

SECTION A. 1892.

# JOHN DAVIS & SON,

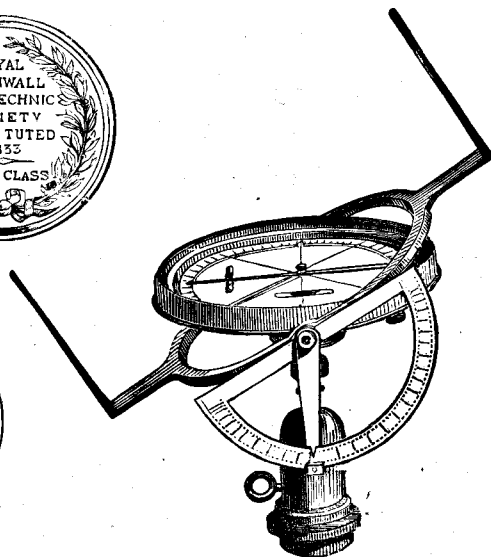
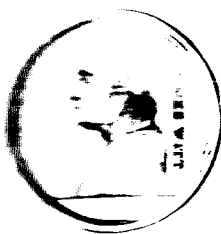
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Mining, Surveying, Engineering, and  
Mathematical Instruments.

## MINERS' SAFETY LAMPS.

BREWERS' INSTRUMENTS.

ELECTRIC LIGHT AND POWER ENGINEERS.



## ALL SAINTS' WORKS, DERBY.

Telegraphic Address—"DAVIS, DERBY."

118, NEWGATE STREET, LONDON, E.C.

BUTE CRESCENT, CARDIFF.



Catalogue Section B, } FREE UPON APPLICATION.  
Electrical Department, }

Electric Lighting Plant, Electric Transmission of Power,  
Electric Blasting Apparatus. Electric Light Fittings.

TELEPHONES, ELECTRIC SIGNALS, LIGHTNING CONDUCTORS.

## NOTES AND TERMS.

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IN consequence of the great development of our Works, particularly in Electrical Engineering, we have found it necessary to group the management under two heads, and to publish two distinct catalogues representing the two Departments.

CATALOGUE A represents our manufactures in Mining, Surveying, Engineering, Mathematical and Meteorological Instruments, Miners' Safety Lamps, &c.

CATALOGUE B represents our Electrical Engineering Department, and contains Prices, Specimen Estimates, &c., of Plants for Electric Lighting, Electric Transmission of Power, Plants for Hauling, Coal Cutting, Drilling, Pumping, &c. Electric Signals, Electric Blasting Apparatus, Electric Light Fittings, &c.

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With regard to the present edition of Catalogue A, we beg to call attention to the fact that we are manufacturing Surveying instruments, where great lightness combined with strength is desirable, in a special alloy of Aluminium.

It may not be generally known that instruments such as Theodolites, Levels, Dials, Anemometers, as well as Thermometers, may be sent to Kew Observatory to be tested, and when desired we undertake to forward instruments to be verified.

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With more modern machinery and improved screw cutting appliances we have for some years manufactured Miners' Safety Lamps to Standard Sizes, thus ensuring all parts being interchangeable; the same system has been introduced in Surveying Instruments, and throughout our manufactures generally.

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TERMS:— $2\frac{1}{2}$  % Cash, or Net Monthly. Packing and delivery extra.

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Export orders  $2\frac{1}{2}$  % cash with orders or upon presentation of Bills of Lading to British houses. Packing for shipment in tin-lined cases  $2\frac{1}{2}$  % upon value of goods.

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SPECIAL ESTIMATES FOR REGULAR SUPPLIES.

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PRICES ARE SUBJECT TO ALTERATION WITHOUT NOTICE.

# THE HOFFMAN PATENT TRIPOD HEAD.

IMPERFECTIONS OF THE ORDINARY FORM OF TRIPODS FOR FIELD INSTRUMENTS, &c.  
WITH A DESCRIPTION OF A NEW TRIPOD,  
FOR INSTANTANEOUSLY SETTING AND LEVELLING UP FIELD INSTRUMENTS.

SOLE MANUFACTURERS UNDER THE ENGLISH, FRENCH, AND BELGIAN PATENTS.

ENGLISH PATENT ... No. 2,084.

FRENCH PATENT ... No. 113,969

BELGIAN ... No. 32,507.

## EXTRACTS.

(Transactions of the American Institute of Mining Engineers.)

### IMPERFECTIONS IN SURVEYING INSTRUMENTS.

By JOHN HENRY HARDEN, University of Pennsylvania, Philadelphia.

With imperfect instruments it is impossible to make accurate surveys; the results are inaccurate maps, with their attendant expenses. The design of the writer is to describe an improved form of a tripod head, and certain defects in an English surveyor's dial, and a miner's dial, with the method taken to remedy the defects of the transit. When the present transit supercedes the surveyor's compass, there was one special objection brought against it, and with some show of reason; namely, that the tripod of the compass with its ball and socket motion, allowed a quicker levelling up, and consequently more work was possible with the transit. To this objection it was replied, that the ball and socket would not allow the instrument to be levelled with the same degree of precision that could be attained with the levelling screws, and that if accuracy was sacrificed greater accuracy was attained. Nevertheless it is a well known fact that in this country, and especially in England, the compass or miner's dial holds its ground solely from its rapid adjustment.

Ever since the introduction of the transit efforts have been made to give to this instrument the same facilities of levelling possessed by the compass or dial, and the same means have been tried, i.e., a ball and socket motion, since a modification of this in some form was the only method that would answer. The upper part of a transit is, however, much heavier than the corresponding parts of a compass, and therefore requires more binding power, which cannot be obtained with an ordinary ball and socket joint. It has been a study with instrument makers to combine the facility of these two methods—the quickness of the ball and socket with the steadiness and accuracy of the screws; but in all attempts in this direction the ball and socket of the compass has been literally followed, the entire stability of the instrument depending upon the friction of the ball in its socket.

There is great need for a tripod that can be more easily manipulated than the usual form, for it rarely happens that a surveyor has a level surface on which to set his instrument; and very often the topography of the country, or the irregularly inclined strata of the mine, present places where it is often very difficult to set up an instrument. Much of the time in surveying is employed in this adjustment—and, during this time, the assistants are generally kept waiting; it will therefore be readily understood that any change tending to give greater speed in the setting up and levelling operations is of small importance.

The ordinary form of tripod has many defects, which have been borne with simply because no method has been devised to correct them. One of the disadvantages is that it is almost impossible to level up a sensitive bubble so that it will remain in the centre of its run long enough to take a satisfactory sight; that is, after setting the instrument level and looking at the bubble a second look at the bubble it is almost invariably found out of place. It is then necessary to level up the instrument in this operation two or three times before one can feel satisfied that the observation is correct. These errors are due to arise from the springing of the plates by forcing the levelling screws too tight; investigation, however, has shown that in the majority of cases there is one common cause—the springing of the screws themselves. The screws, when they are tightened to a considerable extent, do not stand perpendicularly to the plate on which they rest, but on an inclined plane, and when they are loosened their points have a tendency to slide down this plane. (See Fig. 4, page 5.) In this position the points of the screws have a tendency to bind or bend them. If any two opposite levelling screws are used, the other two will be other unscrewed (as in levelling up an instrument), the points of the two remaining screws will describe small arcs of circles instead of standing upon fixed points.

There is another imperfection in the construction of some instruments; that is, the plummet is attached to some point on the axis above or below the centre of the ball and socket. In either case the plummet, after being set over a station, will, during the operation of levelling up, travel away from the point. This will be found to operate in a degree proportionate to the distance of the attachment of the plummet from the centre of the ball, and the deviation of the axis from the perpendicular at the time the instrument is moved over the centre. This defect can be got over by levelling the instrument first, then moving it over the station. No such defects exist in the construction of the improved tripod to be described.

Although all the other parts of the instrument have been improved from time to time, the tripod head, with one exception, remains the same as originally devised. The one change is the addition of the shifting-head, allowing the entire instrument with its plummet to be accurately placed over a fixed point after the operation has been approximately performed by moving the legs. This improvement, in various shapes, common to all first-class theodolites, is a valuable one, and is shown in Fig. 1. *II* is the screw cap of the tripod; *JJ*, the shifting plate; *HH*, the levelling screws. On unscrewing these, the plate *JJ*, forming a part of the socket *NN*, of the small ball *OO* (the centre of which is the axis of the instrument, and the point from which the plummet is suspended) can be moved in any direction within the limits of the inside opening *LL*, of the screw cap *II*.

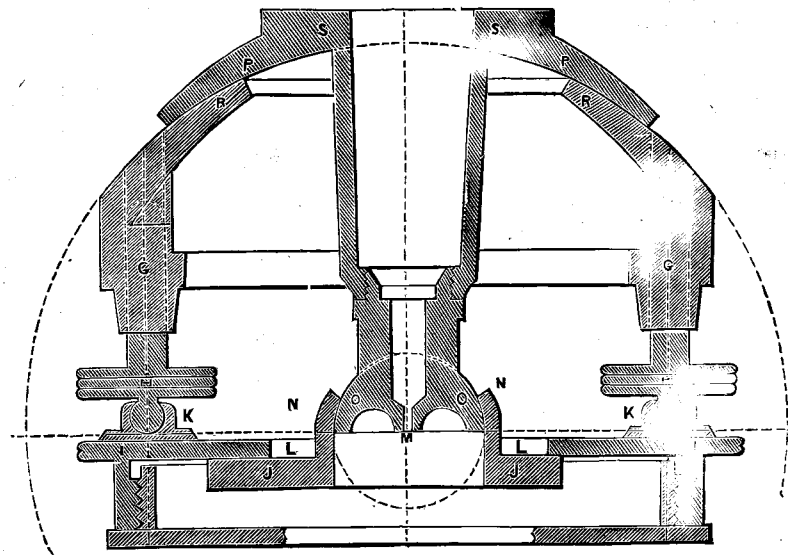
The advantages possessed by the new form of tripod are as follows:—

*First.* A saving of time, arising from an increased facility of setting-up and levelling, which can be done approximately at once without the use of the screws. Less than half a turn is then necessary to bring the instrument to a perfect level, the operation at the same time clamping both the joint and centring movement. *Second.* The levelling screws, *HH*, are at all times perpendicular to the plate *GG*, to which they are attached, and the plate *KK*, and screw cap *II*, on which they rest. *Third.* The levelling screws are reduced in length, and in their duty to a minimum, the instrument being no higher or heavier than before. The shifting head for plumbing over a fixed point is retained, no extra screws being required to clamp the instrument, this operation being performed at the time it is brought over the point, and finally levelled by half a turn or less of the screws. When this is accomplished, the centre of the cross-wires of the telescope, the centre around which the instrument turns (being the centre of the two balls (*M*), the point from which the plummet is suspended), the point of the plummet, and the fixed point or station over which the instrument stands coincide with each other.

Fig. 1 is the cross-section of the improved tripod head, and Fig. 4, page 5, is a section of the old form of tripod. In the former *II* is the screw cap, *JJ* the shifting plate, a part of the small socket *NN* of the ball *OO*, and *HH* are the levelling screws; these parts are common to all first-class instruments. It will be observed, however, that besides the half ball and socket (*NN*, *OO*) above mentioned, there is an extra and larger ball and socket represented by the letters *PP*, *RR*, forming a part of plate *SS*, to which the instrument is fastened, and part *GG*, to which the levelling screws are attached, the latter part always remaining parallel to the screw cap of the tripod head, on which the points of those screws rest; so that, whatever position the instrument may assume in relation to the tripod head, the screws will always act directly perpendicular to both plates, *GG* and *II*. The contrary is the case in the old form of tripod, as shown in the cross section, Fig. 4, where the screws appear resting upon the inclined plane, *CD*. In Fig. 1, the two half-balls, *NO*, *NO*, and *PR*, *PR*, are respectively  $1\frac{1}{2}$  and  $3\frac{1}{2}$  inches in diameter, and the instrument moves under all conditions upon a centre common to both balls, this being the point (*M*) to which the plummet is attached; it is therefore impossible for the plummet to be otherwise than perpendicular to the axis of the instrument.

