidity are more numerous and conflicting than is commonly thought but have been so successfully gained in the new "Buff" as to completely meet and satisfy all requirements. Engineers contemplating purchase, however, must not overlook facts and base their calculations arbitrarily upon power and relative weight, without considering that, particularly for mining uses, power is not so much desired (sights are shorter than for surface work) as light and definition. The design is strictly up-to-date in every detail, and in modified form is of the same type as our larger triangulation instruments, that permit utmost rigidity consistent with weight and ensuring most efficient operation.

In every way they are built with the same exactitude of fit, to withstand hard usage under mining conditions, and with only reasonable care give splendid service for many years.

The following engraving will show to the critical engineer points of excellence sought for and secured.

Accessories and attachments are perfect and very complete. The hard bronze finish, highly pleasing without being elaborate, is of the practical kind, consistent with every-day service in mines.

MINING INSTRUMENT.

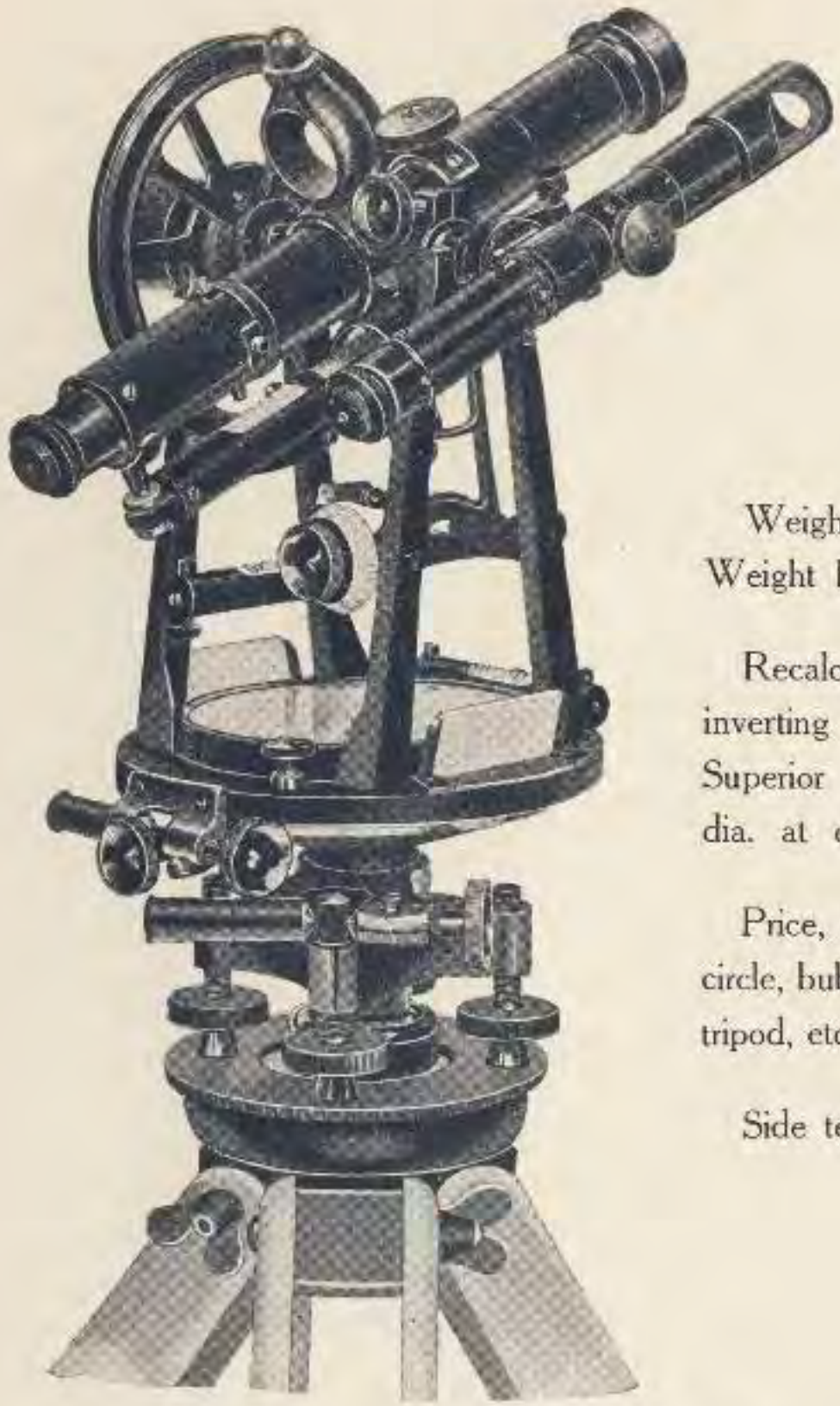
No effort has been made to cheapen these instruments at any point, the result being instruments constructed by superior labor under superior supervision, which must give *superior service for many years.*

The following engravings from photographs of our instruments actually built clearly indicate to the critical engineer where their superiority of design exists, and why the "Buff" so invariably meets and successfully undergoes the most severe conditions of usage without injury.

Our aim is not to manufacture instruments so that we may get the business of repairing them when they fail through poor design and workmanship, *but it is to keep them out of our own and other repair shops indefinitely.* Glasses and centres require reasonable attention semi-occasionally only.

THE "BUFF" PRECISE MINE TRANSIT.

No. 2 P.



Weight as in cut, 12½ lbs.
Weight Extension Tripod, 9½ lbs.

Recalculated lens system and inverting or erecting eye-piece. Superior graduations. Five-inch dia. at edge.

Price, complete, with full vert. circle, bubble and guard, extension tripod, etc., $234.00

Side telescope, $35.00.

(Erecting Eye-Piece.)

Code-Word — TRANDOLITE. See Code Page 111.

NOTE — Transit will be provided with Universal telescope axle only when top telescope is ordered.

SPECIFICATIONS.

Horizontal circle 5½ inch diameter, with double opposite verniers reading to minutes on graduation which is silvered.

Needle 3¾ inches long and of improved form.

Standards cloth finish.

Telescope, 10¾ inches long and aperture of 1¼ inch.

Power of 22 dia. with erecting eye-piece.

Sensitive level bubble 5½ inches long to telescope, with clamp and tangent adjustment.

Verniers may be either at 90° or 30° to line of sight (see page 27).

Weight of instrument complete 12½ lbs., extension tripod 9½ pounds, regular tripod 7 pounds.

Aluminum protection guard for circle.

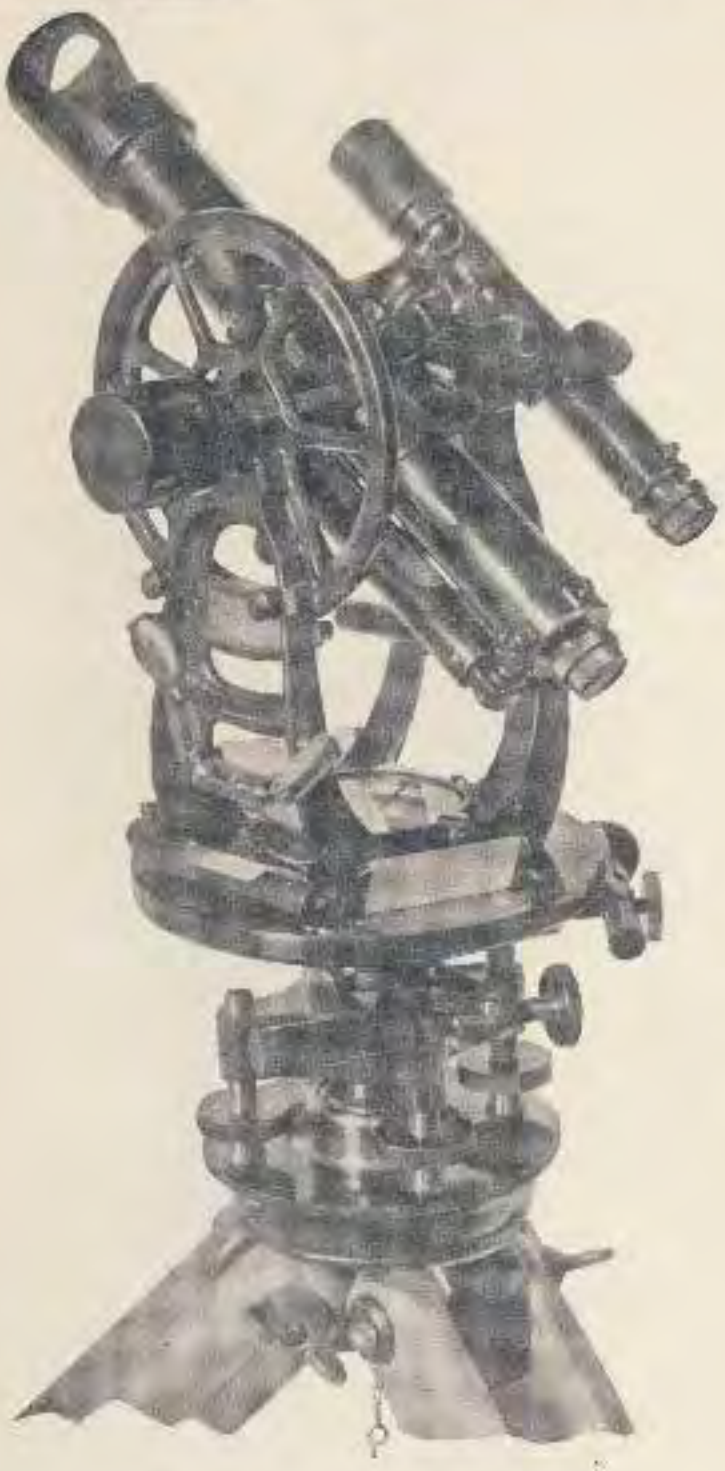
Weight and size are the only difference from the No. 1, being in every detail equally thorough in construction.

Mahogany case, with fittings as for No. 1 transit and with extension tripod.

EXTRAS TO MOUNTAIN TRANSIT NO. 2.

Ground glass shades, to facilitate reading of vernier	$ 3.00
Standards finished and polished bright or bronze	5.00
Fixed stadia (see p. 23)	3.00
Gradienter attachment, improved	5.00
Graduations, horizontal circle on solid silver	10.00
Graduations on vertical circle on solid silver	5.00
Edge graduations, vertical circle	10.00
Horizontal circle graduated to 30"	5.00
Variation plate, with ring	10.00
Leather cover	11.00
Leather cover, with straps	13.50
Silk waterproof bag to cover transit	1.00
Superfine watch oil, to lubricate centres and axle	.25
Saegmuller Solar attachment	50.00
Prism, attachable to eye-piece	8.00
Prism, combination pivoted, with colored glasses	12.00
Top Telescope	45.00
Short focus Lens Attachment, 2 sets in combination	16.00
Trivet, for setting instrument on beams, etc., in longitudinal passages, 2 inch, 3 inch and 6 inch legs	3.50
Complete Mining Target, with lamp and tripod (send for special circular), (see p. 82)	90.00
Detachable side telescope with counterpoise	35.00
Extra regular tripod	16.00
Extra ½ length tripod	13.00
Plummet-lamp, improved form	9.00
Bracket — for use in mines — instead of tripod — heavy bronze castings complete and ready for instrument to be attached	10.00
Reflector shade for cross wires	4.00

BUFF & BUFF MFG Co
BOSTON



NO. 2 MINE TRANSIT.

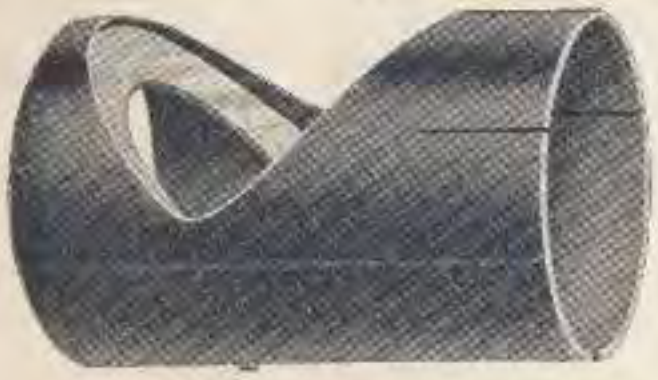
U-shaped standards equipped with 2 inch compass, extra $20.00.

Striding level, $20.00.

Universal reading glass with jointed arm $7.50.

REFLECTOR SHADE.

To Illuminate the Cross-Wires in Mining Work.

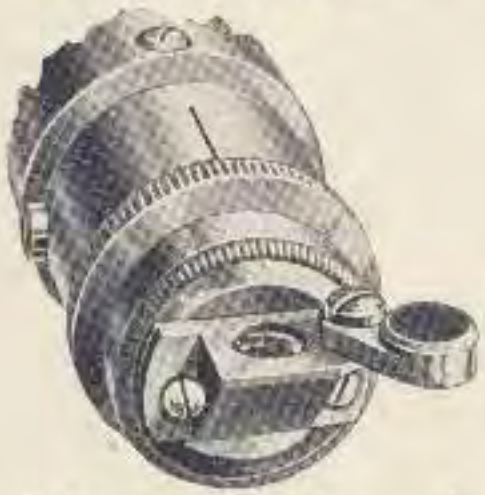


Mirror is heavily silver plated and polished.

Made in all sizes to attach to object end of telescope. It is the best method of illuminating the cross wires. Price, ready to attach, $4.00.

PRISM AND COLOR GLASS.

For Solar Observations.

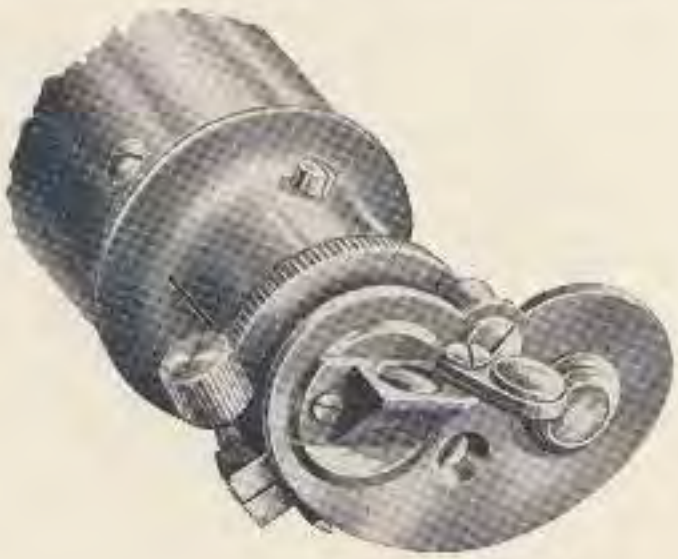


Plain diagonal prism with hinged color glass, and to be screwed on to eye-piece, $8.00.

PIVOTED PRISM AND COLORED GLASSES.

1. Direct sight through colored glass. 2. Direct sight. 3. Prism with pivoted color glass.

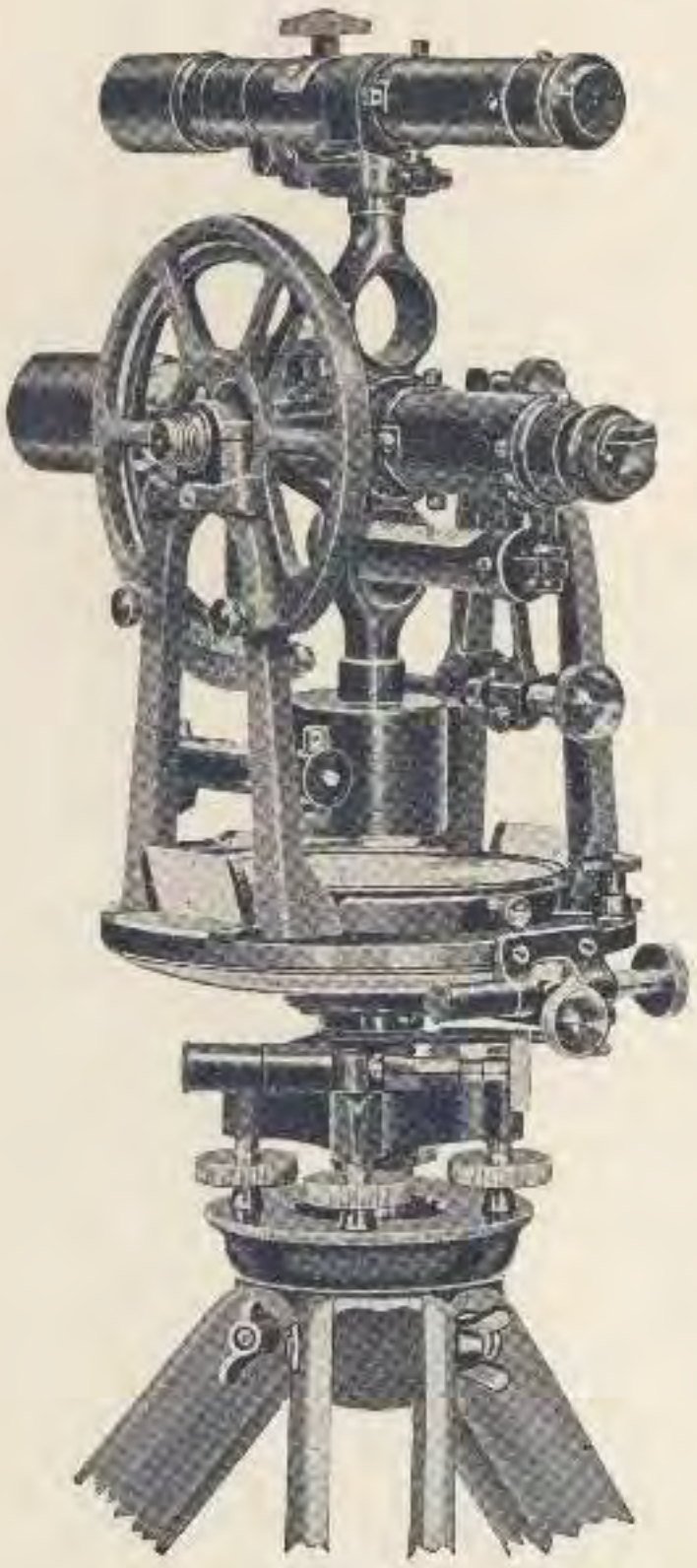
Prism and glasses, pivoted, and a very convenient arrangement, $12.00.



3. 2. 1.

THE "ROCKY MOUNTAIN FAVORITE."

No. 3 f.



Weight as in cut, without top telescope, 7 lbs.

Extension Tripod, 7 lbs.

Remodeled design of axle ensures utmost rigidity to top telescope.