It is scarcely necessary to give here the *modus operandi* of using the instrument fitted with this improvement; it will be readily understood from an examination of the drawing. The improved head saves from one-half to two-thirds of the time usually occupied with screwing and unscrewing as in the old plan."

*Estimates given for altering Theodolites, Levels, Dials, etc., to the Patent Hoffman system upon receiving the instruments, or full particulars.*



HOFFMAN PATENT JOINT FOR THEODOLITES, TAKING THE PLACE OF THE PARALLEL PLATES, AND THE BALL AND SOCKET JOINT.

Fig. 1.—Hoffman Patent Tripod Head, with Centring Movement.

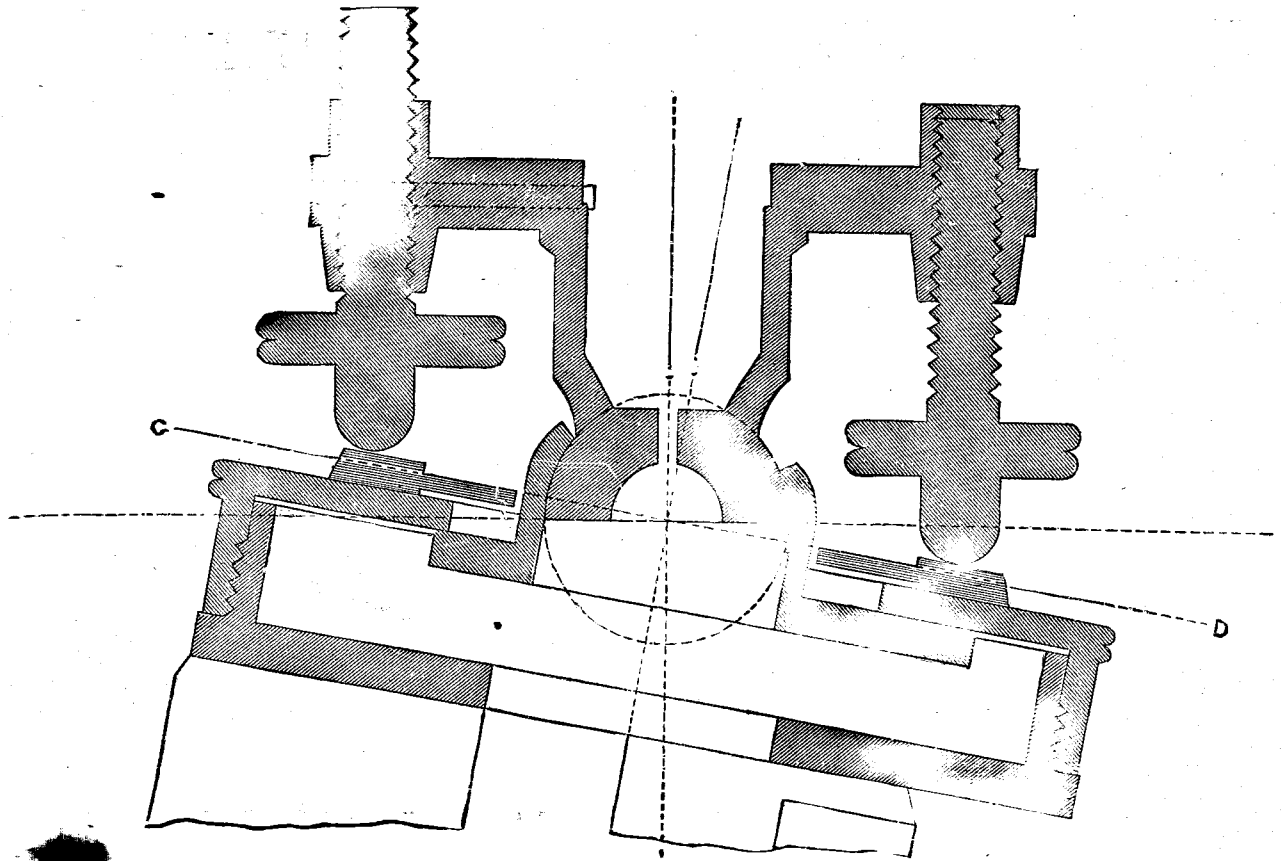


Fig. 4—Old Form of Parallel Plates.

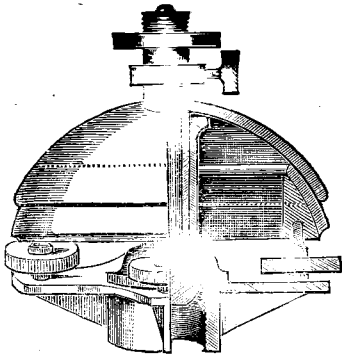
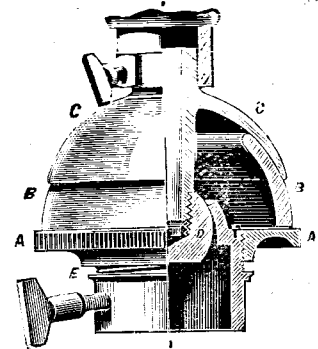


Fig. 2.—Hoffman Patent Joint for Levels or Dials with Telescopes with 4 screws for fine adjustment and for clamping joint.



HALF SIZE.

Fig. 3.—Davis's Improved Hoffman Joint for Dials without Telescopes.

Fig. 3.—Improved Joint, is specially designed for Miners' Dials, without Telescopes, and possesses many advantages over the ball and socket, amongst which the following may be mentioned:—

- (1) The plumb line is suspended from D, the actual centre of the dial, which cannot be achieved with the ball and socket.
- (2) The rubbing surface is some ten times greater, and, therefore, the joint is far more rigid.
- (3) The joint is manipulated with greater ease and despatch, a slight turn of the milled flange, A, A, from right to left liberates the two concentric balls, B and D, the dial is then levelled up, and a slight turn of the flange from left to right secures the joint.
- (4) Only one hand is required to manipulate the joint.
- (5) The total height of the improved joint is 3 in., the ordinary ball and socket  $3\frac{3}{8}$  in.
- (6) The length of the centre is  $2\frac{1}{2}$  in., that of the ball and socket is barely  $1\frac{1}{2}$  in., thus the dial reverses with greater accuracy.

*While possessing many and important advantages, the joint is no heavier than the ball and Socket.*

Existing Theodolites, Levels, and Dials, may be adopted to the Hoffman Patent Joints.

# DAVIS'S MINER'S DIAL.

*In his Treatise on Mine Surveying (London: C. Griffin & Co., 3rd edit., 1891) Mr. B. H. Brough, Assoc. R.S.M., F.G.S., &c., gives the following description of the Davis Dial.*

**DAVIS'S MINER'S DIAL.**—This improved form of Hedley Dial is the best instrument for colliery use.

See Fig. 14, page 11, of this Catalogue. The Dial combines all the latest improvements of the Hedley Dial with the outside vernier of the theodolite.

It consists of a compass box 5 or 6 inches in diameter, divided into 360° on the compass ring, and into four times 90° on the plate, 0° being at the north and south points, and 90° at the east and west points. There are two spirit levels at right angles to each other in the face of the instrument, protected by the glass cover of the compass box. The sights are the same as those of the older form of Hedley Dial.

Underneath the main-plate there is a circle or limb divided into 360°. A vernier attached to the outside of the compass box enables horizontal angles to be read with great precision. Being placed on the outside circumference of the Dial, the vernier is more easily read than when placed inside the compass box, and the necessity of raising the head above the dial-face is obviated. The upper and lower limbs of the instrument may be fixed together at 360° if required, by means of a pin under the body of the instrument.

The Hedley form of side arc for taking vertical angles is replaced by a fixed circular box 1 $\frac{3}{4}$  inch in diameter, with a hand traversing a dial-plate divided into 90°. This new form of arc presents the advantages of always being in position, and of being so compact that it does not interfere with the manipulation of the screws under the body of the Dial.

For surface surveying, a telescope may be substituted for the sights. The tripod on which the Dial is supported is made of mahogany, with a brass screw joint at the centre of each leg. For very shallow seams, it is necessary to have an extra set of joints in the legs. All the joints in the legs are made interchangeable, and great rigidity is obtained by increasing the diameter of the legs towards the centre.

The special feature of the Davis Dial is the arrangements by which bearings may be taken simultaneously with the magnetic-needle and with the vernier, the latter automatically checking the former. Thus any error arising from incorrect reading is at once detected. The graduations of the vernier ring and of the needle ring are so arranged that the readings correspond. This is effected by numbering the Dial from the north from left to right, and by numbering the vernier ring also from left to right. [Page 61.]

Excerpt from "A TREATISE ON MINE SURVEYING," by Bennett H. Brough.

**DIAL JOINT.**—The Miners' Dial is usually fitted to a slightly conical spindle, having on its lower end a ball, which is confined in a socket in such a way that it can be moved in any direction in the operation of levelling the instrument.

For facilitating the setting up of the instrument, an American invention (see plates on page 4 and 5), the Hoffman joint, has been adopted in conjunction with the Davis Dial. This tripod head combines the play of the ball and socket joint, and the accuracy and rigidity of the theodolite parallel plates.

The ordinary form of tripod has the disadvantage, that it is almost impossible to level up a sensitive bubble, so that it will remain in the centre of its run long enough to take a satisfactory sight. On levelling the instrument and sighting, a second glance at the bubble almost invariably shows that it has changed its position, and it is necessary to level up again. This defect is due to the fact that the levelling screws, when moved in or out to a considerable extent, do not stand perpendicular to the plate on which they rest, but on an inclined plane, so that, on turning them, their points have a tendency to slide down the plane. In this position they spring, and turning them is apt to bind and bend them.

Another imperfection in many tripod heads, is that the plummet is attached to some point on the axis above or below the centre of the ball and socket. In either case, the plummet, after being set over a station, will during the operation of levelling up travel away from the point in a degree proportionate to the distance of the attachment of the plummet from the centre of the ball, and the deviation of the axis from the perpendicular at the time the instrument is placed over the centre.

Fig. 3, page 5, shows the form of Hoffman joint supplied with the Davis Dial. It is claimed to possess the following advantages over the ball and socket joint: 1.—The plumb line is suspended from the actual centre of the Dial. 2.—The rubbing surface is some ten times greater, and consequently the joint is more rigid. 3.—The joint is manipulated with greater ease and rapidity. A slight turn from right to left liberates the two concentric hemispheres. The Dial is then levelled up, and a slight turn of the flange from left to right secures the joint. 4.—Only one hand is required to manipulate the joint. 5.—The total height of the Hoffman joint is 3 inches, that of the ball and socket joint  $3\frac{1}{2}$  inches. The length of the centre is  $2\frac{1}{8}$  inches, that of the ball and socket is barely  $1\frac{1}{2}$  inch. The Hoffman joint is not heavier than the ball and socket joint.

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Excerpt from "A TREATISE ON MINE SURVEYING," by Bennett H. Brough.

The Hoffman tripod head, as modified by Professor J. H. Harden, of the University of Pennsylvania, Philadelphia, is shown in Fig. 1, page 4. On unscrewing the levelling screws, the plate forming part of the socket of the small ball, the centre of which is the axis of the instrument, and the point from which the plummet is suspended, can be moved in any direction within the limits of the inside opening of the screw cap. It will be observed that besides the small ball and socket, there is an extra and larger ball and socket formed by a part of the plate to which the instrument is fastened, and the part to which the levelling screws are attached. The latter part always remains parallel to the screw cap of the tripod head on which the points of the levelling screws rest, so that whatever position the instrument may assume in relation to the tripod head, the screws will always act directly perpendicular to both plates.

Under all conditions, the instrument moves upon a centre common to the two balls, this being the point to which the plummet is attached. It is therefore impossible for the plummet not to be perpendicular to the axis of the instrument.

The advantages claimed for the Hoffman tripod head are as follows: 1.—A saving of one-half to two-thirds of the time usually occupied with screwing and unscrewing as in the old plan. The instrument can be levelled approximately without the use of the screws. Less than half a turn is then necessary to bring the instrument to a perfect level, the operation at the same time clamping it. 2.—The levelling screws are at all times perpendicular to the plate to which they are attached and to the plate and screw cap on which they rest. 3.—The levelling screws are reduced in length, and their duty to a minimum, the instrument being no higher nor heavier than before. 4.—The shifting head for plumbing over a fixed point—an improvement common to all first class instruments—is retained, and no extra screws are required to clamp the instrument. 5.—The levelling screws are covered from dust, and at the same time are no obstruction to the working of the instrument in any position in which it can be placed.

# THEODOLITES.

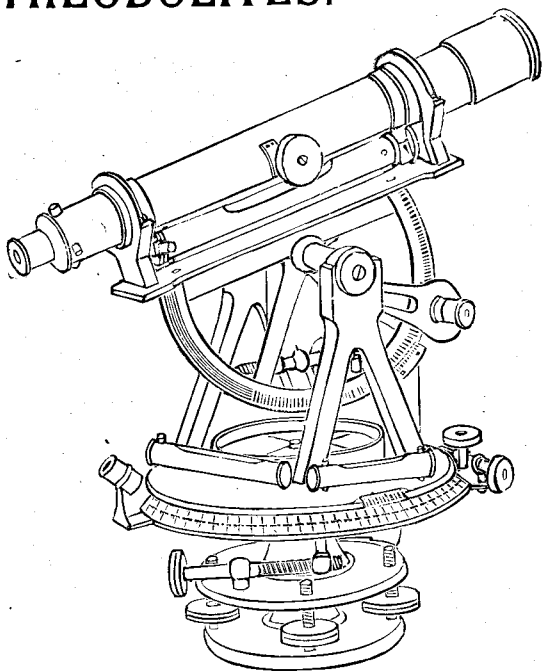


Fig. 3.—Plain Theodolite.

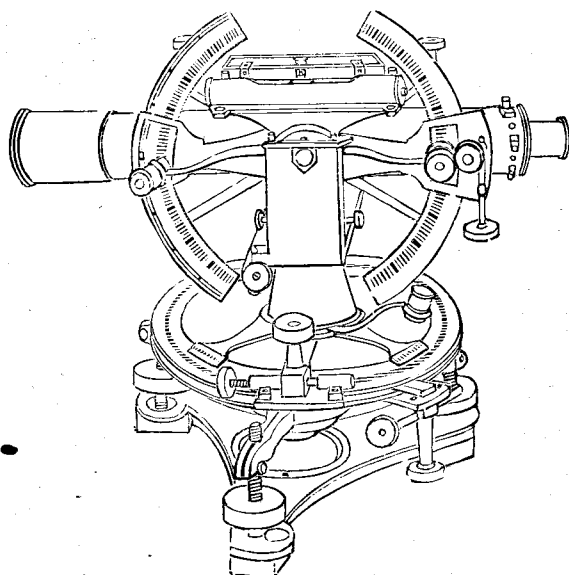


Fig. 5.—Everest's Theodolite.

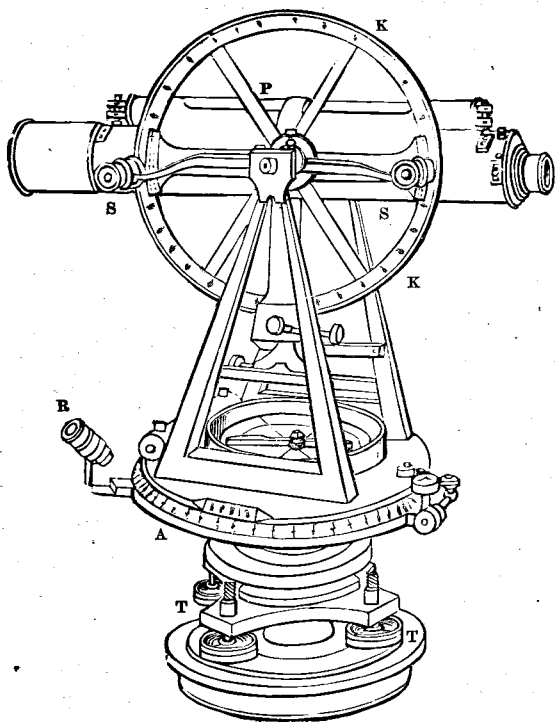


Fig. 4.—Transit Theodolite, with the Hoffman Patent Joint and Centring Movement.

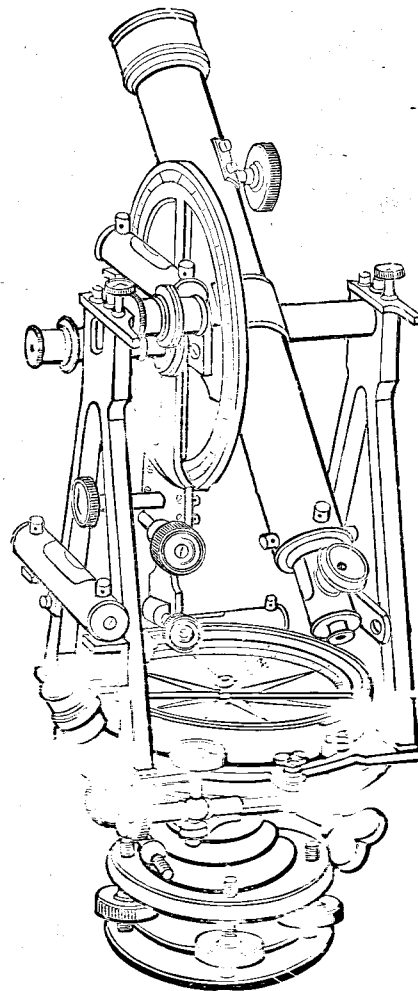


Fig. 6.—Hoskold's Miner's Transit Theodolite.

Instruments made in Aluminium at an extra cost.

**THE HOFFMAN HEAD MAY BE ADAPTED TO EXISTING INSTRUMENTS.**

The Magnetic Needles are Jewelled with Sapphires.



**THEODOLITES.—continued.**

						If fitted with Hoffman Patent Joint and Centring Motion.	
	No. 1.—4 in. best Theodolite, Y pattern, divided on silver, reading to 30 seconds, 2 verniers, mahogany tripod and case complete			£20 0 0		£23 0 0	
Fig. 3.	„ 2.—5 in. ditto ditto ditto			22 10 0		25 5 0	
	„ 3.—6 in. ditto ditto reading to 20 seconds			26 0 0		30 0 0	
	„ 4.—5 in. ditto ditto not divided on silver			17 0 0		20 0 0	
<hr/>							
	No. 4.—4 in. best Transit Theodolite, divided on silver, reading to 30 seconds, verniers, and microscopes to each vernier, mahogany tripod and case complete			£23 10 0		£26 0 0	
Fig. 4.	„ 5.—5 in. ditto ditto ditto			25 10 0		29 0 0	
	„ 6.—5 in. ditto ditto with axis level and lantern, reading to 20 seconds			28 10 0		32 5 0	
	„ 8.—6 in. best Transit Theodolite reading to 20 seconds			28 10 0		33 0 0	
	„ 11.—8 in. ditto ditto 10 „			50 0 0		55 0 0	
<hr/>							
	No. 12.—5 in. Everest Theodolite, divided on silver, reading to 30 seconds			£24 0 0		£27 15 0	
Fig. 5.	„ 13.—6 in. ditto ditto reading to 20 seconds			27 0 0		31 0 0	
<hr/>							
	No. 15.—5 in. Hoskold Miner's Transit, divided on silver, reading to 30 seconds			£25 10 0		£29 5 0	
Fig. 6.	„ 16.—6 in. ditto ditto reading to 20 seconds			30 5 0		34 10 0	
	„ 17.—5 in. ditto ditto with diagonal eyepiece and sights, reading to 30 seconds			27 15 0		31 15 0	
	„ 18.—6 in. ditto ditto ditto to 20 seconds			33 10 0		38 5 0	

**EXTRAS AND ACCESSORIES, &c.**

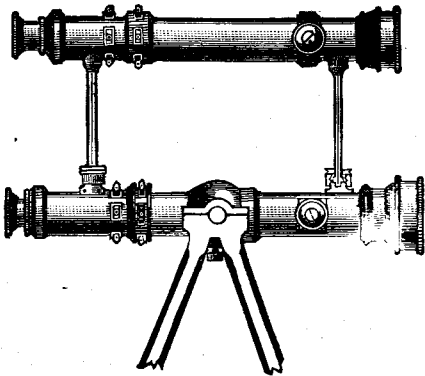
Long Needle or Trough Compass fitted to any of our Theodolites in place of the usual small compass, recommended	£1 5 0
Sub-dividing to 20 seconds instead of 30 seconds, or to 10 seconds instead of 20 seconds	3 0 0
Supplementary Telescope to attach to end of axis or to existing Telescopes as per System A or B, Page 10, to swing clear of the plates so that a Vertical Angle may be taken up or down a shaft or any Angle too great for the Central Telescope to measure	5 0 0
Diagonal Eyepiece	0 16 0
Diagonal Eyepiece, with small Telescope	1 4 0
Solid Leather Cases, with sling straps	30/- to 1 18 0
Joints to divide Theodolite Legs	0 15 0
Louis's Sun Protector or Umbrella to cover bubble and needle of Theodolites, Levels, and Dials, in hot countries, consisting of a light frame, covered with white cloth, lined green, clamped on to axis of Theodolite or bar of level or limb of dial, at will, about 12 in. square	1 10 0

See Notes on the Hoffman Tripod Head and Centring Motion. This invention enables the operator to set up and level his Theodolite instantly—it is now very extensively adopted.

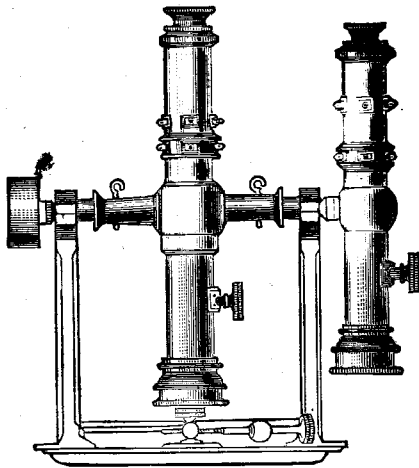
The Hoffman Tripod Head may be adapted to existing Instruments.  
The Magnetic Needles are Jewelled with Sapphires.

Extra Telescopes for Theodolites for Vertical Sighting.

System A.



System B.