Superior graduations guaranteed.

Unexcelled Telescopes.

Four-and-a-half inch dia. at edge of graduation. Price, complete, with full vertical circle, bubble and guard, extension tripod, etc. See specification, page 47, $224.00.

Top telescope, $45.00.

Buff Mining Transit.

(Erecting Eye-Piece.)

Code-Word TRIGON. See Code Page 111.

NOTE — Transit provided with Universal axle only when top telescope is ordered.

SPECIFICATIONS NO. 3 SIZE "ROCKY MOUNTAIN FAVORITE."

Horizontal circle 4½ inch dia. at edge of graduation with double opposite verniers reading to minutes on silvered surface.

Needle is 3¾ inches long.

Standards are cloth finished.

Telescope is 8 inches long with 1⅛ inch aperture of power of 18.

Sensitive level bubble to telescope is 4 inches long, and provided with clamp and tangent adjustment.

Verniers may be either at 30° or 90° to line of sight.

Vertical circle reads to minutes and is protected by an aluminum guard.

Weight of instrument complete is 7 lbs., extension tripod 7 lbs., regular stiff leg tripod 5 lbs.

Instrument complete in mahogany case with plumb-bob and adjuster, pocket reading glass, screw-driver, wrenches and adjusting pins, etc. Price, $224.00.

EXTRAS TO NO. 3 MINING TRANSIT.

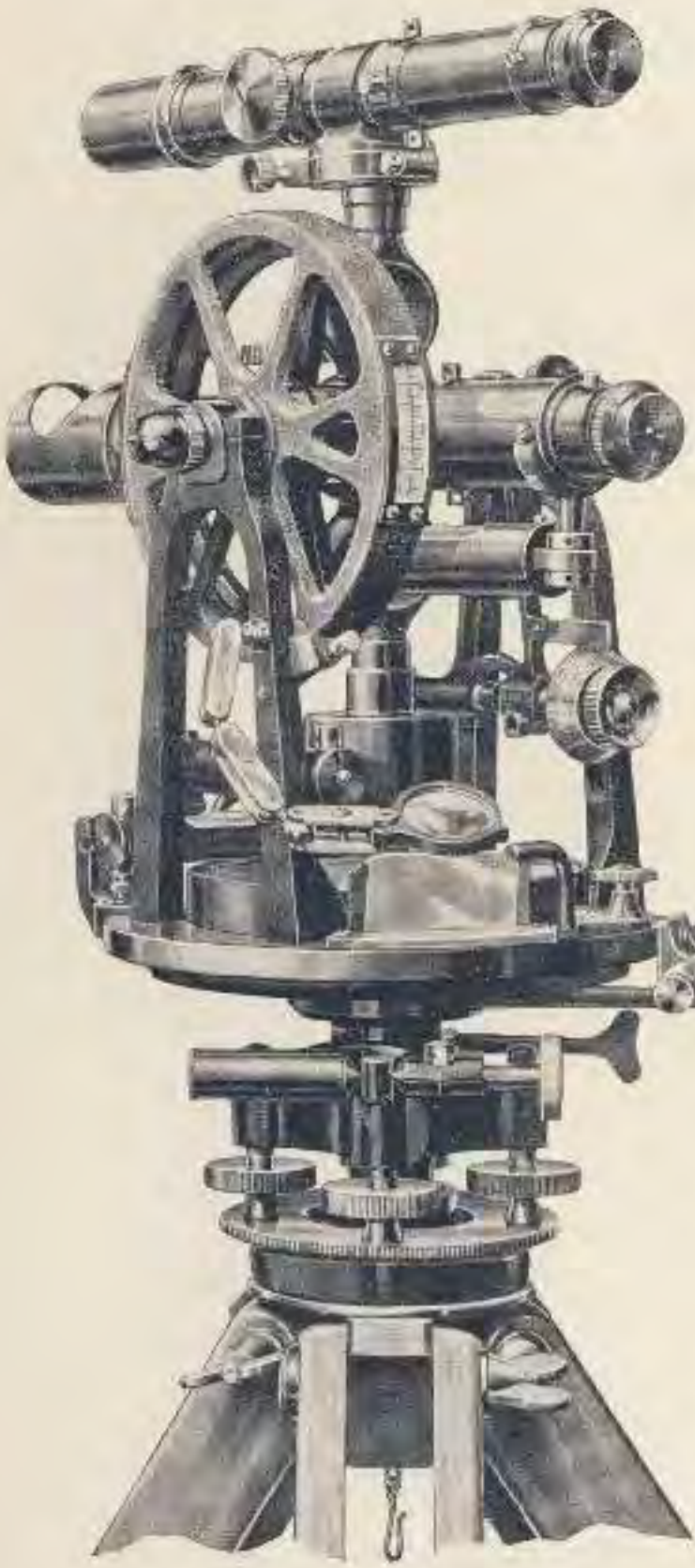
Solid silver graduations to horizontal circle	$10.00
Solid silver graduations to vertical circle	5.00
Edge graduation to vertical circle	10.00
Horizontal circle graduated to 30″	5.00
Standards, hand polished, bright or bronze	5.00
Gradienter attachment, complete	5.00
Fixed stadia wires	3.00
Ground glass shades to vernier	3.00
Variation plate with ring	10.00
Top telescope	45.00
Silk waterproof cover for instrument	1.00
Superfine watch oil for lubrication	.25
Reflector shade for illuminating cross wires	4.00
Trivet for setting instrument on beams	3.50
Edge graduation 4 inch circle (see page 56)	10.00
Reading glasses for horizontal circle	12.00

BUFF & BUFF MFG Co
BOSTON

THE "ROCKY MOUNTAIN FAVORITE."

With Edge Graduation.

No. 3 g.



Weight as in cut, without top telescope, 7 lbs.

Extension tripod, 7 lbs.

Remodeled design of axle ensures utmost rigidity to top telescope.

Superior graduations.

Unexcelled telescopes.

Four-and-a-half inch dia. at edge of graduation. Price, complete, with full vertical circle, bubble and guard, extension tripod, etc., $224.00.

Top telescope, $45.00.

Edge graduation, complete as in cut and fully protected, $10.00.

Universal jointed reading glass for both horizontal and vertical graduations as in cut, $7.50.

"Buff" Mining Transit.

Code-Word — TRIGONATE.

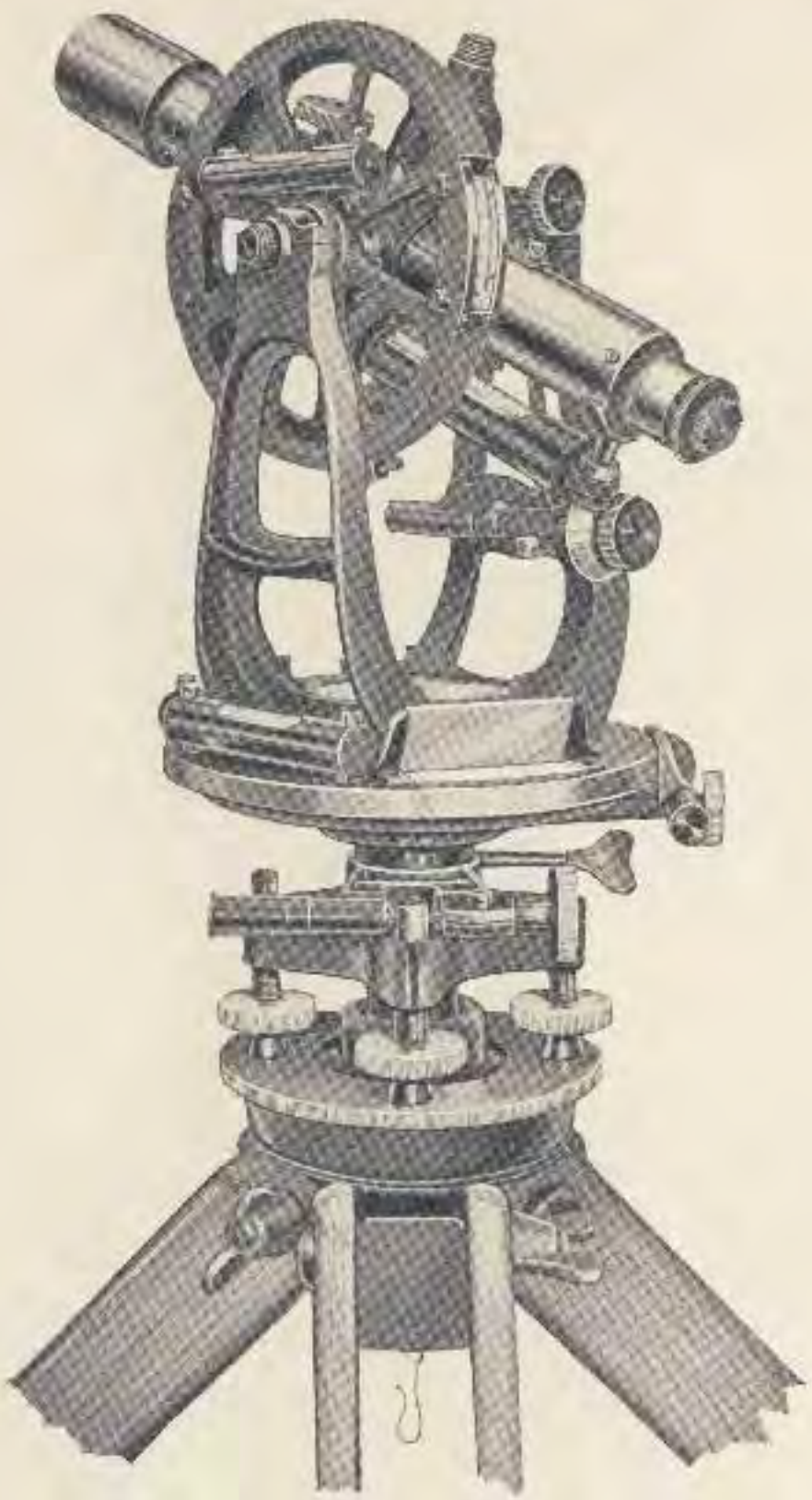
BUFF & BUFF MFG Co
BOSTON

THE "BUFF" MINE TRANSIT.

No. 2 c.

Code-Word — TRANDOLITE. See Code Page 111.

Price, complete with extension tripod and full accessories, $234.00. See page 45 for specifications.

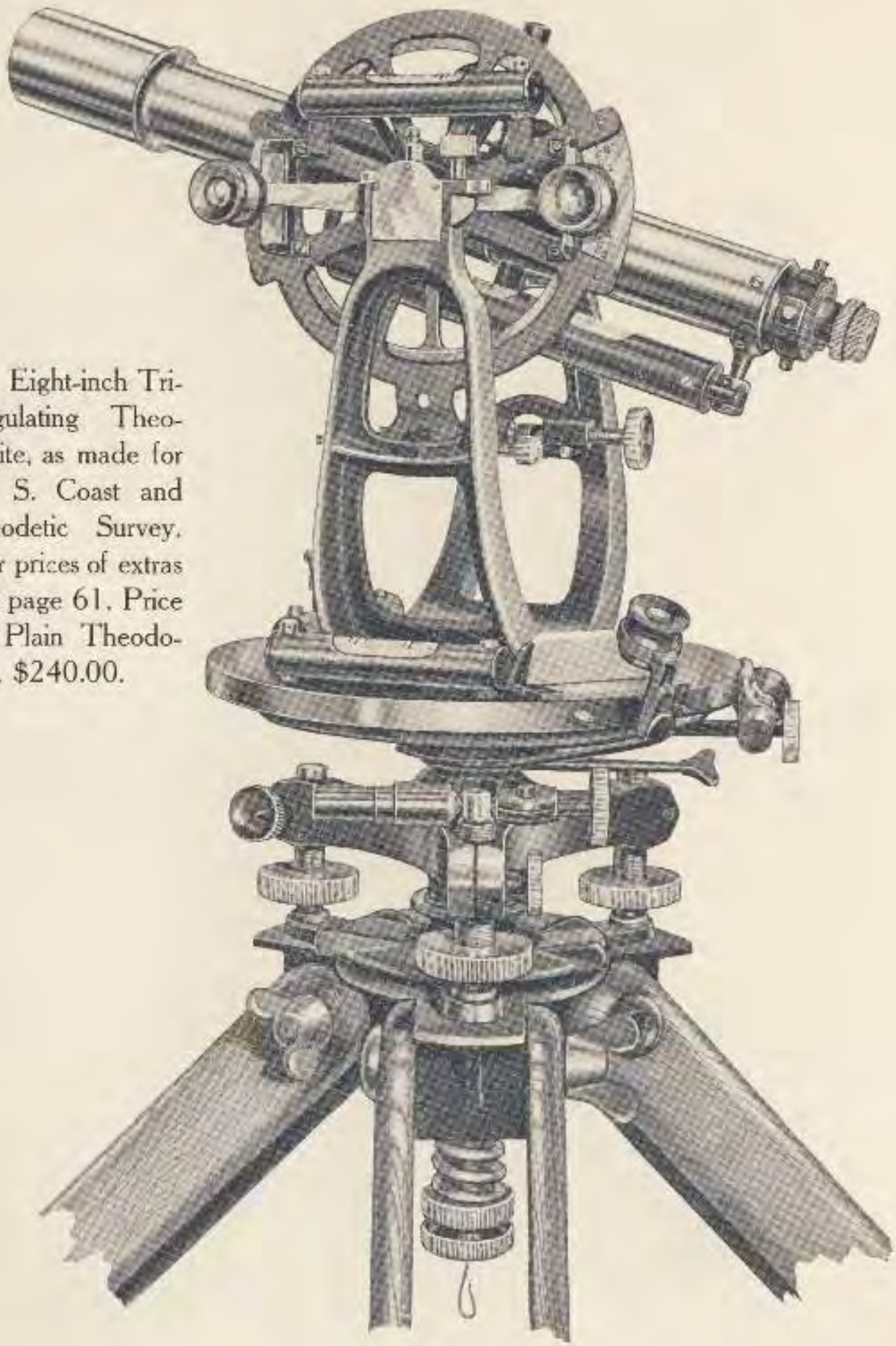


No. 2 h.

Code-Word—TRANDALUS.

Price, without compass	$234.00
Edge Graduation, vertical circle	10.00
Double Opposite Verniers, vertical circle	20.00
Auxiliary Bubble, vertical circle	10.00
$2\frac{1}{4}''$ Compass	20.00

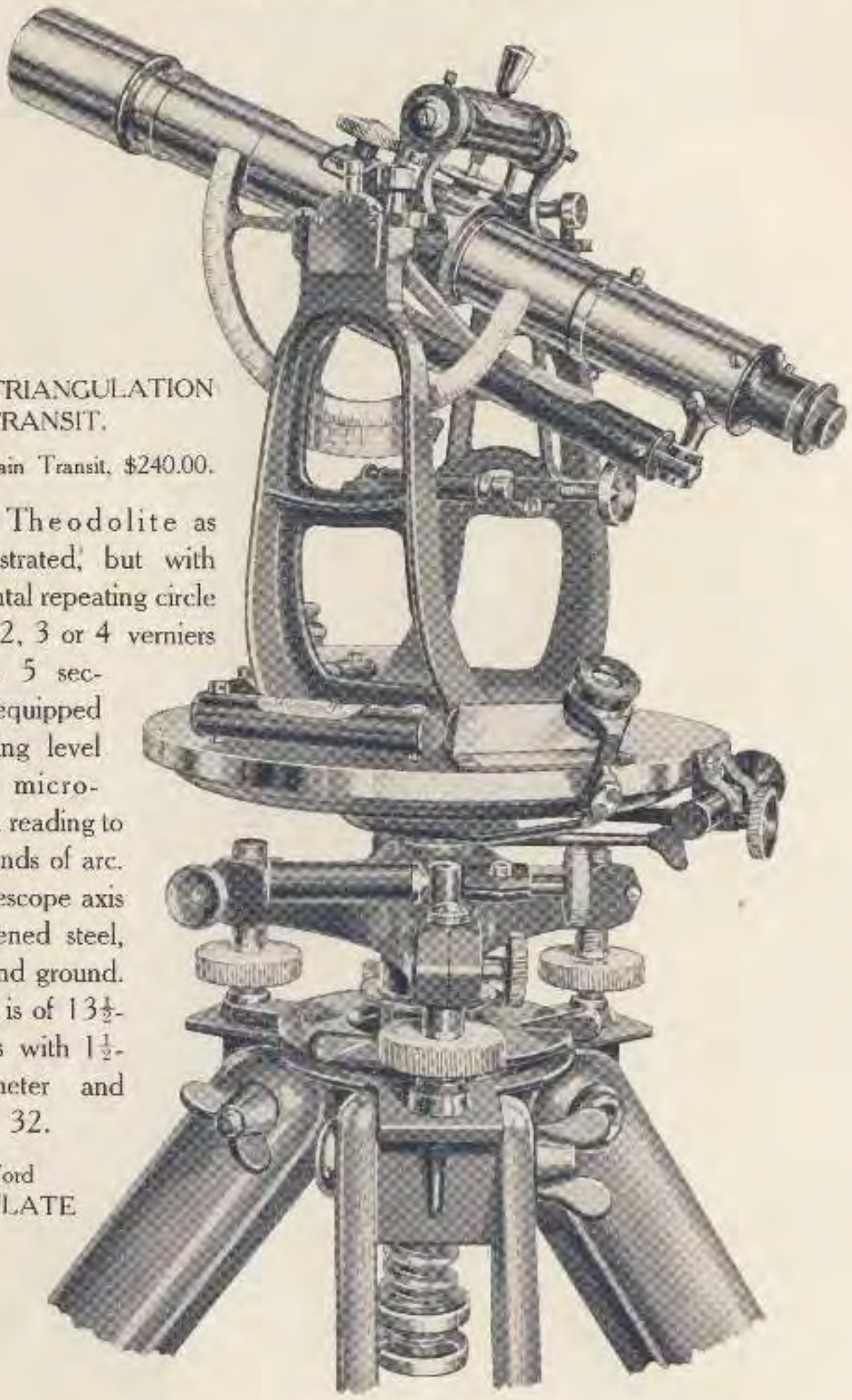
The best balanced and most consistent transit, embodying extreme compactness and graceful design.



Eight-inch Triangulating Theodolite, as made for U. S. Coast and Geodetic Survey. For prices of extras see page 61. Price of Plain Theodolite, $240.00.

BUFF & BUFF MFG Co
BOSTON

TRIANGULATION TRANSIT.



"BUFF" TRIANGULATION TRANSIT.

Price of Plain Transit, $240.00.