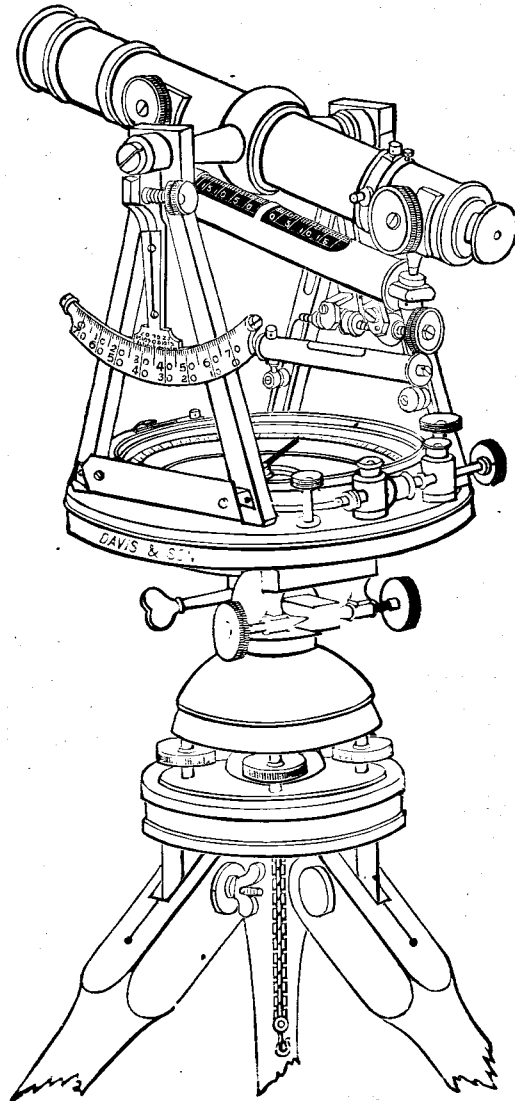
Cost of extra Telescope for Vertical Sighting or to read any angle upwards or downwards to 90° System A or B ... .. £5

Diagonal Eyepiece ... .. 16/-  
 Diagonal Eyepiece, with small Telescope ... .. 24/-

Price of American Transit ... .. £42 0 0  
 Ditto, with the Hoffman Patent Joint and Centring Motion, as Illustrated ... .. £44 0 0

AMERICAN TRANSIT.

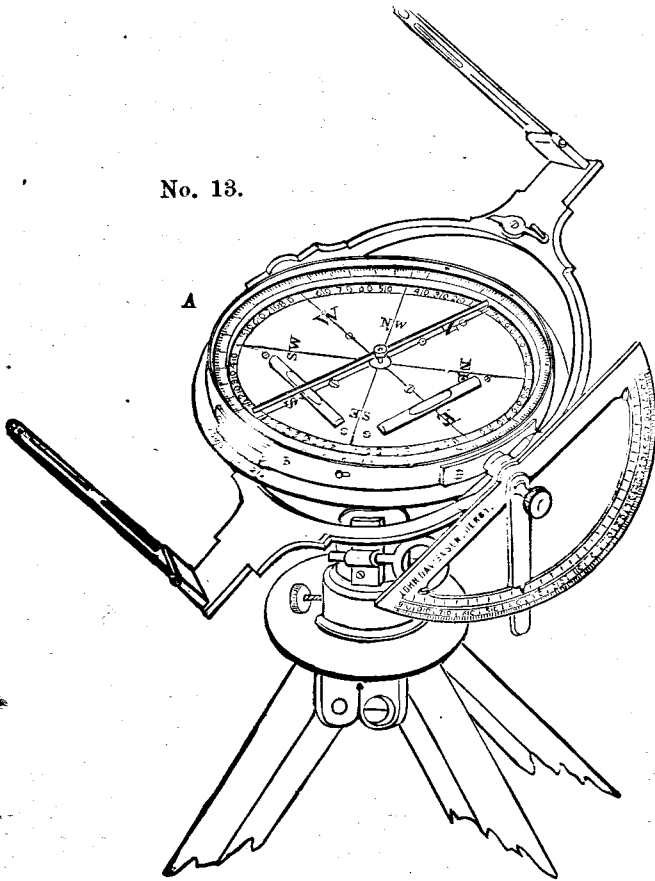
Instruments made in Aluminium at an extra cost.



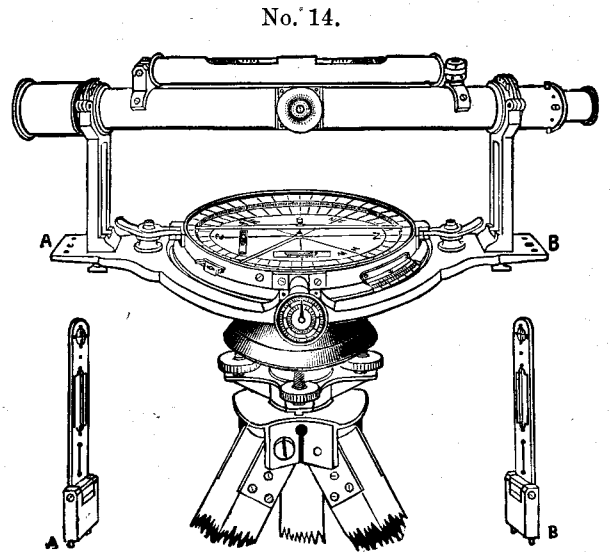
American Transit Theodolite and Levelling Instrument, with 5 in. needle, long compound centres, divided on silver vertical arc, centring movement to tripod, wide openings in vernier plate of horizontal limb covered with glass, divisions clearly cut.

# DAVIS'S IMPROVED HEDLEY DIAL.

TWELVE PRIZE MEDALS.



No. 13.



No. 14.

For description of Davis's Improved Hedley Dials, see page 6. For description of the Hoffman Patent Joint see pages 3 to 7.

No. 13. Davis's Improved Hedley Dial with outside vernier automatically checking the needle. Davis's Improved Arc, Improved form of Legs—complete in Mahogany case.

No. 13. Fitted with Ball and Socket Joint.	No. 13. Fitted with Hoffman Patent Joint. Fig. 3, Page 5.	No. 13. Fitted with Hoffman Patent Joint. Fig. 2, Page 5.
Prices—5 in., £14 10 0	£15 15 0	£16 0 0
„ 6 in., £16 10 0	£17 15 0	£18 0 0

No. 14. Davis's improved Hedley Dial with outside vernier automatically checking the needle. Davis's Improved Arc, Powerful Telescope with sights interchangeable, transforming the Dial into a Theodolite, Improved form of Legs—complete in Mahogany case.

No. 14. Fitted with Parallel Plates.	No. 14. Fitted with Hoffman Patent Joint. Fig. 2, Page 5.	No. 14. Fitted with Hoffman Patent Joint, with centring motion. Fig. 1, Page 4.
Prices—5 in., £19 0 0	£21 0 0	£22 10 0
„ 6 in., £21 0 0	£23 0 0	£24 10 0

**EXTRAS AND ACCESSORIES, &c. :**

Prices for Dials include one set of Legs, jointed in the middle (for surveying in shallow seams an extra set of joints is necessary)	£	s.	d.
Extra set of Improved Legs, interchangeable with Dial, with one set of Joints	2	0	0
„ „ half size (no joints)	1	10	0
Lamp Cups for ditto	0	5	0
Lamp Cups with cross levels to facilitate setting up the extra legs	0	12	0
Candlesticks to fit on Dial legs	0	12	0
Solid Leather Cases, with sling straps, to contain dial case, for 5 in., No. 13 16/-	For 5 in., No. 14	25/-	
„ „ „ „ 6 in., „ 19/-	„ 6 in., „	30/-	
A Diagonal Eyepiece may be supplied with the telescope dials. See page 10.			
Extra for dividing the Verniers to one instead of three minutes		15/-	

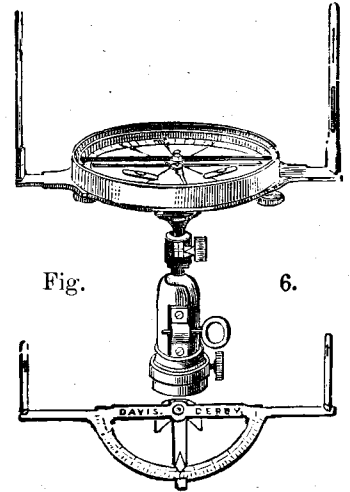
**THE HOFFMAN PATENT JOINT** may be adapted to existing Instruments.

The Magnetic Needles are Jewelled with Sapphires.

# MINERS' DIALS.

## RIGID DIALS.

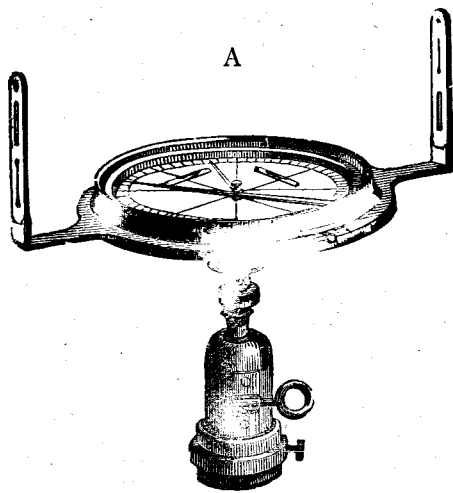
No. 5.—5 in. Brass Dial, 2 levels, ball and socket joint, mahogany case, jointed legs ... ..	£7 10 0
„ 6.—5 in. ditto, with rack and pinion vernier (fast needle) to 3 minutes (see plate No. 6) ... ..	13 5 0
Arc for ditto, with folding sights (see plate), extra ... ..	1 10 0



## THE HEDLEY DIAL (Original Construction).

No. 7A.—4 in. Hedley Dial, admirably adapted for use in mines of considerable dip ... ..	£9 0 0	
„ 7.—5 in. ditto ditto ditto ... ..	9 5 0	
„ 8A.—4 in. ditto with arc ... ..	11 0 0	
„ 8.—5 in. ditto ditto ... ..	11 5 0	
„ 9.—6 in. ditto ditto ... ..	13 5 0	
„ 10.—5 in. Hedley Dial, with rack and pinion vernier, Davis's improved arc, improved clamp, improved form of legs, complete in mahogany case ... ..	13 5 0	£15 0 0
„ 11.—6 in. ditto with vernier, without arc, ditto ditto ... ..	13 5 0	15 0 0
„ 12.—6 in. ditto with vernier and arc, ditto ditto ... ..	14 10 0	16 10 0

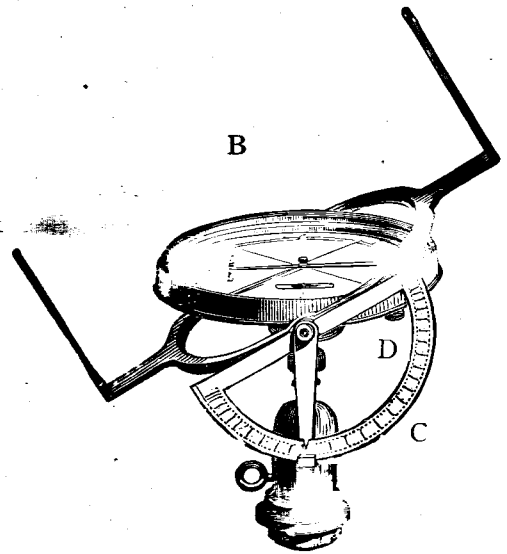
Fitted with Hoffman Patent Head. Fig. 2—see page 5.



No. 7.

A. The Hedley Dial as an Ordinary Rigid One.

B. Inclined to suit the declivity of a Pit, or for taking a longer sight.



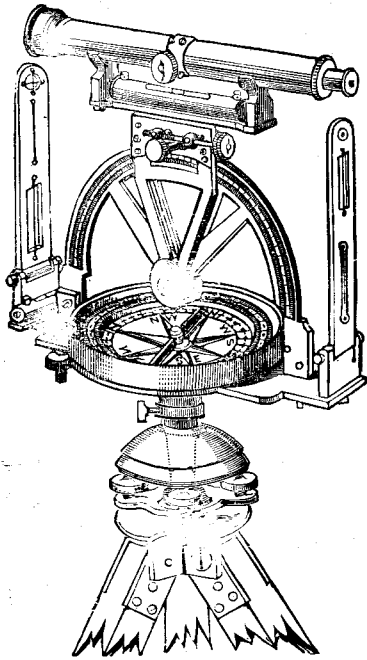
Nos. 8, 9, 10, & 12, Hedley Dial.

C. Arc attached at pleasure, for ascertaining the angle or dip.

D. Screw for moving the Vernier.

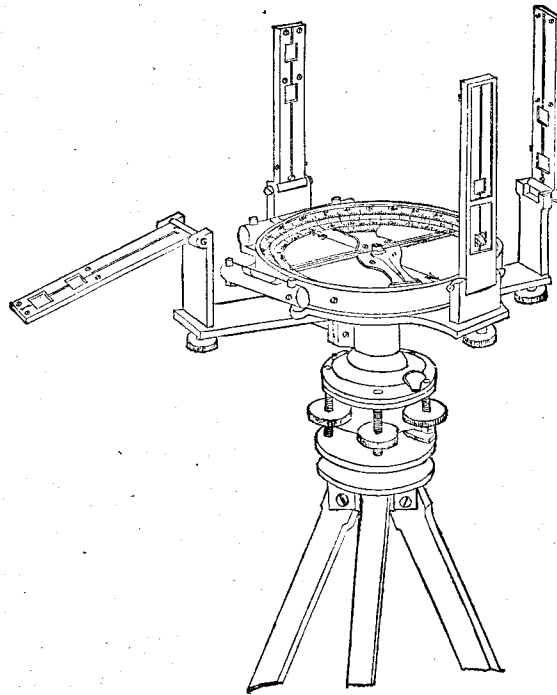
.....

The Hoffman Patent Joint may be adapted to existing Instruments.  
The Magnetic Needles are Jewelled with Sapphires.



No. 15.

Miner's Theodolite,  
Lean's Type.



No. 17.

Henderson Dial.

No. 15 Miner's Theodolite, Lean's Type, with sights, telescope on arc over dial, reading angles upwards or downwards to 90 degrees, rack and pinion vernier, both dial and arc verniers reading on silver to 1 minute.

Fitted with Parallel Plates.	Hoffman Patent Joint. Fig 2. Page 5. As Illustrated.	Hoffman Patent Joint, with Centring Motion. Fig 1, Page 4.
Prices—5 in., £23 10s. 0d.	£25 0s. 0d.	£26 10s. 0d.
„ 6 in., £25 0s. 0d.	£26 10s. 0d.	£28 0s. 0d.

No. 16 Lean's Miner's Dials of ordinary construction, with Vertical Arc, Telescope, Sights, Rack Motion—with Case and Legs complete. 5 in., £15 0s. 0d. 6 in., £16 10s. 0d.

No. 17 Henderson Dial, with 2 Sets of Folding Sights, as represented by Fig. 17.

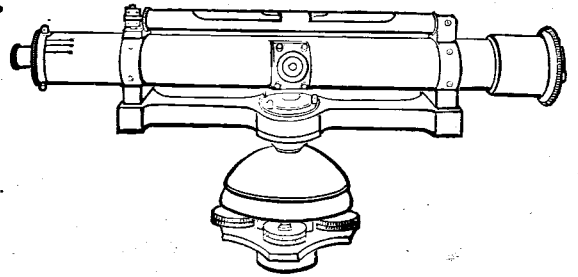
Fitted with Parallel Plates. As Illustrated.	Hoffman Patent Joint. Fig. 2, Page 5.	Hoffman Patent Joint, with Centring Motion. Fig. 1, Page 4.
Prices—6 in., £28 10s. 0d.	£30 0s. 0d.	£31 10s. 0d.
Two Extra Sets of Legs, with Candelabra for fast Needle Dialling ...	...	... £8 5s. 0d.

THE HOFFMAN PATENT JOINT may be adapted to existing Instruments.

The Magnetic Needles are Jewelled with Sapphires.

## DUMPY OR GRAVATT LEVELS.

Best Achromatic Lenses, all parts of gun metal.  
Improved Construction, two Eye Pieces.  
Polished Mahogany tripod stand.



**DUMPY LEVEL.**  
With Hoffman Patent Joint.

	With Compass.	Without Compass.	Fitted with Hoffman Patent Head, Fig. 2, Page 5. without Compass.
16 in. ...	£16 0 0	£14 10 0	£16 0 0
14 in. ...	14 0 0	12 10 0	14 0 0
12 in. ...	12 0 0	11 0 0	12 10 0

Solid Leather Case } for 12 in. 22/6, 14 in. 25/-, 16 in. 30/-  
with Sling Strap

## BUILDERS' OR CONTRACTORS' LEVELS.

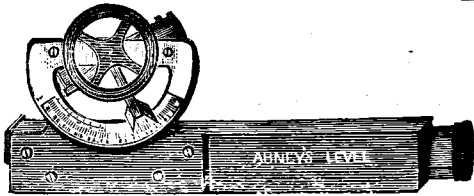
Complete with case and tripod stand, 8 in. with compass, £5 Os. Od.; ditto no compass, £4 Os. Od.

**Y Levels** ... 14 in., £12 10s. Od. 12 in., £12 0s. Od.

Ditto, fitted with Hoffman Patent Head, Fig. 2, Page 5. ,, £14 0s. Od. ,, £13 10s. Od.

Compasses to any of the above, 30s. extra.

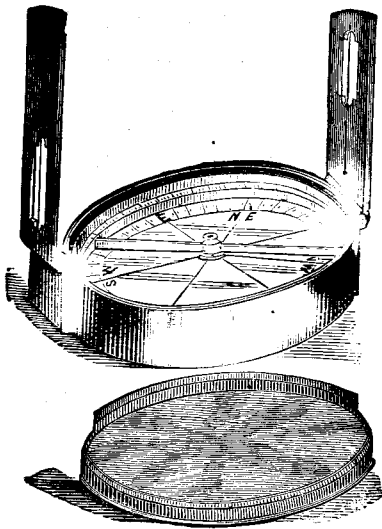
Levels Repaired and Adjusted. Existing Theodolites, Levels, and Dials fitted with the Hoffman Patent Joint.



**Abney's Level**, with arc for dips as supplied to the Royal Engineers ... .. £1 18 0

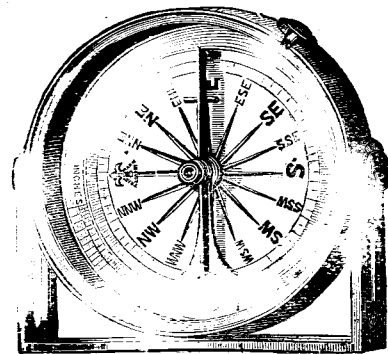
Ditto, with compass and magnifier ... .. 2 2 0

## POCKET DIALS.



Pocket Dials with Sights, best needles—			
No. 1.	Size 2 in.	2½ in.	3 in.
	Price 13/6	16/6	23/-
Ditto, with raised graduated ring—			
No. 2.	Size 3 in.	4 in.	5 in.
	Price 36/-	45/-	60/-

## CLINOMETER COMPASS.



The Clinometer Compass may be used as a Pocket Dial with sights, as a Level or Clinometer reading the dip of strata in degrees or inches per yard. In case complete—

Size	2½ in.	3 in.	4 in.
Price	19/-	24/-	28/6

**Levelling Staves.**

18 feet Sopwith Staff, in 3 lengths, painted any pattern, English or Metre, best quality well screwed	£3 10 0
16 feet ditto painted	3 0 0
16 feet ditto papered	2 12 0
14 feet ditto painted	2 5 0
14 feet ditto papered	2 2 0
10 feet ordinary Staff ditto	1 6 0

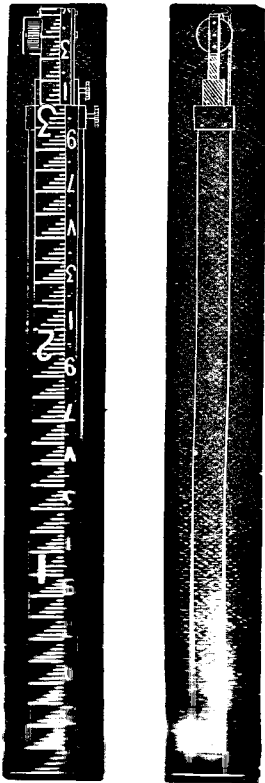
Cases to hold staves made of strong canvas, bound with leather,  
to contain 1 staff 14 feet      2 x 14 feet      1 x 16 feet      2 x 16 feet

Price	10/-	16/6	12/-	20/6
Triangular Iron-plate to place a staff upon, with chain and ring	...	...	...	0 2 6
Papers for repairing Staff, the set, 14 feet 3/-, 16 feet	...	...	...	0 3 0
Repainting 14 feet Staff, usual pattern	...	...	...	1 0 0
Repapering ditto ditto	...	...	...	0 10 0

**Pit Levelling Staves.**

9 feet Sopwith Staff, to close down to 3 ft. 6 in.	£2 0 0
6 feet ditto ditto 2 ft 6 in.	1 18 0

**Jee's Pit Levelling Staff** (for underground levelling).



In his Treatise on Mine Surveying (3rd Edition), Mr. Bennett H Brough gives the following description of this Levelling Staff:—

“Mr. G. J. Jee has designed a useful staff for colliery work. It consists of three lengths sliding one into the other. The bottom length is graduated upwards in the ordinary way, and is 3 feet in length. At the top of the first division of the staff is attached a 2 inch band, which is graduated upwards, and forms an accurate continuation of the scale on the lower division of the staff. The band passes over a brass roller attached to the top division of the staff, and thence is carried down and wound round a brass drum fixed just below the roller, to the top of the same length of the staff, the band being kept in tension by means of a box spring attached on one side to the axis of the cylinder. It is thus evident that when the second length of the staff is drawn out, the band unwinds and gives a continuous reading up to 5 feet 8 inches, or to any intermediate distance that the roof will allow. In the same way when the third length is drawn out a continuous reading may be obtained up to 9 feet, or to any intermediate distance required. The weight of the staff is 5 lbs. It is manufactured by Messrs. J. Davis & Son, of Derby.”

Prices.	{	9 ft., closing down to 3 ft. 6 in., improved tape	...	...	£3 0 0
		6 ft. ,, ,, 2 ft. 6 in., do. do.	...	...	15 0

Existing Staves may be altered to above construction.

**Ranging Poles and Offset Rods.**

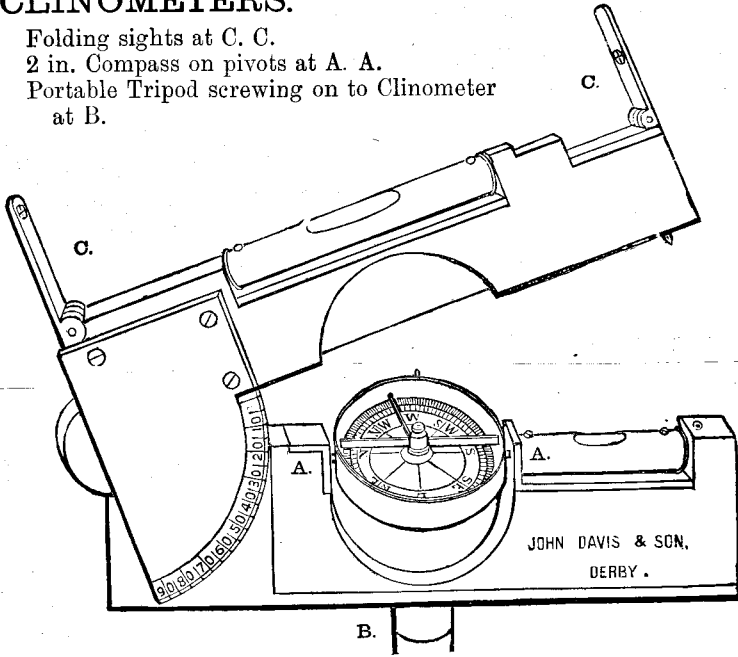
	6 ft.	8 ft.	10 ft.
Ranging Poles, shod with iron, painted any three colours to order	per dozen £1 10 0	1 16 0	3 0 0
Offset Rods. 10 links...	0 3 6		
Offset Rods. 10 links, shod with point and hook for chain	0 5 6		
Offset Rods. 10 links, joined in centre with hook and point	0 7 6		
Offset Rods. ditto with plain ferruled ends	0 8 6		

**Surveyor's Rods.**

Surveyor's Rods in one length, 2/6 and 3/6	Jointed 5/-
Surveyor's Rods 5 ft. red. figures and divisions white and red 6/-	ditto 8/-

**CLINOMETERS.**

Folding sights at C. C.  
 2 in. Compass on pivots at A. A.  
 Portable Tripod screwing on to Clinometer  
 at B.