Transit Theodolite as above illustrated, but with 10″ horizontal repeating circle and with 2, 3 or 4 verniers reading to 5 seconds, is equipped with striding level and filar micrometer, both reading to single seconds of arc.

The telescope axis is of hardened steel, polished and ground. Telescope is of 13½-inch focus with 1½-inch diameter and power of 32.

Code Word
TRIANGULATE

Triangulation Transit.

MADE IN 6¼, 7, 8 AND 10 INCH DIA. HOR. LIMBS.

Designed for use in cities and triangulating.

SPECIFICATIONS.

Graduation, 6¼-inch in diameter with two double opposite verniers to 30′ and placed at 30° to line of sight. Graduations on solid silver and protected by crystal plate glass. Two rows of figures in opposite directions.

Telescope, 12½-inch, power 29, aperture 1¼-inch to 1½-inch, improved eyepiece. Reversible in standards and bearings, and erecting or inverting image.

Improved tangent clamps.

Shifting centre.

Finish, bright or bronze throughout.

Improved form of tripod and case.

Price for plain transit, $240.00.

EXTRAS.

Graduations, reading to 20″	$10.00
Graduations, on 7-inch circle to 10″	30.00
Verticle arc, reading to minutes	20.00
Reading glasses, as in cut, with shades	15.00
Shifting centre for three levelling screws	5.00
Striding level	20.00
Spirit level with clamp to reverse to telescope	35.00

A striding level should always be ordered with above instrument.

BUFF & BUFF MFG Co
BOSTON

STRAIGHT LINE TUNNEL THEODOLITE.

SPECIFICATIONS.

Seven-inch horizontal circle, with open graduation, eliminating any chance of parallax. Extreme rigidity.

Price, as in cut, including graduations, solid silver and reading to 30″, and with full equipment, $285.00.

Code-Word—TUNNEL.

7-INCH TRIANGULATION TRANSIT.

Special Design for
Long Distance Levelling.

Equipped with special telescope and levelling bubble for long distance levelling.

Power, 32 dia.

Height, 14½ inch.

Objective, 1⅝ inch.

Price, as in cut, including graduation on solid silver and reading to 30 sec., and with full equipment, $250.00.

Code-Word
TRIMONT.

THE "BUFF" SIGHTING LEVEL.

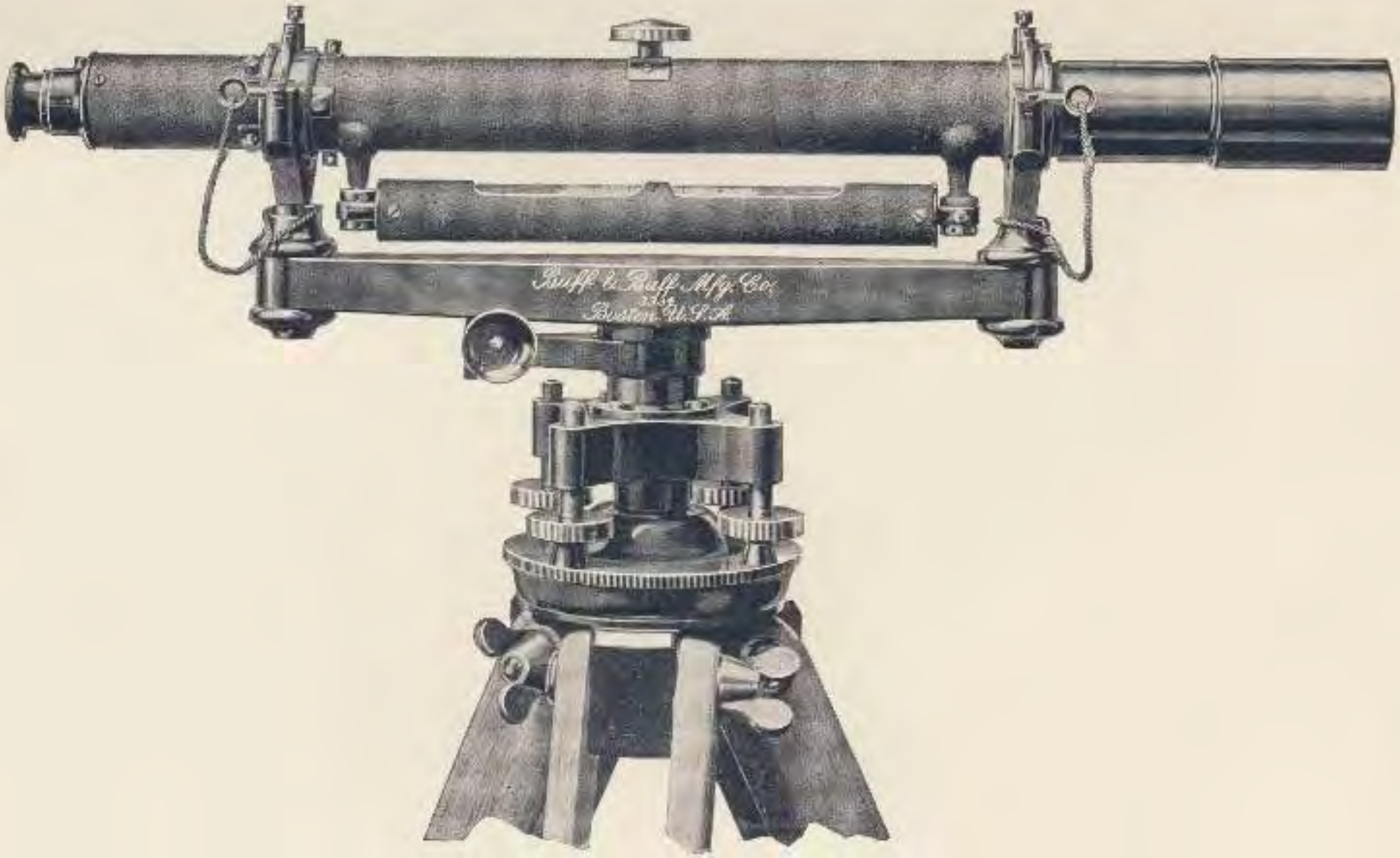
Code-Word — SIGVEL.

For erection of iron frame building construction, gas holders, etc. Price, complete $200.00.

BUFF & BUFF MFG Co
BOSTON

ASTRONOMICAL 3 INCH TRANSIT.

Price complete $560.00.



ENGINEER'S 18-INCH WYE LEVEL.

Power, wtih erecting eye-piece, 36 diameters. Price, complete, $140.00.

Code-Word— WYES. See Code Page 111.

Engineers' Levels.

18-inch Hydrographers' Wye Level. 18-inch Wye Level.
14⅜-inch Wye Level. 15½-inch Dumpy Level.

ENGINEERS' 18-INCH WYE LEVEL.

(Power, 36 diameters.)

The Improved Telescope being eighteen inches long and having 1⅝-inch objective gives increased illumination and clearness. Protection to object slide. Erecting or inverting eye-piece gives large, flat field of view. Entire telescope and level tube is cloth finished. Phosphor-bronze contact points in wyes for the bell-metal collars. Regular bell-metal centre in socket of phosphor-bronze. Line of collimation correct for all distances. Instrument finally adjusted to the finest possible accuracy with sun-shade in position and focused on mean distance. Complete in mahogany case with strap and hooks, sun-shade, wrench, screw-driver, adjusting pins, etc.

Unless otherwise ordered on this level, the sensitiveness of spirit level will be what is rated as a 10 seconds bubble.

(One division of scale equals 10 seconds of arc.)

Weight of complete instrument, about 10¾ lbs. Tripod, 7 lbs.

NET PRICE, $140.00

The best metals for surveying Instruments are those which have coefficients of expansion equal to that of glass. This is important in order to retain the adjustments despite temperature changes.

Coefficient of glass per foot, for 1° Fah.	.00005 inches
" " steel per foot, for 1° Fah.	.00007 "
" " brass per foot, for 1° Fah.	.00012 "
" " aluminum	.00014 "

Steel or cast iron are nearest and lighter and harder than brass. These metals might be adopted for the transit were it not for the compass needle. See following note for wye levels.

Note — For the most precise uses — where a specially sensitive spirit level is specified, the steel and iron centre (p. 72) is strongly recommended as securing the most nearly perfect centre theoretically as well as practically, and giving the ideal bearing.

EXTRAS.

Hardened steel centre in phosphor-bronze socket	$10.00
Hardened steel centre in annealed iron	10.00
Fixed stadia wires	3.00
Extra sun-shade having aperture for use when the light is too bright for accurate work	1.50
Metal mirror, to read bubble without moving from eye-piece, silver-plated arms and jointed	10.00
Waterproof bag of rubber to protect the level from rain	1.00
Bottle of superfine watch oil to lubricate the centres	.25

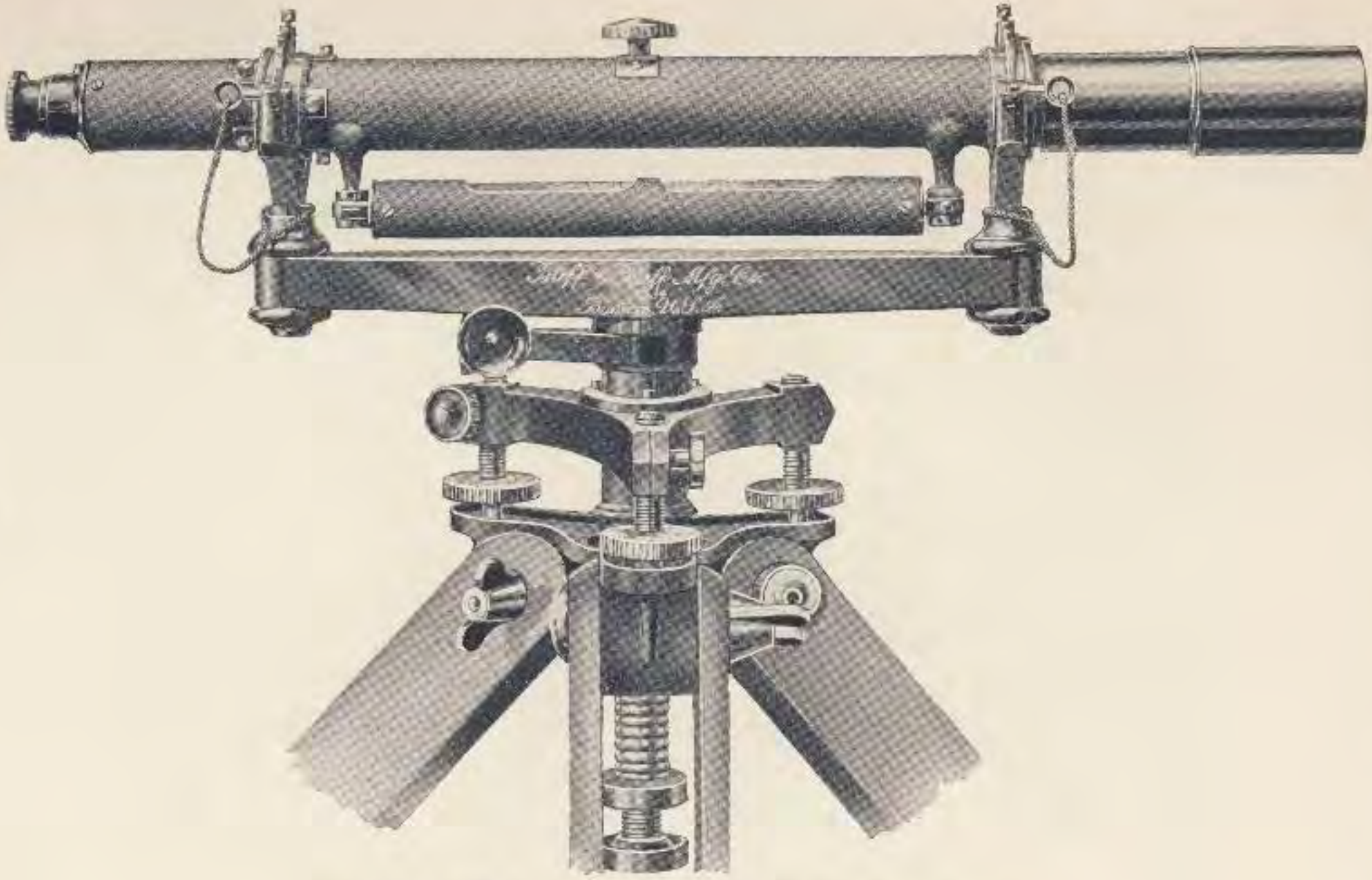
Hydrographers' Wye Level.

The precision wye level is similar in construction to the engineers' wye level, except that three levelling screws are provided instead of four. The sensitiveness of the spirit level is somewhat increased, being from 8" to 10" for 1 div. of scale. The weight is 1 lb. more, owing to the larger form of tripod. Telescope and bubble are cloth finished. Price, complete, $158.00.

The general preference is given to this three levelling screw instrument, because for bench levelling, the bubble and the line of sight are more easily controlled. Frequently the levels have a sensitiveness of a single second of arc for a division of $\frac{1}{10}$ of an inch. We are prepared to attach our auxiliary micrometer screw to even further facilitate the ease and accuracy of manipulations. Price and description as per list.

EXTRAS TO HYDROGRAPHERS' WYE LEVEL.

Hardened steel centre in annealed iron	$10.00
Hardened steel centre in phos.-bronze	10.00
Fixed Stadia wires	3.00
Metal Mirror with universal joint (see cut page 71)	10.00
Extra sun-shade with smaller aperture	1.50
Gossamer waterproof bag	1.00
Bottle of fine watch oil	.25
Auxiliary micrometer screw	18.00



HYDROGRAPHERS' 18-INCH WYE LEVEL.

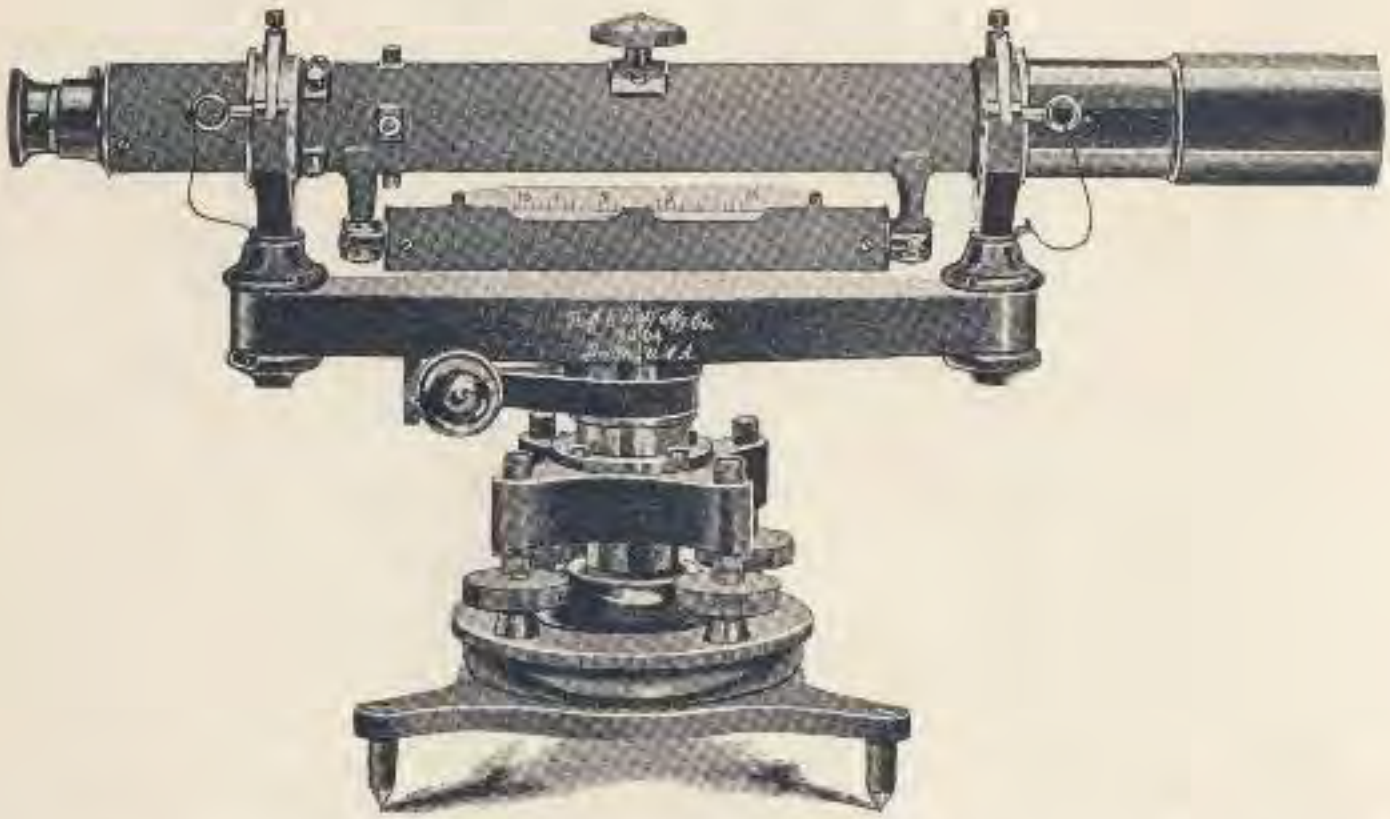
With three-levelling screw lower centre.

Weight, complete, 12 lbs. Regular stiff-leg tripod, 8½ lbs.

Code Word—HYDROGRAPH. See Page 111.

ENGINEER'S 14½ INCH WYE LEVEL.

Code-Word WYEING. See Page 111.



Power, 28 diameters. Similar to the preceding style level, and complete with box and tripod.

Net price, $125.00. Weight, 9½ lbs.

Aluminum bar on this instrument reduces the weight to 8 lbs.