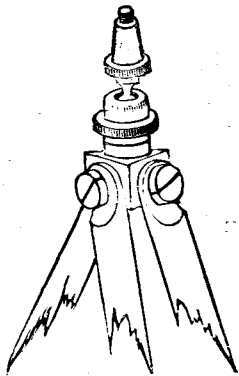
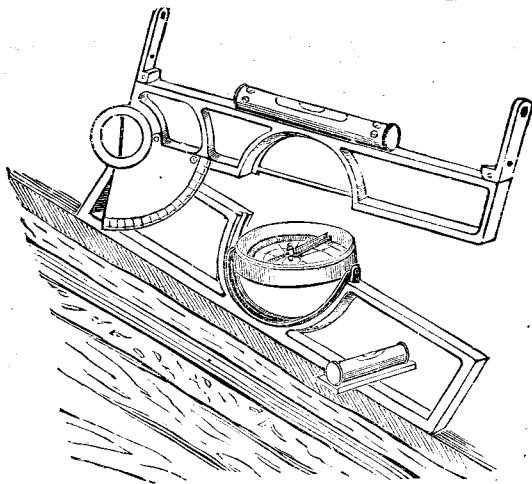
**Davis's New Clinometer.**

The Clinometer, as shown, is capable of doing the work of the Dumpy Level and the Hedley Dial approximately, although it is not intended to take the place of either. Where great accuracy is not required it will save time and a more expensive instrument and may be used where a level or dial cannot, on account of its extreme portability, its outside dimensions being 6½ in. long, ½ in. wide, 3 in. deep. Price complete, in case, with portable tripod ...

£3 10 0
Ditto, with portable ball and socket joint ... 4 4 0
Ordinary Clinometer, with 2 level's, sights and compass in case with useful tables marked on sides ... 1 18 0
Ditto, without sights ... 1 5 0
Plumb Bobs in brass ... 0 3 0
Large size ... 4/6 to 10/-
Ditto ditto improved with groove to wrap ... each ... 0 4 0

Extract from "THE COLLIERY GUARDIAN," 29th March, 1889.

**LOUIS'S IMPROVED DAVIS'S CLINOMETER.**



"In this Instrument the compass pivots are carried on a brass are capable of revolving in the lower portion of the clinometer frame, so that the compass can be placed horizontally and therefore read, whatever be the position of the lower limb. The arrangement therefore allows both the amount of dip and the exact strike of strata, the amount and direction of inclination of an inclined shaft, &c., to be read simultaneously on the instrument. The best way of determining the strike of strata being by ascertaining the direction of their maximum dip, this can readily be done by turning the compass until it is horizontal, whilst the lower limb is resting on the strata in the desired position. The improvement also allows the compass to be instantly reversed, so that the same end of the needle may be used for all dial readings in running survey lines up and down hill; this cannot be done with any of the other forms of clinometer, and the instrument in its new shape may be used for all purposes, and will be found sufficiently accurate for most of the requirements of the miner or prospector in metal mining. A further improvement consists in mounting the dial of the lower limb on a swivel, so that the clinometer may be levelled in two ways without being reversed. The size of the clinometer is 6½ in. long x ½ in. wide x 3 in. deep, weight 1 lb. 2 oz.; fitted with ball-and-socket joint, length 3 ft. 10 in., weight 1 lb. 8 oz. This handy instrument is manufactured by Messrs. John Davis and Son of Derby, and 118, Newgate Street, London, and is an improvement on their clinometer, which is very extensively used in prospecting."

Price of Louis's Improved Davis's Clinometer in case complete, with Ball and Socket Joint with Tripod ... .. £5 5s. Od

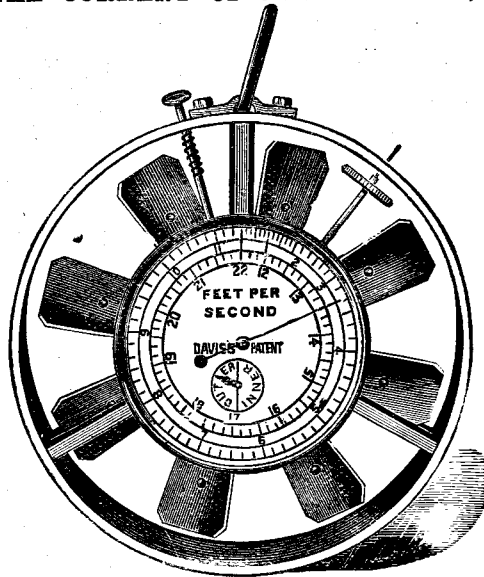


# DAVIS'S PATENT SELF-TIMING ANEMOMETER.

FOR SELF-RECORDING THE CURRENT OF AIR IN MINES, FURNACES, SEWERS, &c.

This Anemometer  
being Self-timing dis-  
penses with the  
use of a Watch.

The readings are in  
feet per second  
or metre per second.



Gold Medal, Awarded Mining  
Exhibition, 1890.

PATENT No. 13182.

PRICE IN LEATHER CASE.

READING IN FEET.

£4 : 10 : 0.

READING IN METRES 10/- EXTRA.

EXTRACT from "THE MINING JOURNAL," 11th OCTOBER, 1884.

An ingenious and very valuable mining instrument has just been perfected and patented. It is an improved Anemometer, which dispenses with the use of a watch. By holding the instrument in the current of air to be measured for a few minutes, it correctly indicates feet per second. This Anemometer is exceedingly portable, being only four inches in diameter. In general appearance it very much resembles the Biram Anemometer, which is now in general use. Every colliery manager and engineer acknowledges the difficulty and inconvenience experienced in using the Biram Anemometer, which necessitates the use of a watch; and, unless he is assisted by a man to carry his lamp, he has to hold his Anemometer, watch, and lamp. The new instrument—Davis's Patent Anemometer—dispenses with the use of a watch or timer, and also of a lamp carrier; and, when held up in the current of air, without loss of time, indicates the velocity per second.

Paper read before the Chesterfield and Midland Counties Institution of Engineers, 8th September, 1885.  
Copy forwarded upon application.

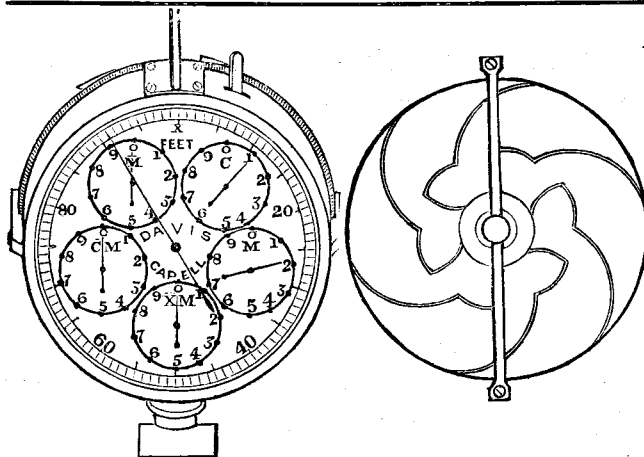
## INSTRUCTIONS.

This instrument, like the Biram, is held up with its back to the current of air to be measured, and on no account must the air enter from the face.

When the vanes have revolved for a few seconds, press the spring button at **A**, the large hand then indicates feet per second. After reading, screw down the milled head at **B**, until the plunger **A** is relieved, after which unscrew the milled head as far as it will go, and the hands return to zero.

Should the velocity be such that the hand travels more than one revolution, then read the inner circle of figures. The small hand shows whether the outer or inner circle should be read.

**NOTE.**—As EVERY INSTRUMENT is graduated at EACH UNIT by ACTUAL EXPERIMENT, no allowance has to be made for friction.



Front view showing dials,  
disconnecter, and stick-holder.

Back view showing the vanes on  
the Capell fan principle.

## CAPELL-DAVIS ANEMOMETER.

FOR ASCERTAINING VELOCITIES OVER 30 FEET  
PER SECOND.

This instrument is designed to test such high velocities as would endanger the Biram or Davis's Self-timing Anemometer.

Size 4 inch diameter reading to ten million feet, contained in a leather covered case with strap, price £5 5s. Od.

Reading in metres 5s. extra.

Manufacturers by Appointment of Biram's Patent Anemometer,  
FOR ASCERTAINING THE CURRENT OF AIR IN MINES, FURNACES, SEWERS, &c.

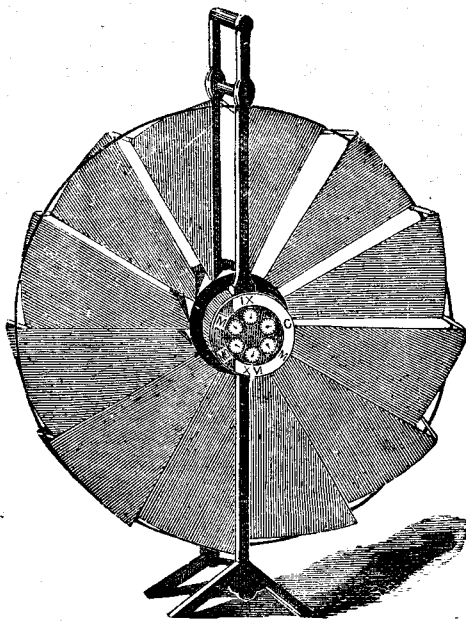


Fig. 1.—12 in. size.

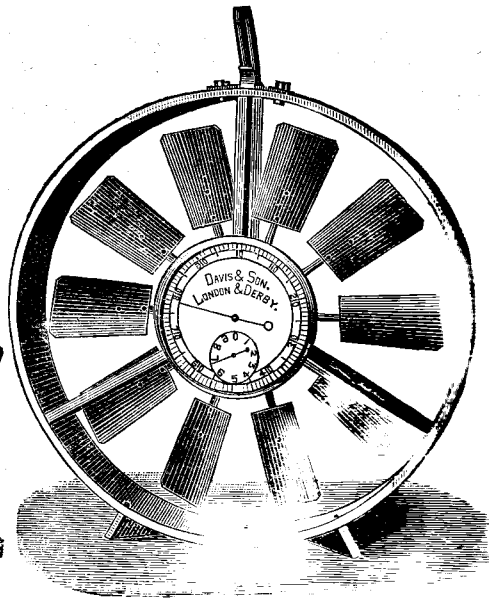


Fig. 2.—6 in., 4 in. and 3 in. sizes.

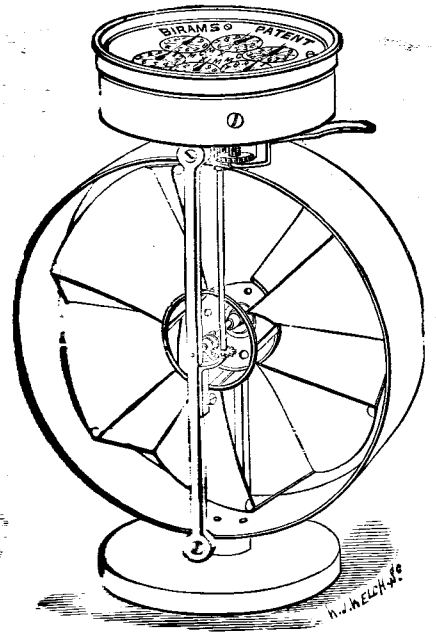


Fig. 3.—4 in. and 6 in. "New" Anemometer.