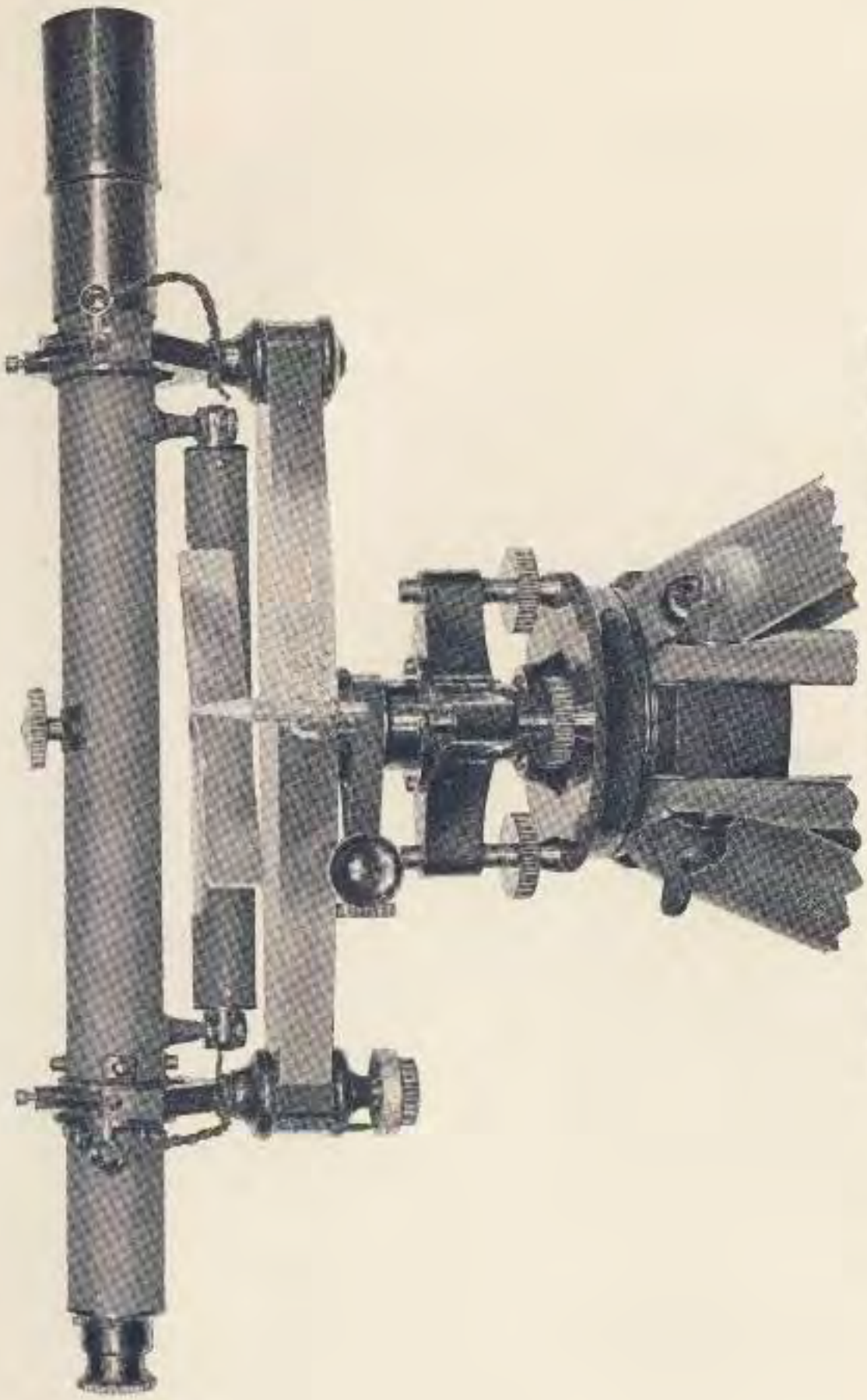
SPECIAL.

In all but one respect this level is fully the equal of its large prototype.—But having a shorter telescope of less power, its sensitiveness is slightly cut down to correspond. The level bubble, unless specified, has the rating of 12 to 14 sec. sensitiveness.

Altogether this level is specially adapted to the closest work in mountain levelling where weight is an object, and where it is important to have a level capable of instant and accurate adjustment.

EXTRAS.

Stadia wires, fixed	$3.00
Hardened steel centre in socket of annealed iron	10.00
Extra sun-shade for use when sun's rays are too strong, having small aperture	1.50
Gossamer rubber bag, for protection against the weather	1.00
Bottle of superfine watch oil to lubricate the centre	.25



AUXILIARY MICROMETER-SCREW LEVEL.

With one of the Y's moveable by a graduated micrometer screw with index.

Special to All Wye Levels.

A STEEL CENTRE IN A SOCKET OF ANNEALED IRON.

This new adoption of the steel centre in a socket of annealed iron (though an old practice in the construction of large astronomical instruments as giving the ideal non-friction and non-expansive bearing) is one that has been withheld from application to engineers' levels heretofore, because of the great expense involved in setting up the precision grinding machines necessary to fit the hardened steel centre and also of the rapid dulling of the reamers by the iron socket. These, the only obstacles, no longer stand in the way of securing such admirable centres in field instruments.

The shop cost of making such a centre for a level is greater than in making one of bell metal or phosphor bronze, for the reason that the hardened steel centre requires to be ground with special apparatus and consumes more time in the final fitting. It is even superior, because more permanent to the regular Buff centre of bell metal, which has been so far ahead of other makes in durability.

The prime advantage, however, is in the small and equal co-efficient of expansion, ensuring freedom from the errors due to atmospheric changes, and also in the small co-efficient of friction.

Adjustments.

The adjustments of a standard Buff Transit important to the engineer in the field are: —

1. That the plate and standard bubbles are perpendicular to the axis of the plate.

2. That the line of collimation moves in the plane that is exactly above centre of horizontal circle.

3. That the line of collimation is perpendicular to the horizontal axis.

4. That the line of collimation is parallel to the telescope level bubble.

The adjustments of the Engineers' Wye Level, important in the field and which can be corrected by him, are: —

1. That the telescope spirit-level is parallel to the axis of collimation.

2. That the optical axis is identical with the axis of collimation.

3. That the vertical axis of revolution is perpendicular to line of collimation.

For the simplest field methods of making these adjustments we issue a special pamphlet entitled *The Buff Precise Transit and its Adjustments*, which will be mailed on request.

A FEW CAUTIONARY REMARKS AS TO THE CARE OF INSTRUMENTS.

In general, when not in use, it is well to bear in mind that (though in India, where, protection or no protection, the average life of an engineer's transit is short of two years on account of the fine and penetrating dust continually in the atmosphere) a silk hood, as furnished by us, is of much protection to an instrument, both from dust and weather.

When about to remove a film of dust from the glasses notice that the texture of silk is too abrasive, and that only pure and soft linen should be used.

Carefully note the position of instrument in box before removing, and grasp the lower parts (not the standards, for they are not the handles).

Observe before shouldering your instrument that centres are lightly clamped, thus preventing unnecessary wear, and that the levelling screws have a firm bearing, and, above all, that the instrument is screwed well on to tripod head. Nuts on legs of tripod are to be well tightened against the wood. Shoes on tripod should also be examined occasionally, that they be neither loose nor dull, for upon their rigidity depends the entire stability of the instrument.

The most common causes of error are due to: —

1. Loose legs of tripod.
2. Loose tripod shoes.
3. Carelessness in not occasionally verifying adjustments.
4. Thoughtlessness in unnecessarily exposing to dust and weather.
5. Lifting instrument by the standards or telescope or vertical circle, since undue strain of entire weight is put upon these parts, which are not designed for such use.

A FEW DONT'S.

Do not unscrew object glass without reason, since a fixed position of all lenses not only governs the final and nice adjustment of the line of collimation, but also assures the cleanliness of cross-wires.

Do not permit playing with the needle, and do not pick up instrument with needle swinging idly, nor with centres unclamped.

Do not oil or grease object-slide, nor expose screws to collect dust and grit.

Do not think that the small adjusting-pin furnished to adjust the small capstan-headed screws of cross-wire diaphram is not strong enough to impose most injurious strains upon the telescope by excessive tightening; and, above all, if a slight grinding or whirring noise is heard, do not fail to clamp entire instrument and subject it to careful examination in the office. There the centres and principal movements may be examined and subjected to close inspection. The irritation or cause of fretting may be removed by careful treatment and careful and thorough cleaning before applying fresh oil. Care must be taken, however, not to rub or come against the graduation edge in any way, since the slightest burr or sharpness of edge removed, works costly damage to an instrument. After cleaning, fresh watch-oil only, as put up by us, should be applied to all the centres.

With each instrument sold we enclose a carefully prepared treatise on the adjustments of the Precise "Buff" transit.

ENGINEERS' DUMPY LEVEL.

As equally accurate work can be done with a dumpy level of our improved make as with the regular Wye level, since the same sensitiveness of level-bubble is put into this instrument and the same objective of the same focus and diameter, giving the same power of 32 diameters.

Particularly on work of a roughing-out nature, where liability to slight knocks is present that would seriously injure a wye level, the possibilities of a compact dumpy level are at its best.

An engineer certainly can perform as close work with this level — and yet feel sure that his adjustments once made will keep so indefinitely.

The entire instrument is cloth-finished above the levelling screws, including telescope and bubble.

The centres are of the regular type that we put into transits, being the hardest bell metal in phosphor-bronze, and most carefully fitted to a true bearing shoulder. A clamp screw for center is also provided.

The instrument is packed in a mahogany case, with sun-shade, screw-driver, wrench and adjusting pin.

Weight of level, complete, 9½ lbs.

Weight of tripod, regular type, 7 lbs.

Price, complete as above, $100.00.

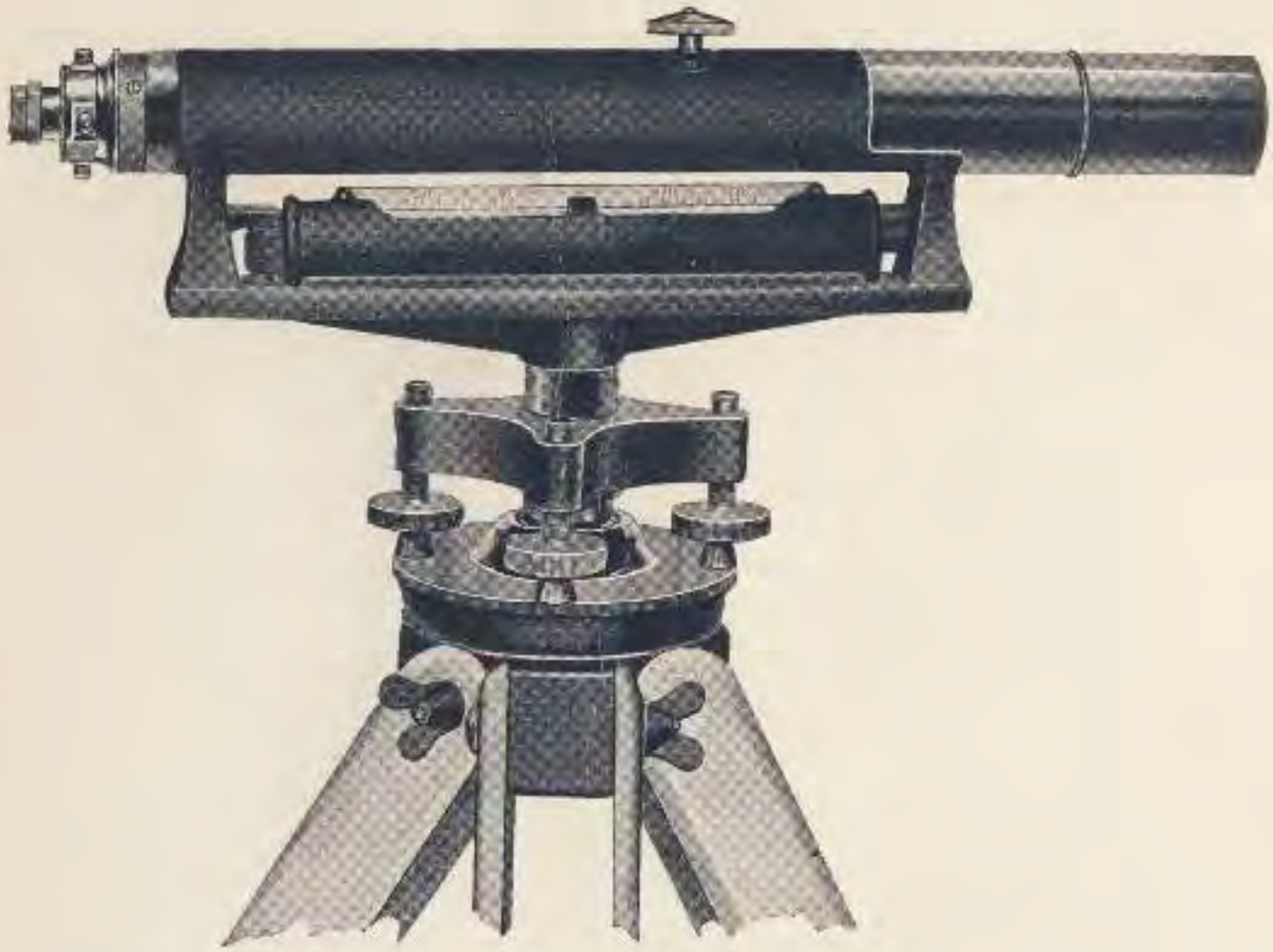
EXTRAS.

Stadia wires, fixed	$3.00
Rubber cover of heavy sheeting, for protection against rain and the weather	1.00
Bottle of superfine watch oil to lubricate the centre	.25
Instrument provided with clamp and tangent screw (see page 66 for same style clamp below bar of wye level)	11.50

Note — The inverting eye-piece in this instrument provides our most ideal telescope for brilliancy and clearness — power — 36 dia.

BUFF & BUFF MFG Co
BOSTON

ENGINEER'S 15½ INCH DUMPY LEVEL.



IMPROVEMENTS.

Focusing screw placed on top. Protection to object-slide. Improved form of telescope barrel casting, of phos-bronze, ensuring great stability.

Centre and lower bar of a single bell-metal casting, obtain utmost strength and permanancy of adjustment.

Power, as above, 36 diameters. (Inverting eye-piece, as per cut, completes an ideal lens system.)

Price, with tripod and mahogany case, $100.00.

Code-Word — DUMPUS

Remodelled design for posts, procuring maximum rigidity with least weight and graceful appearance. Re-calculated lens-system obtaining sharply defined brilliant field.

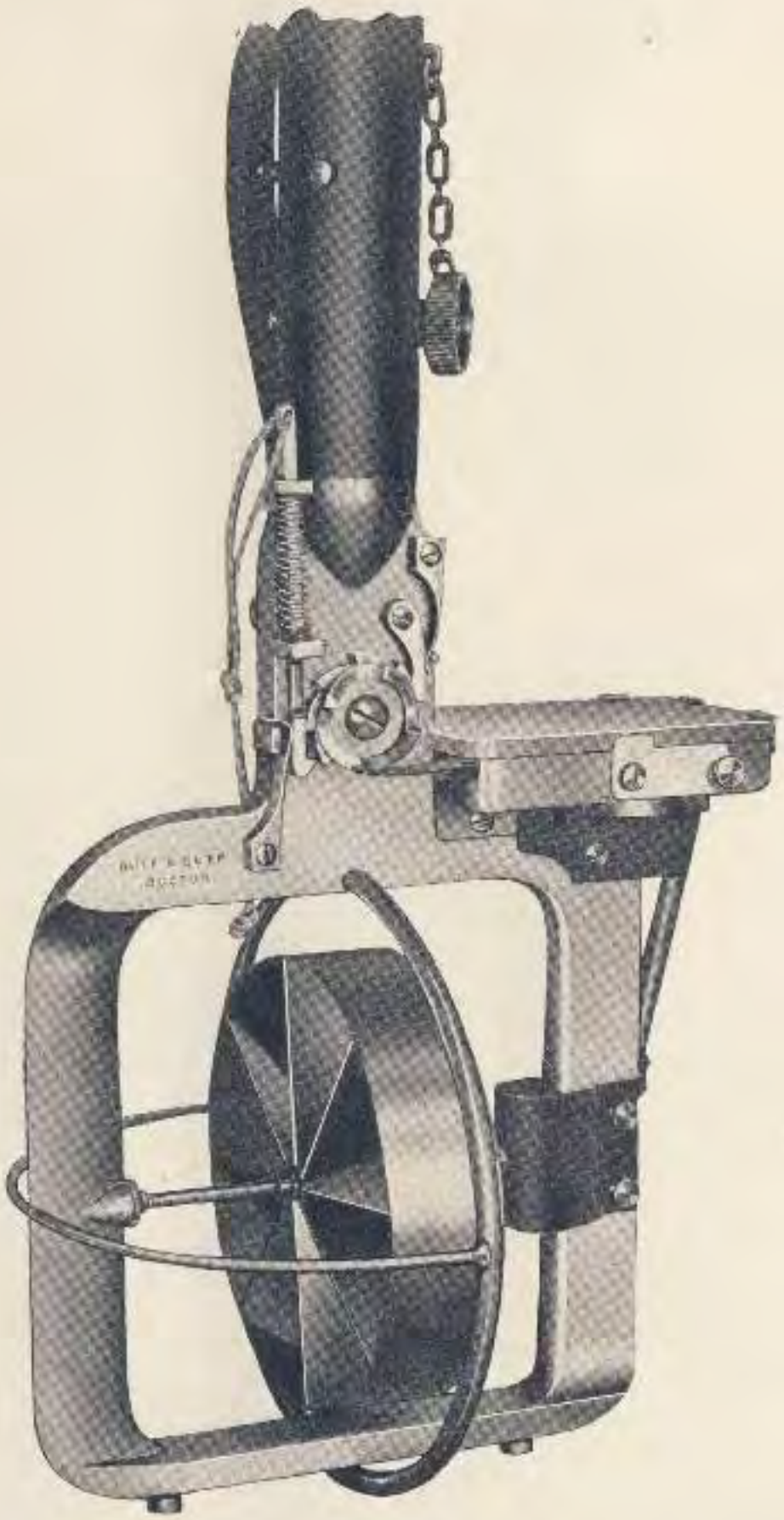
Clamp screw to fix position of telescope.

With erecting eye-piece.

Price, with tripod and mahogany case, $100.00.

Code-Word — DUMPAT.

BUFF CURRENT METERS.



No. 5.

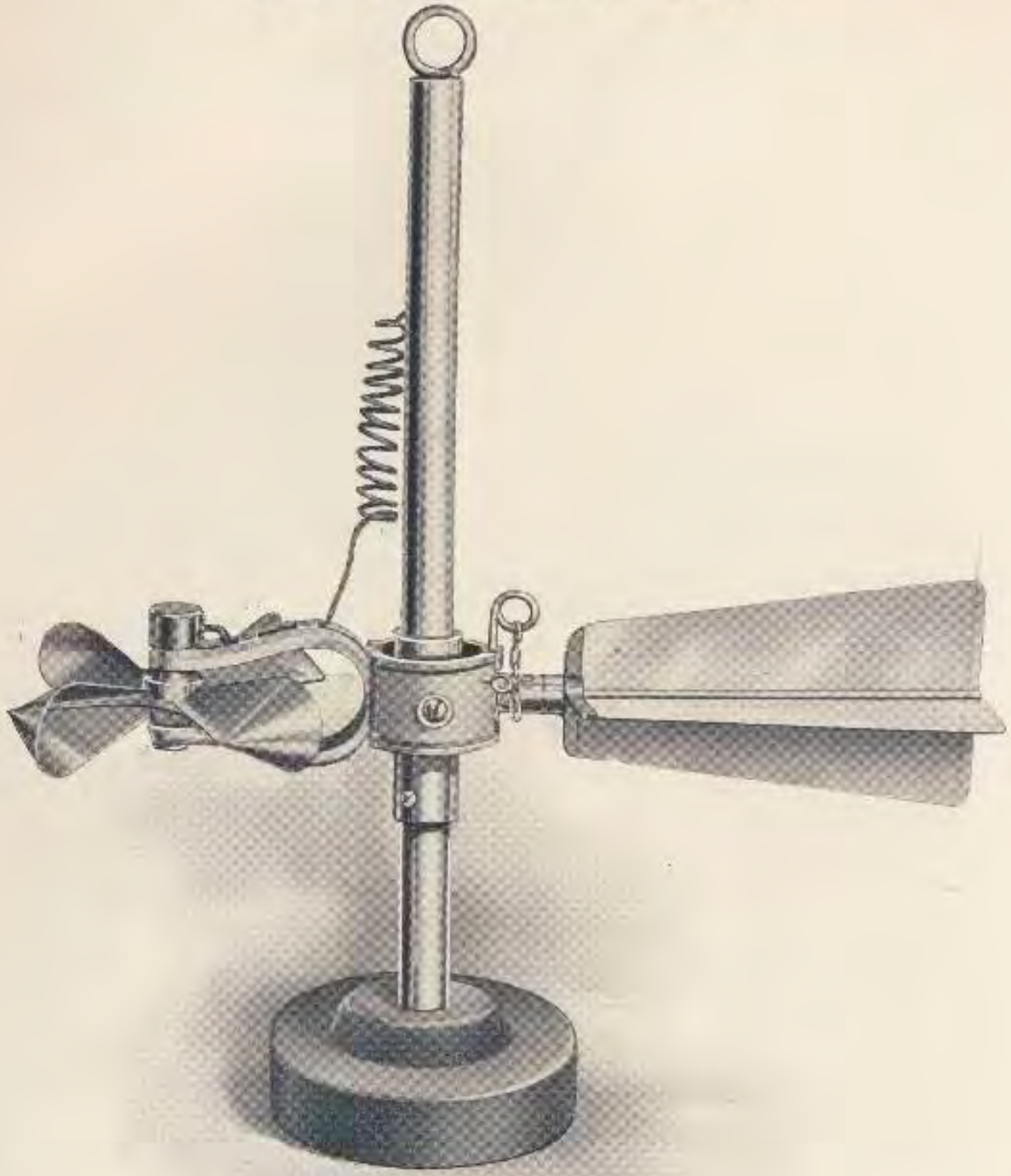
The Fteley & Stearns Model. Price complete, $150.00.

Code-Word—CURRENT.

See pages 80 and 81.

BUFF & BUFF MFG Co
BOSTON

GEN. ELLIS CURRENT METER.



No. 4.

Price, $135.00. Electric register and battery same price as for Fteley & Stearns Model. See next page.

This meter is of new and improved design and construction and is principally intended for deeper river and sea work. As made by us its friction load is extremely light.

BUFF & BUFF MFG Co
BOSTON

Current-Meters.

The various types of Current-Meters — both electrical and mechanical registering, as made by us in the past — have generally been but special orders. Since they have seldom or never been made again, we have removed the cuts of them from this catalogue, and will merely outline the more general forms.

No. 4. Current-Meter with electric register, after Gen. Ellis, embraces a meter applicable to deep-river measurements. In design it is similar to the vanes of the customary wind velocity measuring apparatus.

No. 5. Current-Meter, after A. Fteley, embodies an enclosed type of wheel similar to the turbine water wheel.

No. 7. The latest type of meter, and a successful type for delicate measurements, consists of a propeller form of wheel, and the employment of ball-bearings.

Prices and specifications furnished on request.

(Types of meters formerly illustrated have been omitted, as our present meters are but modifications and improvements on that type.)

Electric register for all our Current-Meters. Price, $50.00.

FTELEY & STEARNS METER.

This meter was especially designed for observation upon rivers, streams, conduits, etc. The registering apparatus is mechanical, but for lengthy observation we equip it with electric counter. The wheels and mechanism are protected from all obstruction, and are completely encased. The operating cam is thrown in and out of gear by a string, alternate pulls engaging the counting wheels and then disengaging.

The electrical connection is made by insulated cable to the commutator of the register wheel. The brush is of fine platinum wire and can be set so as to record whole or half revolutions.

Price of complete Meter No. 5, with complete recording mechanism, as shown in cut, with 12 feet of brass tubing in sections made to screw together, all complete in mahogany case, $150.00.

Price of electric counter reading to 999,999, with switch $50.00.

Three dry cell battery in box with lock and strap, $4.00.

Three wet cell battery in box with lock and strap, $7.00.

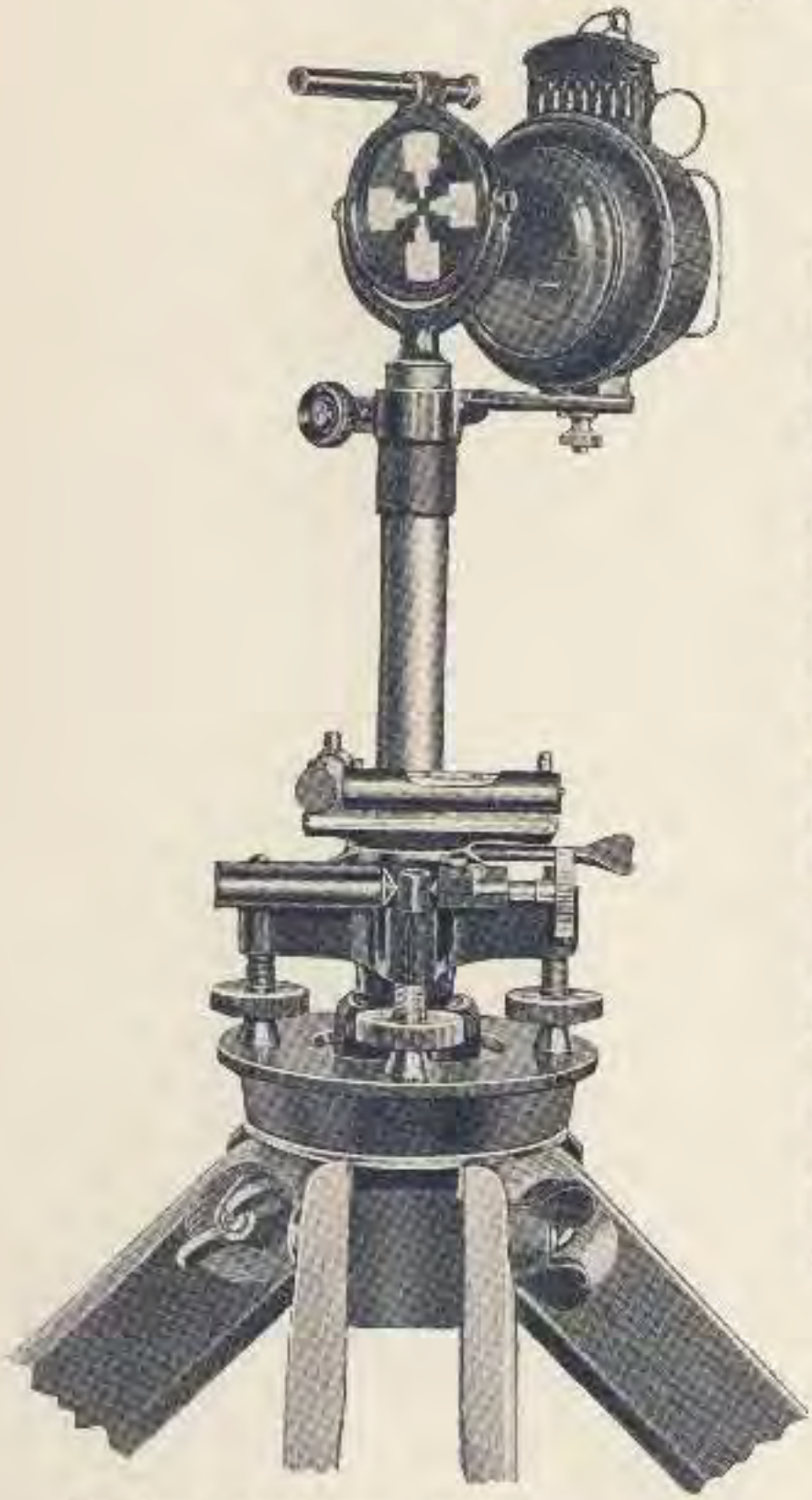
Insulated copper wire for battery, double conductor under one cover, per foot, 5 cents.

Brass tubing graduated to feet and tenths, and jointed in 4-foot lengths, per length, $5.00.

With iridium bearings, extra, $10.00.

The use of a good Current-Meter ensures the accuracy of results so important in conduit and river measurements, and our Fteley & Stearns meter is of the highest grade and guaranteed accurate.

Lamp Targets.



Our lamp targets as illustrated are made precisely of the same height as transit so that they can be interchanged without disturbing tripod. The target is made with a clamp and tangent movement for horizontal movement and can also be revolved in vertical plane. The lamp is complete with a tubular sight on top of target, as shown, so that target and lamp can be lined up more accurately. The lamp itself is also adjustable and can be quickly detached. It burns lard oil. To give better diffusion of light, the light is sent through a disc of milk glass, thus defining the intersection very sharply.

Total weight of lamp, 6½ lbs.

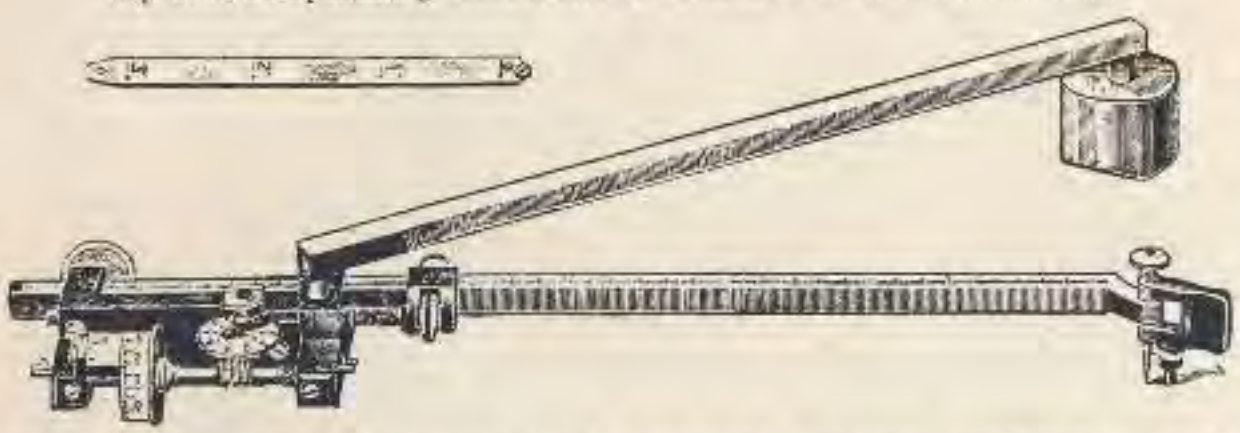
Weight of extension tripod for lamp, 9½ lbs.

Price of lamp target and tripod complete, with spirit levels, in mahogany case $90.00

Note — We make this lamp target regularly for the No. 2 size transit, but will furnish it to order for other sizes as well.

Precision Planimetre.

Improved compensating construction of German silver and bronzed brass.



This compensating Planimetre is of new and modern construction, with adjustable tracer arm, fully guaranteed.

New form of pole weight: — testing rule, and fully rated and provided with table and settings, for standard U. S. measure. Morocco case and complete directions. Price complete, $36.00.

The tracer arm is fully graduated to admit of finest possible settings so that allowance can be made for shrinkage in drawings. Index marks are also provided for standard settings in U. S. and metric measure. All parts of the planimetre are adjustable and provided with hardened steel screws, so that instrumental errors can be corrected.

The new construction of the ball joint gives the tracer-arm a motion of 180° both ways. The range of this instrument is therefore far greater than that of the usual planimetre, which has but 90° motion each way. With this planimetre too, all instrumental errors can be compensated by taking the mean of the measurements obtained with the pole on the left and with the pole on the right side of the tracer-arm.

The tracing point and the pole have both been improved upon — their construction can be clearly seen in the cut.

As these instruments will give not only the area of any figure, but also any multiple of such area and the sum of any number at one operation, they may be used to very great advantage in the calculation of cubical contents.

An original treatise by the maker for manipulating the planimetre is furnished gratis with each instrument.

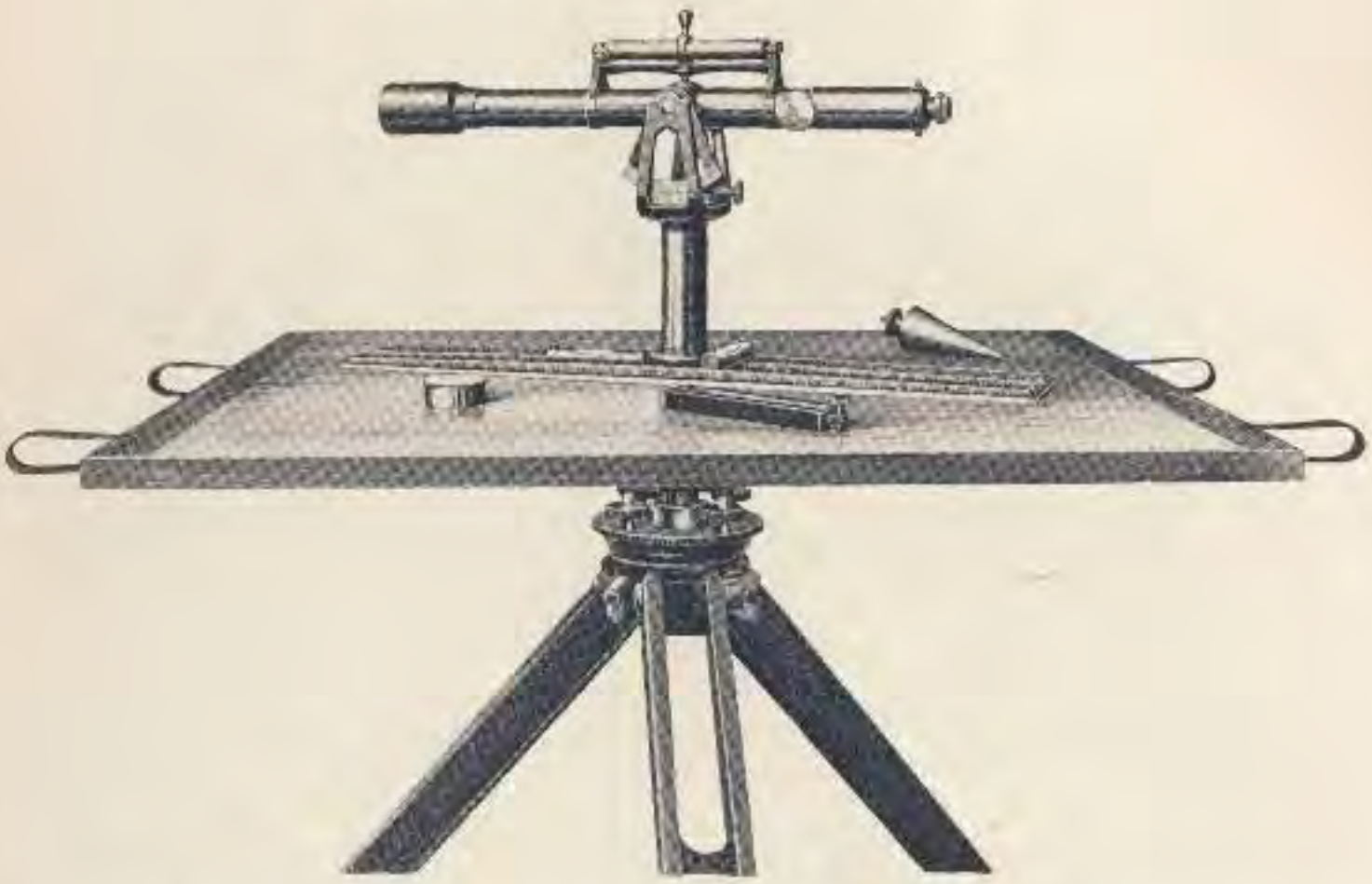
Although until recently somewhat neglected, this instrument has now received the general recognition that its design merits. This is clearly due to the accurate graduations and thorough workmanship now employed, and also to the careful instructions furnished with each instrument.

For cross-section and earth-work of all kinds, the saving of time in obtaining areas of cubic contents in inches, millimeters or acres, make it indispensable to every engineering office.

For the accurate measuring of indicator cards this instrument is specially adapted and recommended to the mechanical engineer. Price complete, $36.00.

BUFF & BUFF MFG Co
BOSTON

The Buff Plane Table.



When strength is combined with lightness in a Plane Table, its field of usefulness is almost unlimited. Heretofore weight has been one great objection to this instrument, but with our improved design, we believe the engineer will give the Plane Table the place it so well deserves in almost every class of work which comes to him in general practice. When once acquainted with its general utility he will find that no other instrument could fill its place, and that many problems in economic surveying could be solved by it.

Few engineers outside government circles have given much attention to the Plane Table, but for topography of every class, river and water works survey, railway and highway location, city and land surveys, in the design of sewerage systems and for all preliminary surveys it has no equal for speed, economy and general effectiveness. For accomplishing desired results with the least expenditure, the Plane Table is worthy the attention of all who have not yet made its acquaintance.

For information surveys, the Plane Table is the best instrument to use.

The Telescope Alidade for the Plane Table.

Its construction

The telescope is the best and most powerful for such work. It has a focal length of 16 inches and aperture of $1\frac{5}{8}$-inch with power of 35. It is equipped with stadia wires accurately set 1′ in 100′ and has a vertical arc of 5-inch radius with graduations on edge and read by vernier to single minutes placed so as to be read from eye end. The striding level is long and especially sensitive. The levelling bubbles are fixed to standard and ruler. The latter is arranged in skeleton form 22 inches long and with fiducial edge true and accurate. Lines can be ruled in the vertical plane of collimation. The adjustment of the line of collimation is made by reversing telescope laterally in its bearings.