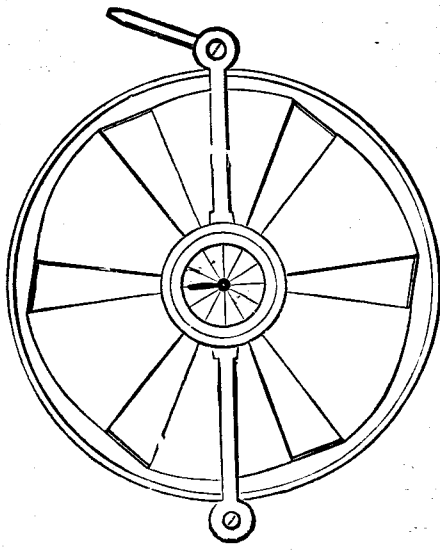


Fig. 4.—4 in. and 2 in. sizes.

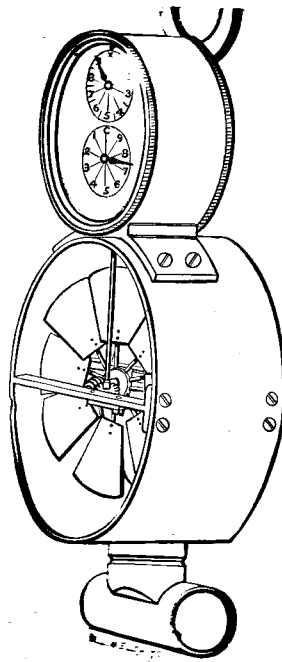


Fig. 5.—2 in. size

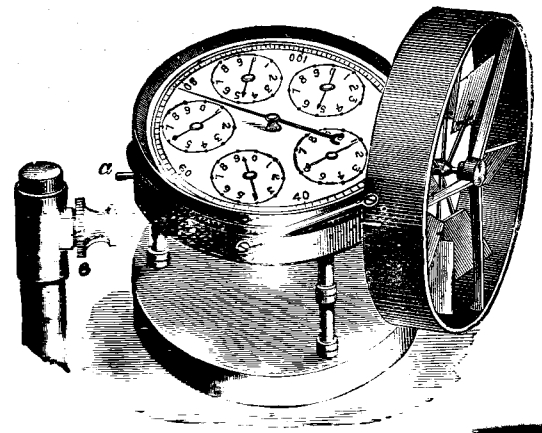


Fig. 6.—Air Meter.

THE BIRAM ANEMOMETER, manufactured by this firm since the year 1847, is recommended with confidence; it self-registers the velocity of the air through any passage in which it is placed, is a sure detector of any slackening of the current by neglect or obstruction in the air-ways, and is a complete check against inattention in the furnace-man or fan driver. (For velocities over 80 feet per second see Cape Davis' Anemometer.)

The inaccuracy of each Anemometer at different velocities is carefully tested by a machine as illustrated on the next page, and a certificate issued with each instrument showing the amount of air in feet to be added or deducted being the result of experiment with each Anemometer separately.

Anemometers may be verified at Kew Observatory, the charge being 7/6 per Anemometer, carriage extra.

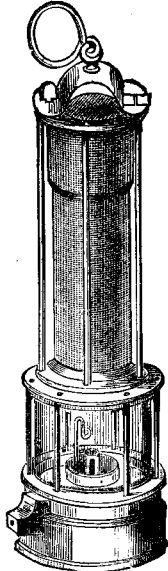
FOR PRICES AND INSTRUCTIONS SEE NEXT PAGE.

# MINERS' SAFETY LAMPS.

MADE TO STANDARD SIZES.

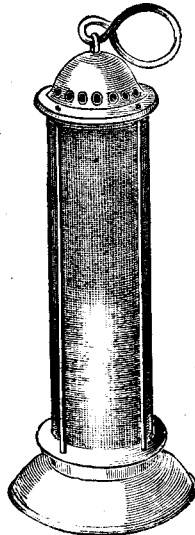
PRICES NEXT PAGE.

No. B.



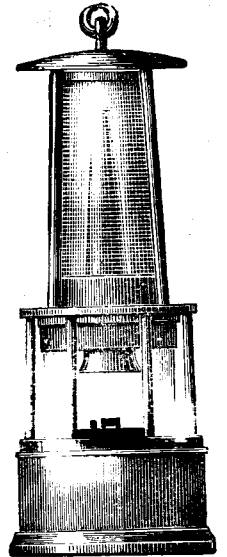
CLANNY.

No. F.



STEPHENSON.

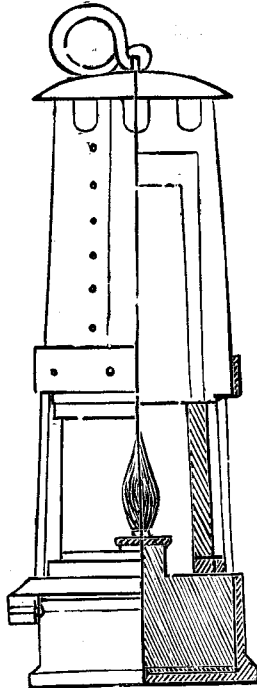
No. G.



MUESELER.

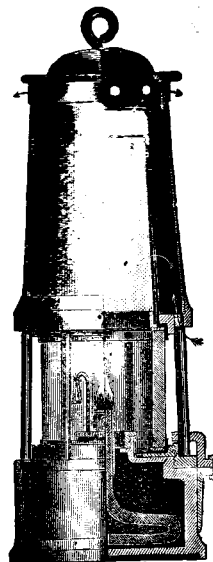
The Lamps Illustrated below are constructed in accordance with the Coal Mines Regulation Act, 1887, and are made to Standard Sizes.

No. N.

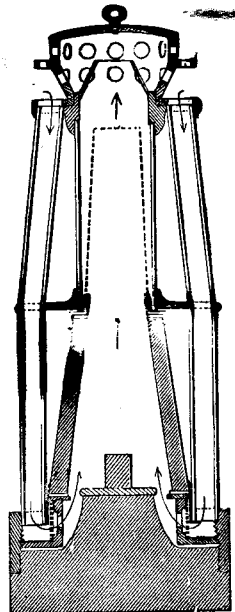


MARSAUT.

No. D.



BONNETED  
CLANNY.  
STOKES'S SHUT-OFF.



ASHWORTH'S  
Patent Hepplewhite-  
Gray Deputy Lamp.

# MINERS' SAFETY LAMPS.

ILLUSTRATED PREVIOUS PAGE.

Type.	No.	Description.	Price.	
			s.	d.
DAVY ... ..	A ...	Ordinary Full size ... ..	4	6
		Medium ... ..	4	3
		Small ... ..	4	0
		Fireman's Improved ... ..	5	0
		Jack Davy ... ..	5	0
STEPHENSON ... ..	F ...	Usual size ... ..	7	0
		Small ... ..	6	6
CLANNY ... ..	B ...	Improved type, standard sizes ... ..	5	9
MUESELER ... ..	G ...	Belgian type, tin vessel ... ..	5	0
	H ...	British type, brass vessel, brass ring to hold glass, lead plug, or screw lock ... ..	5	9

## REGULATION LAMPS (made to Standard sizes).

Constructed in accordance with the Coal Mines Regulation Act, 1837.

Type.	No.	Description.	Price.	
			s.	d.
CLANNY BONNETED	D ...	Bonneted Clanny Regulation Lamp, screw Lock or Improved lead plug lock, Clanny gauze with elongated ring, and Stokes's shut-off appliance ... ..	7	0
		BONNETED CLANNY ditto ditto, but without shut-off ... ..	6	6
MUESELER	I ...	BONNETED MUESELER REGULATION LAMP with screw or improved lead plug lock—British Mueseler Chimney and Stokes's shut-off appliance ... ..	7	0
	J ...	BONNETED MUESELER REGULATION LAMP, but without shut-off ... ..	6	6
	K ...	Bonneted Mueseler dialling Lamp, polished brass... ..	12	0
MARSAUT	L ...	French type, two gauzes, fixed shield or bonnet, tin bottom, screw lock ... ..	6	6
	M ...	REGULATION Lamp, with screw or improved lead plug lock and Stokes's shut-off appliance ... ..	7	0
	N ...	REGULATION Lamp, but without shut-off ... ..	6	6
	NI ...	Dialling Lamp, screw lock ... ..	12	0
BAINBRIDGE	P ...	Bainbridge four part Lamp, screw or lead plug lock ... ..	6	6

Standard Lamps—all parts and internal fittings being interchangeable.

REVISED AND REDUCED.

The above prices include Improved Wick Tubes and best Glasses with polished ends.  
EXTRAS.

Lamps to burn spirit with automatic extinguishing arrangement ... .. each 1/6.

Annual Supplies Contracted for. Gold Medal, Mining Exhibition, 1890.

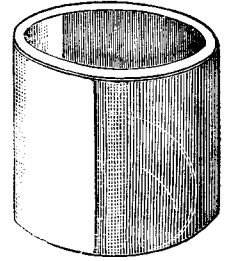


## PARTS OF MINERS' SAFETY LAMPS.

**GLASSES.**—Standard Size,  $2\frac{5}{16}$  in. dia. ×  $2\frac{3}{8}$  in. long, fitting all our Regulation Lamps.

With ground ends, per gross	...	£1 8 0
With polished ends	...	1 15 0

All sizes of Glasses made to order, and a large variety kept in stock.



**REFLECTOR GLASSES,** patent enamelled white one-third inside surface.  
Standard size as above.

With ground ends, per gross	...	£2 10 0
With polished	...	2 15 0

Reflector Glasses, size for Hepplewhite-Gray Lamps.

With ground ends, per gross	...	£3 6 0
With polished ends	...	3 12 0

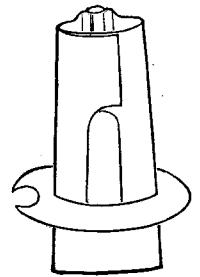
**REFLECTOR GLASS,**  
Patent.

**GAUZES.**—In consequence of improved system of manufacture and special tools, we are enabled to offer Lamp Gauzes of improved make at a considerable reduction in price.

GAUZES.	Description.	Price per doz.
Clanny.	For D & E Regulation Lamps, with elongated copper rings, 8/6, and cap... Ordinary rings	8/-
"	,, B unbonneted Lamp	5/6
Davy.	,, A Lamps	6/-
Stephenson.	,, F Lamps	8/6
Mueseler.	,, G, H, I, and J Lamps, with copper rings	5/6
Marsaut.	,, L, M, and N Lamps, with copper rings	9/-
	,, " " Per dozen	Inside 3/6, Outside 5/6
<b>GAUZE in rolls 9 inches wide, 28 mesh per yard run</b>		
	copper	1/-
	copper	4/-
<b>Chimneys for Mueseler Lamps, with horizontal gauzes, per dozen</b>		
		3/-

### SUNDRIES.

Brass Rings, to protect glasses	...	per gross, 15/-
Asbestos Washers, standard size	...	per gross, 3/-
Wick, round	...	per lb. 1/6
,, flat, $\frac{3}{8}$ in. wide	...	per lb. 2/-
Wick Tubes, round	...	per gross, 9/6
,, for $\frac{3}{8}$ in. flat wick	...	per gross, 12/-
,, " Davis's Improved Corrugated,	...	per gross, 13/-
,, for $\frac{3}{8}$ in. flat wick	...	per gross, 15/-
,, " copper	...	per dozen, 3/6
Keys, square	...	per dozen, 2/6
,, flat	...	per dozen 6/6 and 10/6
Brushes, flat	...	per dozen 9/- and 15/-
,, round	...	per gross, 18/-
Sponge Cloths	...	per gross, 2/6
Prickers	...	per lb. 3/-
Pricker Tubes, brass	...	per lb. 5d.
Lead Rivets...	...	