Workmanship is of our highest grade, and finish is bright throughout. Price of alidade complete with box compass, $175.00.

For adjustments see our treatise.

THE TRIPOD. MOVEMENT AND BOARD.

Our tripod and movement is cast in hard composition, and though we can make same in aluminum at some saving of weight, we do not recommend it as better. The general scheme of our improved movement is "a quick levelling arrangement" of two oblique planes, which is more secure, rigid and speedy than the so-called Johnson type. The points of support for our movement include a larger base and give a stiff support under all conditions of wind pressure.

The method of levelling is instantaneous and the board revolves in a horizontal ring bearing. All movement is clamped securely by but one wing nut of ample size. There is no tangent screw for slow motion as table can be accurately set by hand employing the further edges of the board.

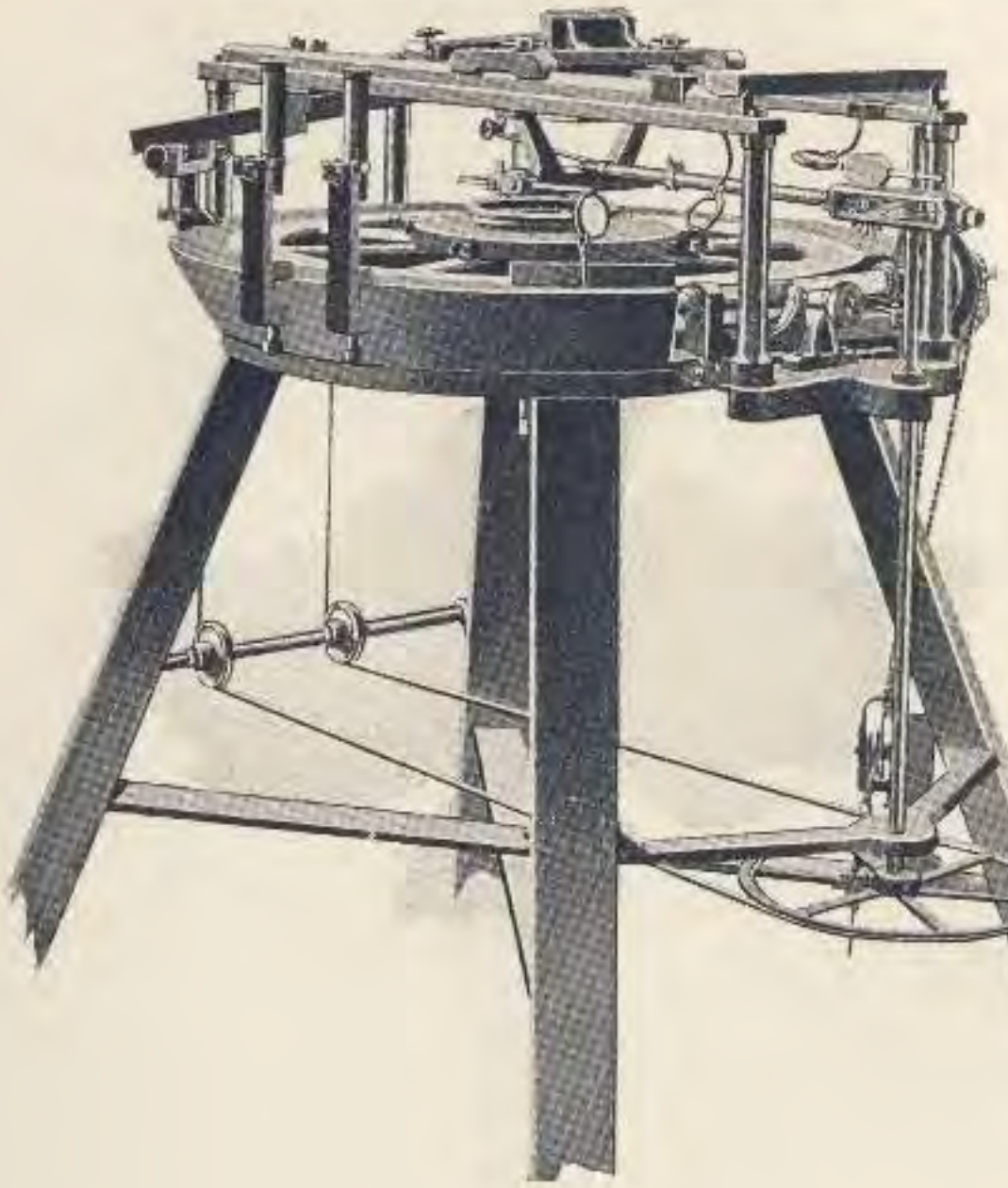
The entire movement, complete with legs, weighs but a pound more than the regular tripod for a transit. The price complete of tripod and movement, including quick levelling arrangement, is $45.00. Price of plane table drawing board, (24 inches x 28 inches), $12.00. Price of larger tripod and movement (weight 19 pounds), $70.00. Tangent and slow motion screw, $18.00.

THE "BUFF" GRADUATING ENGINES.

No. II. Graduating Machine,

BUILT BY OUR

MR. GEORGE L. BUFF, BOSTON, MASS., 1899.



Simplicity and massive design have produced that infinite rigidity which is a vital characteristic.

New construction entirely of steel and iron.

Diameter of horizontal circle, 28.5, with 1800 teeth.

This machine is capable of graduating circles, both horizontal and bevel, up to 30 inches in diameter from $\frac{1}{3}^{\circ}$ to $\frac{1}{12}^{\circ}$ with corresponding verniers of any reading. Also hour circle graduations and the French centesimal system of 400 in the circle with the corresponding verniers.

Accuracy of work upon this machine is guaranteed to be within $\frac{1}{34105}$ part of an inch for a diameter of 28.5 inches. Prices on application.

Our 1903 Graduating Engine.

Our latest and fourth addition to our graduating engines is also the largest in our shops, being 39 inches in diameter. This engine has been in process of construction for many years, and was primarily intended for the graduating of meridian circles of larger size. It is, however, in active use now on all our regular graduating work, owing to the large increase in our regular business.

Our graduations on each transit sent out are guaranteed absolutely accurate within $1\frac{1}{2}$ seconds of arc (being the equal of $\frac{1}{34000}$ part of an inch). Graduations which are tested and tried and have withstood repeated examinations by experts of wide recognition, are certainly worth having on an engineer's transit.

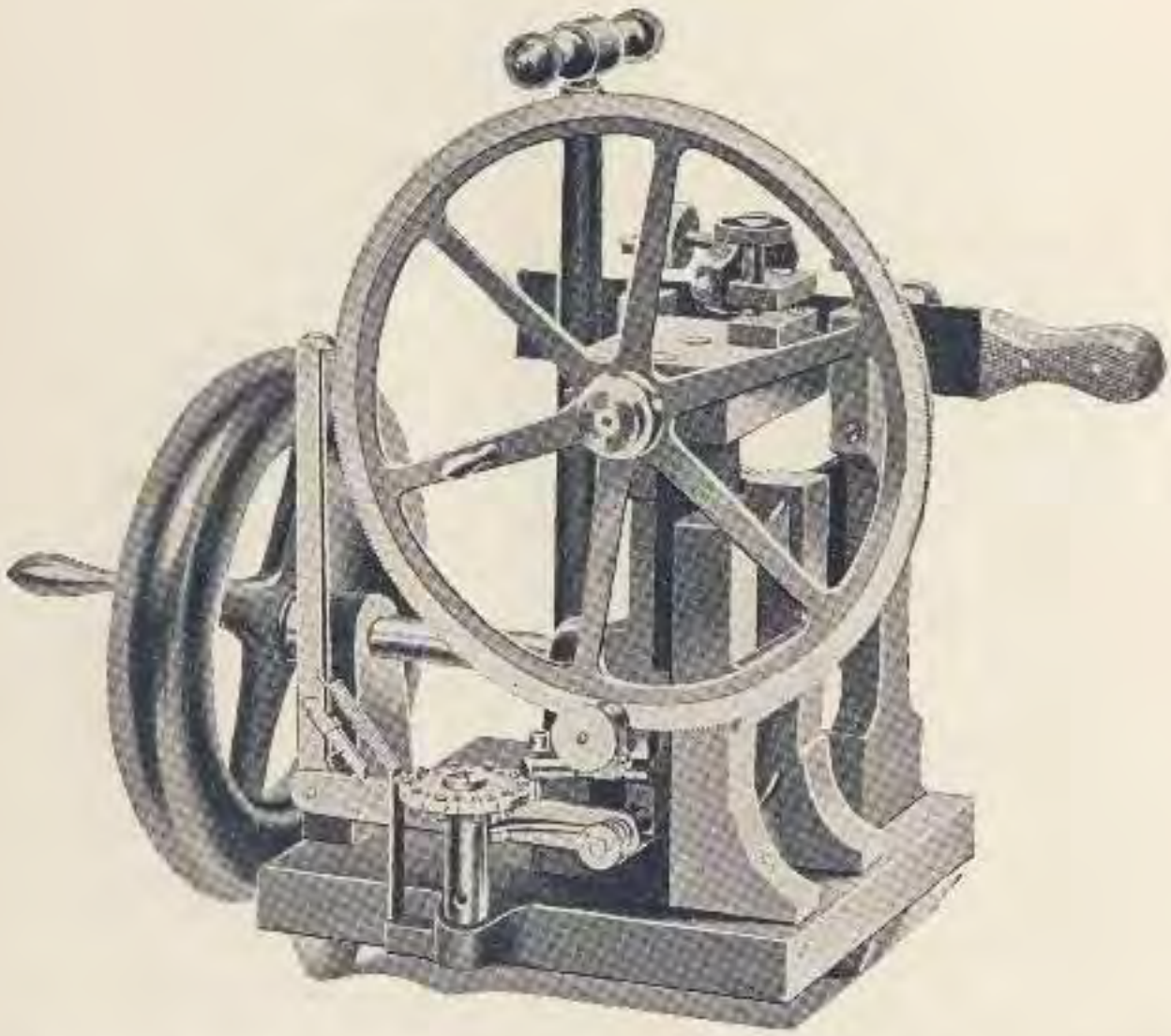
Our latest graduating engine has been the life work of our Mr. Geo. L. Buff in its design of base and construction details. Its accurate reproductions of its own accuracy of construction are alone due to the finest exhibition of precise workmanship of the present day.

Minot-Blake Precision Microtome.

THE MINOT-BLAKE PRECISION MICROTOME.

AS MADE BY

BUFF & BUFF MANUFACTURING CO.



This new microtome was constructed to meet the want for an instrument capable of cutting single-micron section in series accurately. That it has done so was the result of careful design and accurate workmanship.

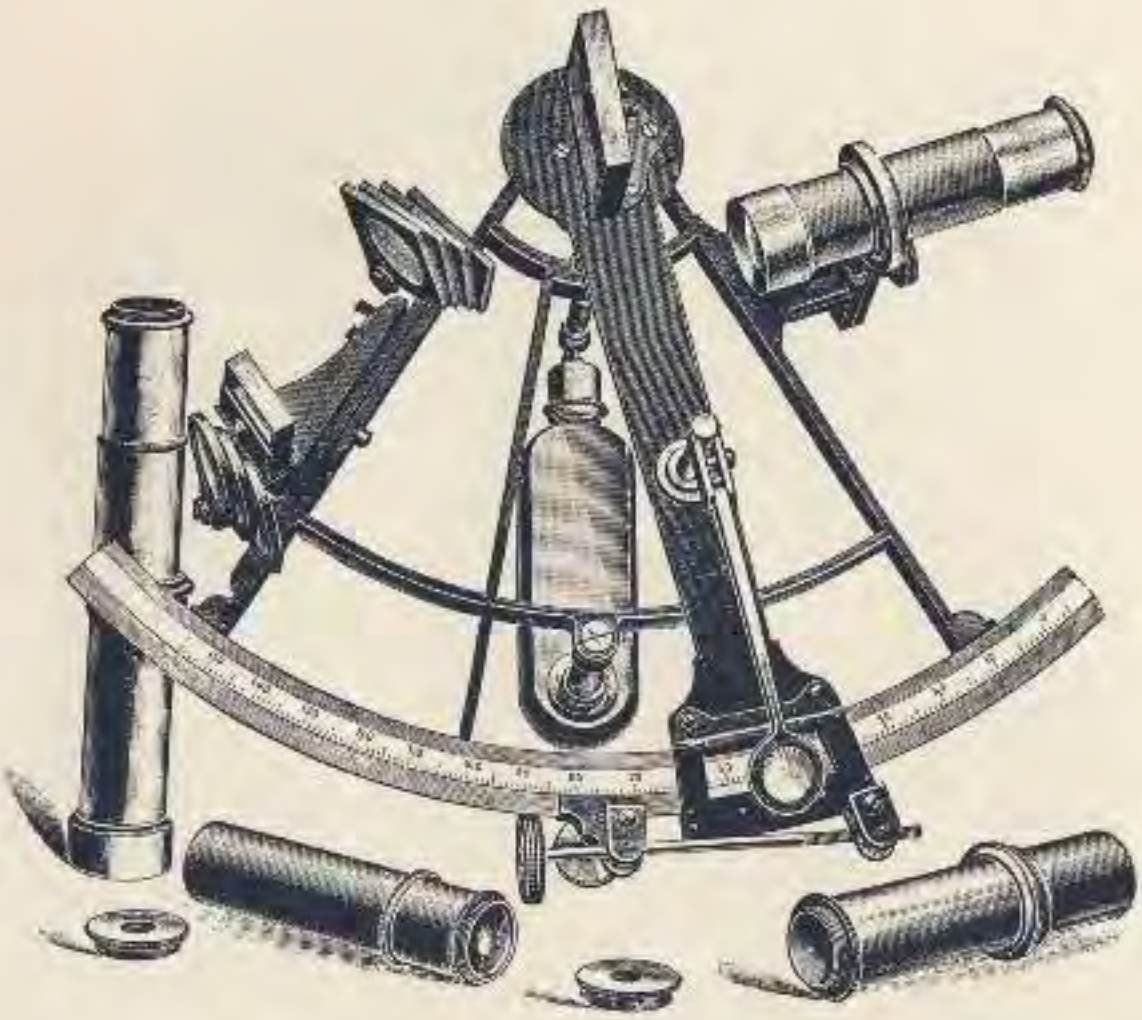
Prices and special description on application.

Dr. Bumpus of Brown University, says: "The only fault that I find with the new microtome is the fact that it has put all our old microtomes out of commission. It does such superior work that the students will use no other machine except under compulsion."

BUFF & BUFF MFG Co
BOSTON

Sextant.

U. S. NAVY, APPROVED TYPE.



Radius 7 inches, for measuring angles up to 130°; four sun glasses between the large and small reflecting mirror, and three sun glasses behind the small mirror, all of which can be turned on their axis 180°. Graduations on inlaid solid silver, reading to 10 minutes, vernier reading to 10 seconds, one reading glass, clamp and tangent screw to vernier.

One inverting telescope with two eye-pieces of magnifying powers of 6 and 12 diameters, one sighting tube and one star telescope. Two neutral glasses for telescopes, one space index and one space horizon mirror.

Instrument complete, as approved by the U. S. Navy, in polished mahogany lock case with two screw drivers, each $120.00.

Lateral Adjuster.

The above cut represents a device for moving a transit rapidly and accurately to a predetermined line. After setting the instrument approximately by the shifting centre, and levelling, it can be quickly moved into line by the Lateral Adjuster, without disturbing the levels.

The advantage of this, over other so-called lateral adjusters is that the screw is opposed by two strong box springs, thus making possible movement with one hand, and eliminating lost motion. This is an entirely new and improved design as made for the Pennsylvania Tunnel and the New York Subways.

Price as above $25.00

SPIRIT-LEVELS.

Spirit-levels of any sensitiveness and size ground to specification, and guaranteed of the same superior quality as those in our instruments, and made by our own improved process, producing that regularity unattainable by any form of hand grinding. Our stock comprises a large variety. Prices on application.

LOCK'S HAND LEVEL.

For preliminary and particularly cross-section work and slope-stake work on railroads this instrument is extremely useful, fully accurate enough and a rapid worker.

Price, complete as in cut, in morocco case, $9.00.

LEVELS ON METALLIC BASE.

8-inch Spirit-Level, with handle, accurately ground so that one division of level is equivalent to a deflection of 30" of arc. Bubble is adjustable. Complete in morocco case, $12.00.

3½-inch Spirit-Level, with handle. One division of level is equivalent to 1 min. of arc. Bubble is adjustable. Complete in morocco case, $6.50.

Both of these levels are used in setting up engines and generators and large fine machine tools.

PLUMB-BOBS AND PLUMMET-LAMPS.

Hardened and Tempered Tool-Steel Points.

PRICE LIST.

PLUMMET-LAMP No. 12.	TUNNEL-BOB No. 13.	SHAFT-BOB No. 14.
Weight, 18 oz.	Weight, 26 oz.	Weight, 44 oz.
Price complete, $9.00	Price complete, $4.00	Price complete, $5.00

In style and construction our plumb-bobs are all of a standard form, one that has been found to taper enough to allow the line of sight to pass easily by, and not be obstructed by rotundity of the bob from easily seeing the point.

Tool-steel points which are hardened and tempered in oil, are fixed to all our plumb-bobs and plummet-lamps. This feature is one that will be appreciated by the engineer accustomed to soft points, which are easily bent by plunging into wood.

PLUMB-BOBS.

All of our plumb-bobs have the hardened and tempered tool-steel points, common only to our make.

PRICE LIST.

SIZE.	WEIGHT.	PRICE.	Generally Furnished with
No. 0	26 oz.	$4.00	Plane-table, Mining.
No. 1	13 oz.	2.50	No. 1 Transit.
No. 2	9 oz.	2.25	No. 2 Transit.
No. 3	6 oz.	2.00	No. 3 Transit.
No. 4	4½ oz.	2.00	No. 4 Transit.

REFLECTOR SHADE.

To illuminate the cross-wires in mining work. Made in all sizes for our different instruments. Price, each, $4.00.

BUFF & BUFF MFG Co
BOSTON

Range Poles.

Wood.

Manufactured from well-seasoned ash, of octagon shape, hand-dressed and painted alternate white and red in feet, with tempered steel point shoe, a thoroughly first-class rod, 6 feet long, $1.70; 7 or 8 feet long, $1.95.

IRON TUBULAR RANGING POLES.

Iron tubular ranging pole, 6 feet long, painted alternate feet red and white, $\frac{11}{16}$-inch diameter, steel shoe, $2.25.

MARKING PINS.

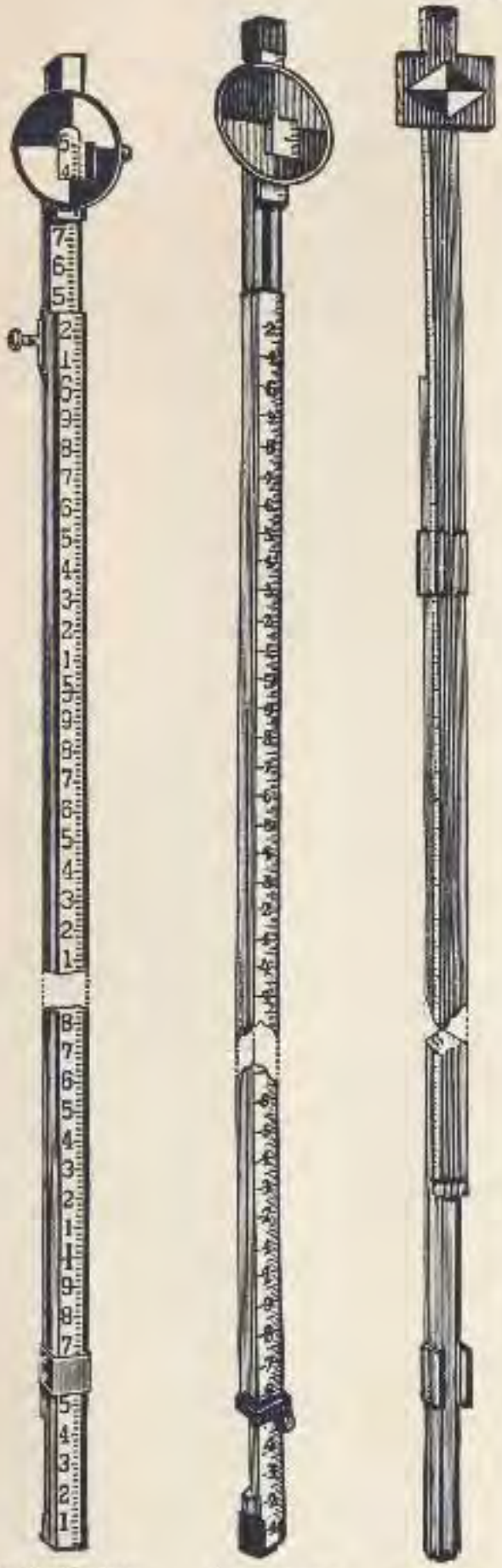
Set of 11 best spring steel marking pins, hand-tapered, 14 inches long, (rings closed to hold tags) $1.50.

Spring balance, extra quality, $\frac{1}{2}$-lb. intervals to 20 lbs.; guaranteed correct, $2.75.

BUFF & BUFF MFG Co
BOSTON

Levelling Rods.

Warranted Accurate.



Philadelphia. New York. Boston.

Philadelphia

LEVELLING ROD.

A perfect self-reading rod, with target, vernier and clamps, 7 feet long, sliding to 12 feet. Scale on tangent, reads to thousandths, $14.00.

New York

LEVELLING ROD.

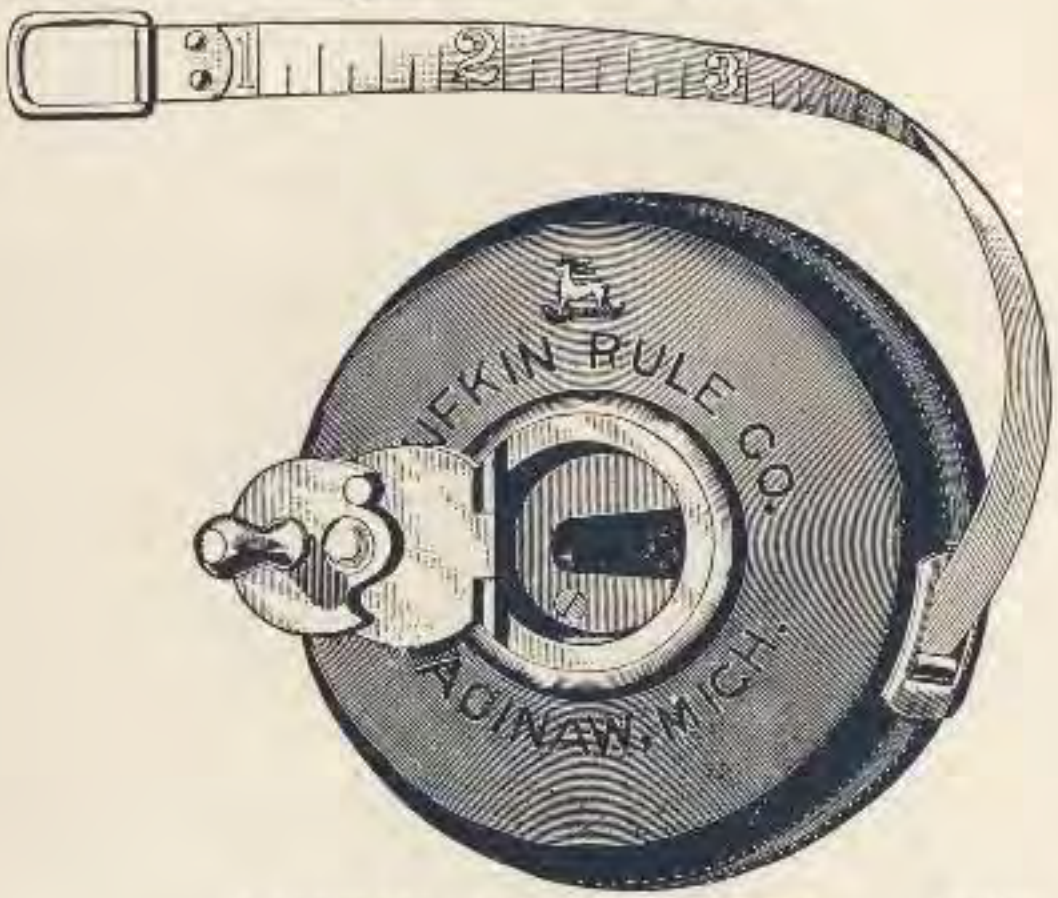
Hardwood, 6½ feet, sliding to 12 feet, verniers to thousandths of a foot, $14.00.

Boston

LEVELLING ROD.

Of mahogany, machine divided on satin-wood with target, verniers at both ends read to thousandths of a foot. 6½ feet long, sliding to 11 feet. Convenient on account of its lightness, $14.00.

Engineers' Tapes.



LUFKIN STEEL TAPES.

					Leather Case	Nickled Steel Case
100 ft.	Lufkin	steel	tape,	⅜ inch wide, in 10ths or 12ths,	$11.00	$6.00
50	"	"	"	" " " " " "	6.00	3.25
25	"	"	"	" " " " " "	4.25	
50	"	"	" Junior "	¼ " " " " " "	4.00	
25	"	"	"	¼ " " " " " "	3.25	

PAINE'S PATTERN STEEL TAPE.

¼ inch wide, in thin leather case, flush handles.

100 ft. steel tape, divided in 10ths or 12ths, ...	$9.00
50 ft. steel tape, divided in 10ths or 12ths, ...	5.00

LUFKIN STEEL CHAIN TAPES.

These tapes are intended to supersede the old chain.

They are made of a superior quality of ¼-inch wide steel — finely blued and polished.

The graduations are plainly figured on fine Babbitt metal.

Their length is guaranteed by U. S. Inspector of W. & M.

PRICES INCLUDE IMPROVED BRASS REEL WITH HANDLES.

50 ft., ¼ inch wide, graduated each foot	$4.60
100 ft., ¼ inch wide, graduated each foot	6.00
200 ft., ¼ inch wide, graduated each foot	12.00

BUFF & BUFF MFG Co
BOSTON

Chesterman's.

⅝ inch wide in leather case.

100 feet . . .	$11.00
50 feet . . .	6.00

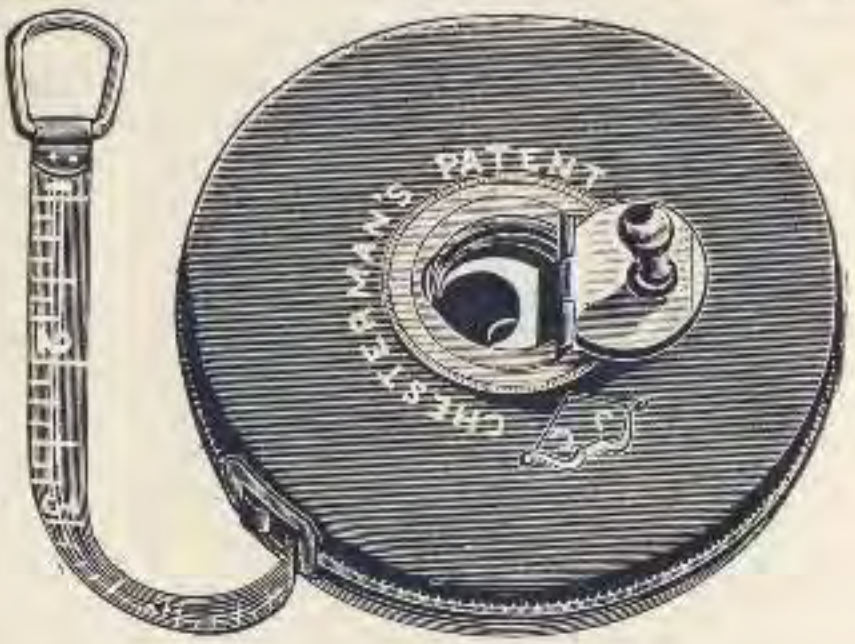
Lufkin

POCKET STEEL TAPE MEASURE

Extra Quality.

In German Silver case, with spring and stop.

36 inch long, divided in 10ths or inches,	$1.25
60 inch long, ...	2.00



Excelsior

STEEL TAPES.

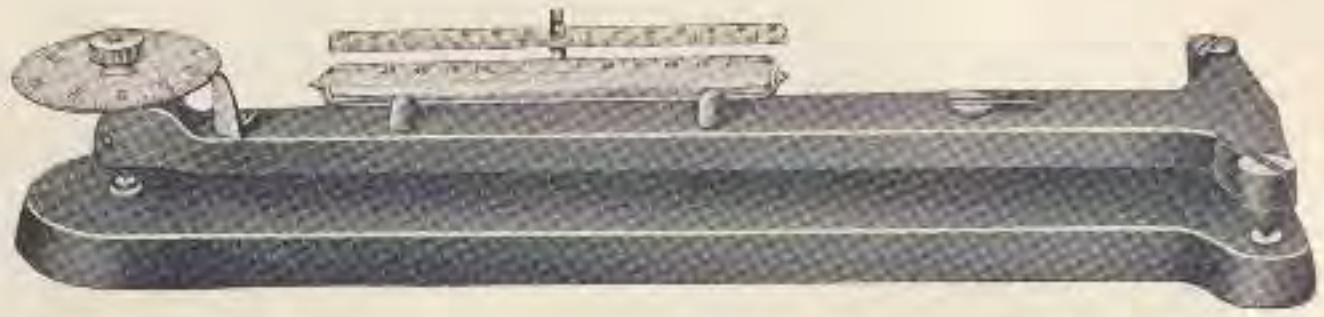
½ inch wide, on patent frame, with folding handle, graduated in 10ths, 100 feet, $11.00, 50 feet, 6.00.

METALLIC TAPES.

In leather case with folding handles.

100 feet, ⅝ inch wide, in 10ths or inches	$3.50
50 " " " " " " " "	1.95
25 " " " " " " " "	1.60

The "Buff" Level Trier.



Price of this instrument, complete, in carrying case, $30.00.

For testing the sensitiveness and regularity of curvature of the spirit vials, the "Buff" Level Trier was designed. The commercial and finished trier as listed and described is constructed like our own testing trier and by the same formula. The value of making this test is great and every college should be provided with a trier. The use of this instrument will at once show why it is that some instruments will not close an angle or a line of levels.

The inconsistency of graduations reading to 30 seconds and of front plate bubbles of four or five minutes' sensitiveness (as is occasionally found in cheaper transits) is forcibly detected and shown. Its application, however, is in testing the curvature and detecting irregularities, if any.

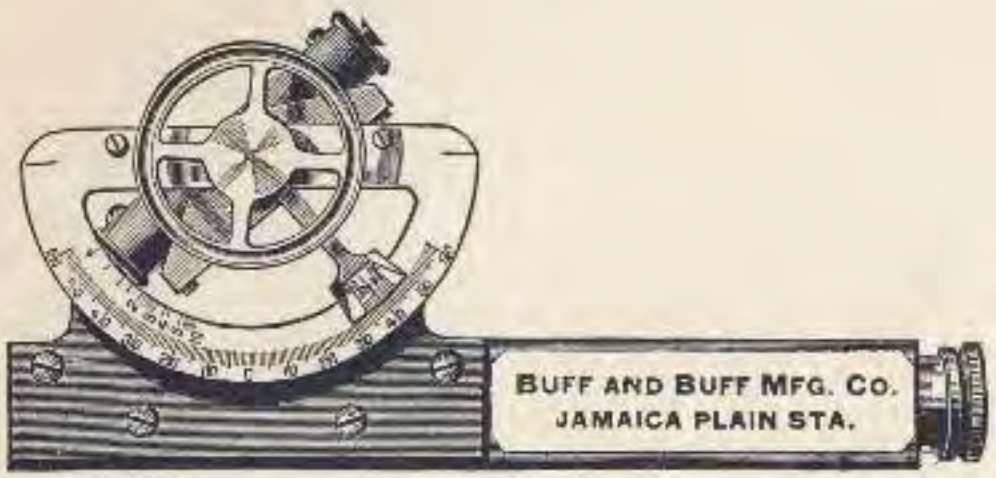
CONSTRUCTION.

The trier is 17 inches long between bearing points and reads with micrometer screw and 4-inch silver disc direct to single seconds of arc. All bearings are hardened and polished steel. Attachments are provided for examination of a complete transit, to be tested as a whole or the different levels separately.

MATHEMATICAL.

In our trier, the distance, length and pitch of micrometer screw and points are such as to give absolute readings to even single seconds and it is therefore only necessary to mention the sensitiveness of each tenth of an inch. Travel is read directly from graduated disc in correct value without making any correction whatever. The observed run of bubble is the true run and the correct curvature of same is at once determined. The vial should always be tested both forwards and backward, and in finer levels the test should be repeated several times.

The Abney Level and Clinometer.



A modification of Lock's Hand Level, with a wider range of usefullness, combining it with an excellent clinometer.

The main tube is square, and can be applied to any surface, the inclination is read from the vernier and arc when the bubble is in the middle. The angle of any slope can be obtained in the same way, by sighting along the slope at any point of the same distance above the ground at which the clinometer is held, with the bubble level.

Abney Level, giving angles of elevation, and also degree of slope as, 1 to 1, 2 to 1, etc. In case, $13.50.

Same with compass and plain staff, compass socket attached . $18.00

Field Glasses.

In the rating given these excellent glasses for the military and navy, 11 lines are equivalent to an inch. The power and definition depend upon the size of the object lenses.

No. 1 Binocular, 24 lines diameter, 8 lenses, power $3\frac{3}{4}$ times, vertical angle 9°. In soft case with handle, price $16.00.

No. 2 Binocular, 19 lines, power 8 times, vertical angle $4\frac{1}{2}$°, with sunshade, finish morocco. In case, with shoulder strap, price $22.50.

No. 1 glass embodies the maximum size of object glass, and is an admirable glass for general search use.

No. 2 is strictly a high-powered glass for the army and navy and mountain use.

Trieder Binocular.

Send for Special Catalogue.

GOERZ TRIEDER BINOCULARS.
One-half its natural size.

The method of construction of the Trieder glass demands a high degree of technical perfection, as is shown by the fact that until within a few years ago it was impossible to obtain the proper material for the reflecting prism.

By employing all the modern improvements in technical optics, and using glass of sufficient purity, C. P. Goerz has overcome all the difficulties experienced in the manufacture of the re-inverting prisms, and we believe we here place before the engineering profession a glass which fulfills every requirement in the most satisfactory manner. Send for special catalogue.

TRIEDER BINOCULAR, No. 10.

Field of view 7 times that of best opera glass of the same power, net, $44.50.

TRIEDER BINOCULAR, No. 20.

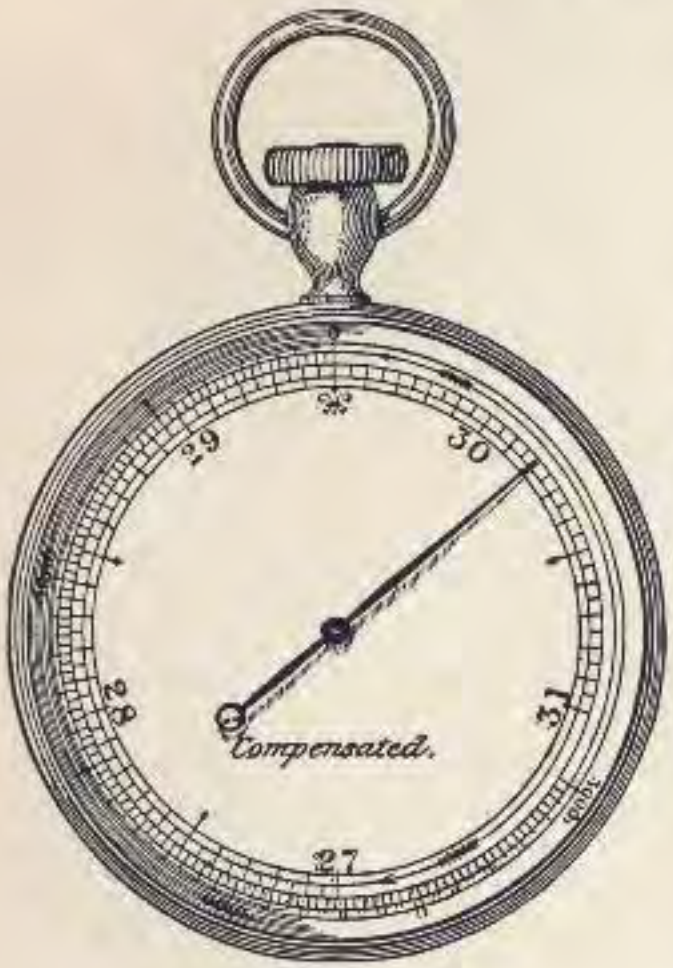
Power 6 times, surface magnification 36 times, a perfect glass for the theatre as well as for touring and the army and navy; for races and regattas unsurpassed; net $54.00

Aneroid Barometers.

To measure heights and atmospheric pressure.

STYLE AS IN CUT.

Made by the most reliable makers, and guaranteed by us to be the best.



SPECIFICATION.

2½ inches diameter, in morocco case, polished brass case, silvered dial, revolving altitude scale, compensation for temperature.

ALTITUDE SCALE.

3,000	by	10	feet	$21.00
6,000	"	20	"	20.00
12,000	"	50	"	21.00
18,000	"	100	"	22.00

MINING BAROMETER.

2,000 feet below / 6,000 feet above \ by 20 feet.

2¾-inch diameter, in bronze-finished case, silvered dial, rack and pinion to operate scale, compensation for temperature. Each $34.50.

A GOOD ANEROID BAROMETER.

1¾-inch diameter, watch pattern, silvered dial, revolving altitude scale, 8,000 feet by 50 feet (estimates to 25 feet), each $13.50.

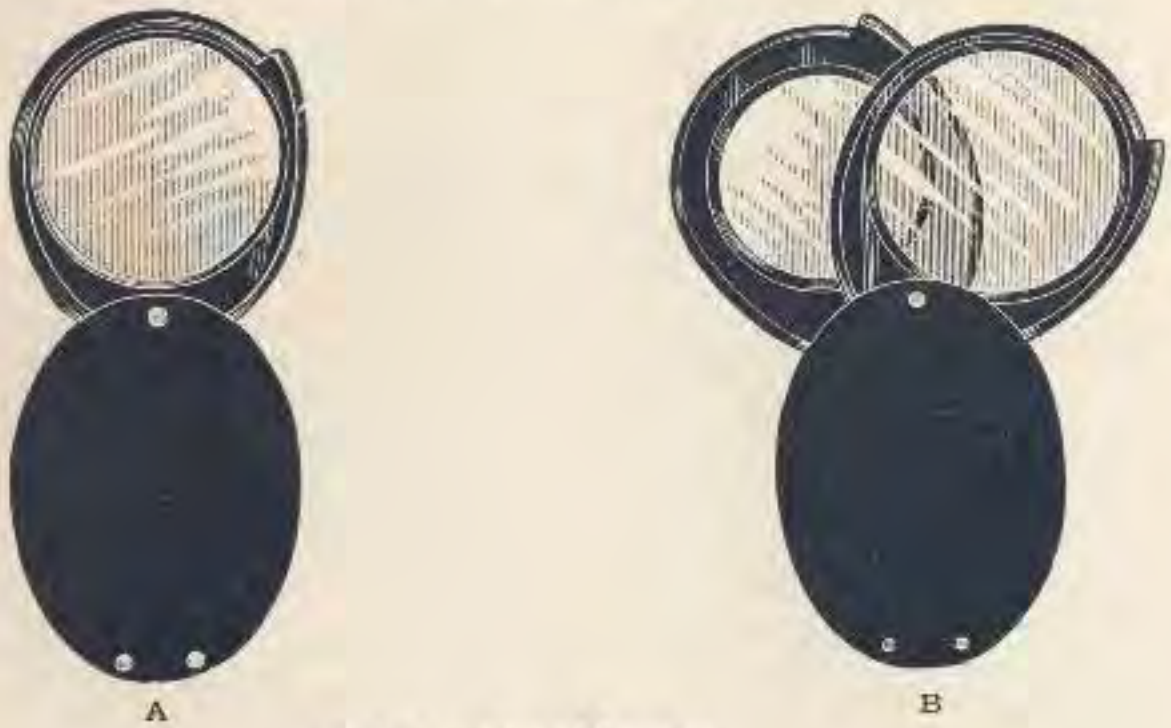
PORTABLE ANEMOMETER.

Portable air meter for the measurement of air currents in shaft mines, sewers, and ventilating ducts in buildings. The velocity is obtained by the revolution of a very light aluminum fan, on a steel shaft, in jewel bearings.

The enumeration is commenced by the long hand, shown in the illustration, continued on the smaller dials, and is continuous up to 10,000,000 feet a projecting lever on the instrument serves to disconnect fan, and stop recording.

Instrument complete, with mahogany case, universal pointed socket, holder and disconnecter, each $25.00.

Pocket Magnifiers.



A B

Style A.— Ivory Mounting.

1 -inch diameter lens, enclosed in ivory cell, ivory case, each	$ .60
1¼-inch diameter lens, enclosed in ivory cell, ivory case, each	.90
1½-inch diameter lens, enclosed in ivory cell, ivory case, each	1.15

Style A.— Black Vulcanite Mounting.

1 -inch diameter lens, enclosed, black vulcanite mounting, each	$ .30
1¼-inch diameter lens, enclosed, black vulcanite mounting, each	.45
1½-inch diameter lens, enclosed, black vulcanite mounting, each	.60

Style B.— Doublets, Black Vulcanite Mounting.

1¼-inch diameter lens, enclosed, Doublets, black vulcanite mounting, each,	$ .90

Style B.— Ivory.

1¼-inch diameter lens, enclosed, each	$1.30

GOSSAMER BAGS.

Bag of rubber sheeting to protect Wye level from dust and rain ; three sizes, each, $1.00.

SILK TRANSIT HOOD.

Made of first quality heavy umbrella silk, for transits of our make, in four sizes, each, $1.00.

OIL.

¼-ounce bottle superfine watch oil, put up expressly for lubricating our instruments, 25 cents.

Solar Attachment.

The Saegmuller Solar attachment is attached to our instruments at the net price of $50.00.

This solar attachment is made of aluminum and its advantages are several:—1st. Accuracy greater than that of others; 2nd. Simplicity of manipulation; 3rd. Its use as a vertical sighting telescope if desired.

We can attach this solar to old instruments of our make at slight cost.

It consists essentially of a small telescope and level, the telescope being mounted in standards, in which it can be elevated or depressed. The standard revolves around an axis, called the polar axis, which is fastened to the telescope axis of the transit instrument. The telescope called the "Solar Telescope" can thus be moved in altitude and azimuth. Two pointers attached to the telescope to set the instrument approximately are so adjusted that when the shadow of one is thrown on the other the sun will appear on the field of view.

DIRECTIONS FOR USING THE ATTACHMENT.

First. Take the declination of the sun as given in the Nautical Almanac for the given day, and correct it for refraction and hourly change. Incline the transit telescope until this amount is indicated by its vertical arc. If the declination of the sun is north, depress it; if south, elevate it. Without disturbing the position of the transit telescope, bring the solar telescope into the vertical plane of the large telescope and to a horizontal position by means of its level. The two telescopes will then form an angle which equals the amount of the declination, and the inclination of the solar telescope to its polar axis will be equal to the polar distance of the sun.

Second. Without disturbing the relative positions of the two telescopes, incline them and set the vernier, to the co-latitude of the place.

By moving the transit and the "Solar Attachment" around their respective vertical axes, the image of the sun will be brought into the field of the solar telescope, and after accurately bisecting it the transit telescope must be in the meridian, and the compass-needle indicates its deviation at that place.

The vertical axis of the "Solar Attachment" will then point to the pole, the apparatus being, in fact, a small equatorial.

A Few Advanced Ideas in Our Instruments.

Greater length of focus in all Transits, producing increased Brilliancy, Additional Power.

TELESCOPE — Improved system of lenses, all made by one maker, thus insuring Flatter Field, More Sharply Defined Field.

GRADUATIONS — All graduations performed by ourselves upon our superior graduating engines, and their accuracy guaranteed. Fitting together of verniers and circular graduations also by ourselves and guaranteed absolutely opposite and of absolute length.

CENTRES — For centres only the hardest bell-metal in a socket of phosphor-bronze, fitted together by the same experts of many years' experience. The regular level centres are of two kinds, the bell-metal in hard composition, and the new and successful hardened steel centre in annealed iron.

SPIRIT-LEVELS — Our spirit-levels are carefully tested, and, as made by our new process, are extremely uniform.

GRADIENTER — Thoroughly worked out and rigidly tested under severest conditions. and claimed to be absolutely accurate within $\frac{1}{10}$ of one per cent. This attachment has been perfected for the smaller No. 3 size of transit.

SPECIAL NEW CONSTRUCTION WORK — We are particularly equipped to develop economically new types of scientific instruments which are to be simplified in form and working.

Come and see us.

Take any train for Jamaica Plain, from South Station, Boston, or any car for either Jamaica Plain or Forest Hills. Whichever way you come get off at Green Street and walk to Lamartine Street. At this junction are our shops.

Very often five minutes conversation will give us a clearer idea of what is wanted than weeks of tedious correspondence.

In ninety-nine cases out of one hundred, we can show exactly what is wanted in a wholly or very nearly wholly finished instrument. Most engineers can decide better after five minute's inspection than by a whole day's study of a catalogue.

We have agents in a few large cities, who carry our instruments in stock, thus permitting engineers a personal examination, and also providing for rush orders.

If you cannot call at our factory, we should be pleased to have you call at our nearest agent, who will welcome you, and take pleasure in showing you our instruments, whether you purchase or not.

Again, remember that a personal examination will do more to convince you that our instrument is the best for you, than anything that can be said, and if you intend to buy, in five minutes or in ten years, or not at all, come and see the Buff Instrument the next time that you are in Boston.

The one best Transit of them all is the Buff — and the price, as things go, is fair and equitable. This is perfectly known in Boston, New York and Chicago, and in all other cities as well as in most of the large railroads in the United States.

We want *you* to know it as well, so let us help you to think about it. We shall do all we can to make your thinking agreeable.

Judge the Transit by itself — judge us by our dealing. Before ordering, judge our Transit by looking at it, if you can, and us by what we say and how we say it.

An inaccuracy is most likely an untruth. If this happens only once, no matter how, wipe us out of your mind.

THAT'S ALL

BUFF & BUFF MFG. CO.,

Jamaica Plain Station, Boston.

General Directions.

ORDERING.

In ordering, — please avoid any possible error by stating plainly, style, size, and kind of finish, also price. Be particular to give plain shipping directions, — the name of Express Co., etc. Transportation charges are always to be borne by purchaser.

Order as long beforehand as you can, for we have never yet been able to keep ahead of the demand, and in spite of our steady increase of plant, and skilled labor, have but a small stock on hand.

We will not send you a half finished instrument and as all of our manufacture requires time and care, we ask you to give us as much of this time as possible. Aid us to please you and we will most carefully endeavor to do so.

With triangulation transits, we can use only general terms in promising completion, for the task is so delicate that "nearly done" may mean anywhere from a day to two weeks.

TERMS.

Our terms are net cash in every case.

The catalogue price is the cash price, and from this we can not make discounts, except to regular agents.

C. O. D. orders, with privilege of examination, must be accompanied by money enough to pay charges both ways.

Packing boxes are charged for at cost price.

SHIP REPAIRS TO

BUFF & BUFF MFG. CO.

JAMAICA PLAIN STATION . . . BOSTON, MASS.

A Few Opinions.

Rapid Transit R. R. Com., New York.

It gives me pleasure to state that we have in use on the present work here in New York ninety-four instruments of your "Buff" make.

Yours very sincerely,
WM. BARCLAY PARSONS, Chief Engineer.

Spokane, Washington.

We judge, therefore, that errors below 2″ of arc have been entirely eliminated in your graduations. * * * * We would state further that it is the first and only transit we have used in which the graduations could be proved accurate to 2″ second of arc and less.

Austin, Texas.

After six months' constant field use of my transit I have found no occasion to adjust the same at all. The gradienter attachment works accurately. The line of collimation is still perfect and the telescope focusing slide works very perfect with no back lash.

Atlanta, Georgia.

I am pleased, in fact very pleased, with your "Buff" Transit lately sent me. After a month's steady use I do not hesitate in stating my convictions that, in your own words, "Quality in Engineering Instruments holds first place in every part." The glasses in the telescope please me greatly and are the best I own in any of my six instruments.

Sault Ste. Marie, Ontario, Canada.

In concluding would say, we are especially pleased with the four transits furnished us recently and will assure you we certainly consider your make the best, and what we shall choose when again in the market.

Denver, Colorado.

The No. 4 Transit is a beauty in looks and more than that in action, for there is not one feature that I should even suggest as having been overlooked to make it the eminent success it is.

Eldora, Colorado.

The telescope in definition far excels my old transit, and certainly makes your transit a superior but above all a "consistent transit of the highest quality."

Honolulu, H. I.

I must say it exceeded my most sanguine expectations. It is the most cute looking instrument I have ever seen. The first preliminary test of the transit fully confirmed your assertions that "it leaves our shops in elegant adjustment." * * * * "Since my last letter I have put the transit to some thorough tests in the field, and it worked splendid. The line of collimation is absolutely perfect for all distances, stadia works beautiful, and the excellence of the graduations was even more demonstrated in triangulation work."

Granite, Colorado.

A transit that is altogether satisfactory in every respect, with particularly clear lenses. Once again complimenting you on the beauty of form and general appearance of the instrument.

Tucson, Arizona.

The finish is really the best I have ever seen, and together with the proportion of the longer telescope, etc., makes a handsomely finished and graceful transit.

Mexico City, Mexico.

It pleases me in the graduations and the clear light in the verniers with your admirable arrangement of the verniers at 30° to telescope. The especial feature that catches my attention is the position of the plate bubble, insomuch as it does not stick out on the edge of the plate, thereby being free from knocks.

Mobile, Alabama.

The summary, then, of this extended triangulation survey with your transit No. 3026 gives the corrected angle with an error of 0.26 second of arc, a result that we have no hesitation in saying is better than the best result ever attained in our office with any of the older transits.

Sydney, N. S., Canada.

Respecting the accuracy of my new "Buff" transit when put to the test, and of its extreme rigidity and satisfactory working capacity, I am more than pleased. Without question the transit is the most gracefully proportioned I have ever seen, etc., etc.

Seattle, Washington.

The particular feature that delights my men is the very excellent telescope that you have furnished in the transit. To use their own words, "the glasses in the Buff & Buff transit are clear and sharp, and better than our old transit."

We are prepared to say that there are no surveying instruments on the market today equal to those manufactured by Buff & Buff of Boston. The instruments are made of the best materials, are durable in use, perfect in construction, of superior workmanship, and have given us absolute satisfaction under all climatic conditions. They are thoroughly reliable in every respect and can be depended upon.

We will also mention that promptitude is a special feature of your business methods, and was one reason why you received duplicate orders.

Repairs.

That our instruments may be protected and kept out of the small repairer's shop, they are designed to secure best possible distribution of metal. Long experience has revealed the general direction and force of blows and falls, and it is protection against them which so strongly marks the difference between our transits and others. Given equally severe falls, the "Buff" withstands them remarkably. The cost is generally less than one-half that of repairing a cheaper instrument. Our charge to the engineer, which is the actual shop cost to us, has formed such an inducement to send injured instruments to our shops for repairs that our splendid facilities for repair work are continually in pressing demand.

We have found this policy to be a promoter of closer relations with our customers which is always to mutual benefit.

It is well to bear in mind that one of our particular shop mottoes is, "To make the "Buff" transit of such thorough and lasting construction as to keep it out of any repair shops indefinitely."

We always guarantee to put the instrument in as good order and adjustment as the extent of damage and the general wear will permit. Engineers sending instruments should point out in detail, parts to be repaired; but the best course is to have the instrument put in thorough order and adjustment, allowing the firm to execute whatever repairs are needed to make it as serviceable as possible. This course is more expensive, but most satisfactory and in the end cheapest. Our own instruments should be sent to us to insure fullest satisfaction. Time and money is saved as we duplicate parts from stock on hand. In order to conform to the rules of most of the large express companies, our customers should, in sending an instrument to us from a distance, place it carefully in a box and again enclose this in a packing case.

Telegraphic Code.

ENGINEERS' TRANSITS.

Transits will include the following (unless ordered to the contrary):

Ground Glass Shades,
Solid Silver Graduations,
Verniers 30" to line of sight,
Erecting Telescope,

Complete in case with accessories.
Regular tripod for No. 1 and No. 2 transit,
Extension tripod for No. 3 and 4 transit.

	No. 1 Transit Dia. 6½" Wt. 14 lbs.	No. 2 Transit Dia. 5½" Wt. 10 lbs.	No. 3 Transit Dia. 4½" Wt. 6½ lbs.
Plain Transit	Theocat	Trandus	Trius
Bubble Transit	Theodite	Trandist	Tribat
Bubble and Arc Transit	Theodas	Trandate	Trio
Bubble Circle and Guard Transit	Theoduse	Trandolite	Trigon
Triangulation Transit	Triangulate	Trimont	
Tunnel Transit	Tunnel		
Penn. Precise	Theopenn		
University Precise	Theopennsy		

ENGINEERS' LEVELS.

	Dumpy Level	14½" Wye Level	18" Wye Level
Erect	Dumpat	Wyeing	Wyes
Invert	Dumpus	Wyeate	Wyat
Erect, Fixed Stadia	Dumpfixt	Wyefix	Wyfixt
Invert, Fixed Stadia	Dumpinfix	Wycatfix	Wyatfix
Hydrographer's Level	Hydrograph		
Sighting Level	Sigvel		

MISCELLANEOUS.

	Code		Code
Send particulars by mail	Ongo	What is the price of, and how soon can you ship	Scandia
Answer by wire, night message	Oakley	We are awaiting your remittance	Schalls
Has letter been received of——inst	Onyu	Shall we ship C. O. D. or await remittance by mail	Salvl
Your letter has not been received	Ongie	Delivery F. O. B. Boston	Scahy
Answer by cable or telegram, our expense	Onvil	What will extra expense be of	Scandall
We do not know what you mean,	Onus	By what line have you shipped	Tabn
Send latest catalogue to	Obtle	Ship by express	Talmo
According to instructions	Oiley	We are shipping today	Tortig
Please reply to our letter of——concerning	Otter	How shall we ship	Telling
Please refer to letter of	Omble	Shall we ship	Tomos
Do nothing until you receive our letter of	Owner	We can ship	Tottles
What will be weight of	Ogly	We will ship immediately	Tostis
Answer by wire at once	Ockle	Send tracer for	Tastin
Enter our order for	Raker	Will ship by steamer leaving N. Y.	Tisty
Add to our order	Runkle	How many shall we ship	Tatlas
We are doing all we can to hurry your order, hope to send it shortly	Ramble	Have you shipped	Tarant
When can you fill an order of	Ratn	We can ship immediately	Tabal
		We can ship after receipt of order in——days	Tasox

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OUR HAND-BOOK,

"THE BUFF TRANSIT AND ITS ADJUSTMENTS,"

WILL BE MAILED GRATIS ON APPLICATION.

OXFORD-PRINT BOSTON