**WICK TUBES.**  
**DAVIS'S IMPROVED CORRUGATED,** for  $\frac{3}{8}$  in. Flat wick.

### LEAD LOCKING APPARATUS, &c.

Machine for moulding lead rivets	...	£1 10 0
Machine with lever for closing lead rivets	...	1 10 0
	Engraved dies extra.	
Hand closing pliers for ditto	...	0 4 0
	Engraved dies extra.	
Side nippers for cutting lead rivets	...	0 3 0

# DAVIS'S IMPROVED DEPUTY'S & FIRE-TRYER'S LAMPS.

## Special Features.

- (1) The upper intake holes are 1½ inch from the top of the lamp.
- (2) Air is prevented from blowing through the inlet holes by an inner shield, which also conducts the air supply to the flame.
- (3) A Regulated Fresh Air Feed is fixed at the base of the bonnet to maintain or recover the light.
- (4) Weight only 2 lbs. 7 oz.
- (5) A small hole is drilled in the glass opposite the flame to heat wire for firing shots.
- (6) All parts are interchangeable with those of our Regulation lamps.

		s.	d.
No. A	Davis's Improved Deputy's and Fire-Tryer's Lamp, with steel shield ... ..	9	0
,, A1	Ditto with brass shield, copper gauze, and silver reflector for dialling, &c. ... ..	12	0

## Instructions for use of Davis's Deputy Lamp.

1. To find Gas, shut off the fresh air feed by turning the collar at the base of the bonnet from left to right. The feed will then be solely through the upper intake holes.
2. When Gas is found, draw down the locking pillar, when the collar will spring back and the light be recovered.

This Lamp has been tested in a velocity of 45 feet per second of explosive mixture; the experiments proving that the heat in the glass has no detrimental effect.

## Ashworth's Patent Hepplewhite-Gray Deputy Safety Lamp.

ILLUSTRATED PAGE 46.

In brass for Fire-Tryers, with shut-off appliance	...	...	...	...	...
Ditto, without shut-off	...	...	...	...	...
Dialling Type, with shut-off	...	...	...	...	...
Ditto, nickel plated	...	...	...	...	...

## Instructions for Manipulating Ashworth's Patent Hepplewhite-Gray Deputy Safety Lamp.

When testing for fire-damp, either one or both of the shutters over the holes near the base of the inlet tubes are pushed up and the holes are left open.

The deputy then raises the lamp *without lowering the wick flame*, until the spiring up of the latter indicates the presence of gas, or until the lamp reaches the roof or highest part of the working.

If no gas be found in this way, the holes are gradually closed by the thumb and fore-finger of the hand holding the lamp, and any small percentage of fire-damp will then be indicated as before described.

Note that the holes in the tubes are for the sole purpose of regulating the supply of fresh air to the wick flame.

## NOTES ON SAFETY LAMPS, FOR USE OF LAMP TRIMMERS.

A mixture of three parts best Colza Oil with not more than one part best Paraffin (flashing point not lower than 80°F.) will give an excellent light. The Royal Commission on Accidents in Mines, states that a superior illuminant is obtained by the admixture of Colza and Paraffin Oils.

It is undesirable to purchase mixed Oils as offered by dealers under various names. It is preferable to buy the best Colza and Paraffin separately, to be mixed at the Colliery Stores.

The lamp wick should invariably be dried immediately before it is used.

Flat wick tubes give a more effective light than round wick tubes.

Davis's Corrugated Wick Tubes, as suggested by Mr. A. H. Stokes, H.M. Inspector of Mines, assist capillary attraction, and consequently a better light is obtained.

## **IMPROVEMENTS IN SAFETY LAMPS.**

**LEAD PLUG LOCK.**—Our Special Lead Plug Lock is very compact, protruding only  $\frac{1}{8}$  inch, it cannot be tampered with without detection, and, unlike other forms, the upper and lower portions are quite free from one another while screwing and unscrewing the oil vessel. The upper portion of the lock has a slot, giving lateral play sufficient to adapt itself to the lower portion, which the wear and tear of the thread of the oil vessel render necessary. No extra charge is made for Lead Locks. There is no waste, as the Lead Plugs are melted and re-cast in moulds supplied for the purpose.

**GUARANTEE.**—All our Regulation types of Lamps have been tested to stand a velocity up to 50 feet per second of explosive mixture *in any direction.*

**SHUT-OFF APPLIANCE.**—The Shut-off Appliance, invented by Mr. Arthur H. Stokes, H.M. Inspector of Mines, forms the upper portion of the bonnet, and is composed of two short brass well fitted cylinders, with holes drilled through the circumference; the inner cylinder is fast to the bonnet, and forms the top of the lamp; the outer cylinder is held and governed by a slot and pin arrangement, and revolves  $\frac{3}{16}$  of an inch, when the holes in the inner cylinder are completely closed by the blank spaces of the outer cylinder.

The Shut-off Appliance extinguishes the light due to the flame or to the ignited gas within the lamp in less than 30 seconds, this rapid action being due to the shut-off being placed at the top of the lamp, thus preventing the escape and throwing down the products of combustion to the extinction of all flame within the lamp.

**STOKES'S ABSOLUTE SHUT-OFF,** with SCREW-OFF SELF-LOCKING BONNET. Patent No. 251. 7th Jan., 1887. This invention renders miners' lamps absolutely safe under all conditions. It is a double shut-off fitted to the upper and lower parts of the bonnet, both working simultaneously, and, when applied, extinguishes all flame within the lamp, whether produced by the illuminant or ignited gas, in less than 10 seconds.

This Shut-off is now being applied to the Marsaut, Bonneted Mueseler, and Bonneted Clanny. Extra cost of the Absolute or Double Shut-off, 6d. per lamp over the Single Shut-off.

**BONNET OR SHIELD.**—The air supply-holes in the Bonneted Lamps are drilled perfectly, so that the air has to travel upwards before it feeds the flame. Bonnets are preferably fixed to the frame of Shut-off Bonnets supplied, if desired, extra cost 3d. per lamp.

**GAUZE.**—The Gauze with elongated ring, as suggested by the Royal Commission, causes the intake air, after entering through the holes in the flange supporting the bonnet, to rise vertically as much as possible before passing through the gauze, and is specially made for the Bonneted Clanny, although it is applicable to any form of lamp; it also prevents the air reaching the flame except at a low velocity. Should a Miner bring his lamp on the ground with the air supply holes facing a current of explosive mixture, the flame in the lamp is protected by the elongated gauze ring.

**GLASSES.**—All our Regulation types of Lamps are fitted with the same size of glass, being  $2\frac{1}{4}$  inches diameter by  $2\frac{3}{8}$  inches long. The sides are perfectly parallel, the thickness is regular, and the ends are accurately ground or polished. Upon reference to our prices, the cost will be found exceedingly low. Our polished end glasses are recommended, being less liable to crack and chip and fray the asbestos wick than the glasses with ground ends.

**WICK TUBES** are preferably flat with corrugations.

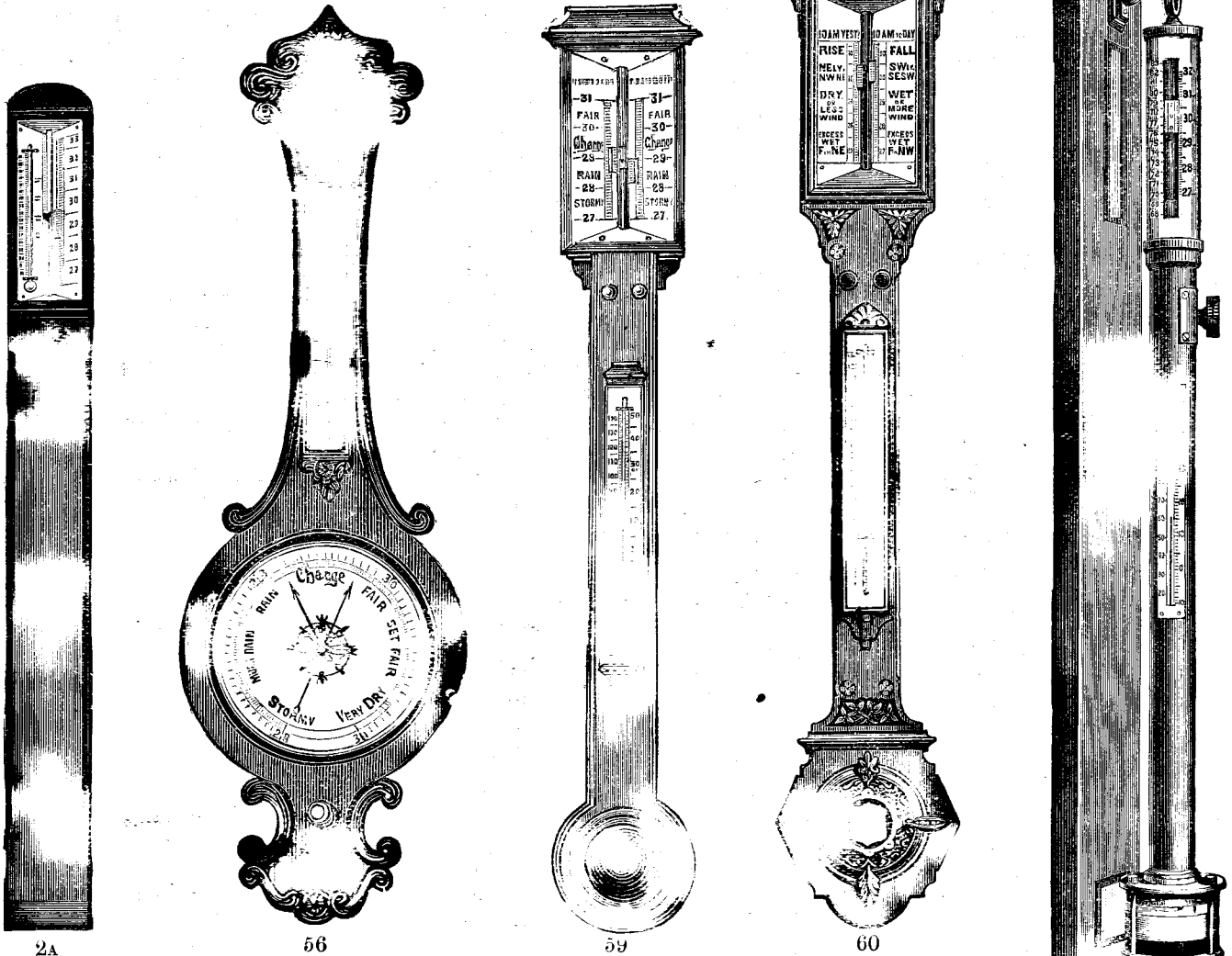
**GENERALLY.**—Our Lamps are constructed with all the experience gained in recent years, all parts are made to standards and are therefore interchangeable, the glasses are fitted above and below with brass rings and asbestos washers, and brass rings to screw up the glass; the oil vessels are of ample size and well tinned internally, and the gauzes are flanged with a pair of spun copper rings.

**ALTERATION OF EXISTING LAMPS.**—We have Bonneted existing Lamps in great numbers. We can replace the whole of the internal fittings, so that the gauzes, glasses, washers, wick tubes, &c., will be supplied with all the parts of our new Marsauts, Bonneted Mueselers, and Bonneted Clannys.

See "Notes on Safety Lamps" previous page.



# BAROMETERS.



## COLLIERY BAROMETERS, as required by the Coal Mines Regulation Act of 1887.

### Colliery Barometer for Surface or Underground.

No. 2A.—Improved Colliery Barometer, in substantial oak frame, glass-covered face, with Thermometer (see plate No. 2A.)	£2 5 0
Second quality ditto	1 13 6

Our No. 2A is specially recommended, all parts being plain, solid, and damp proof—and specially constructed for conveyance by Rail.

### Barometers (Wheel).

No. 54. 8 in. plain wheel Barometer, good frame, with Thermometer	1 10 0
55. 8 in. ditto, best quality, with Thermometer	2 15 0
56. 10 in. ditto, very handsome, with Thermometer (see plate)	6 0 0

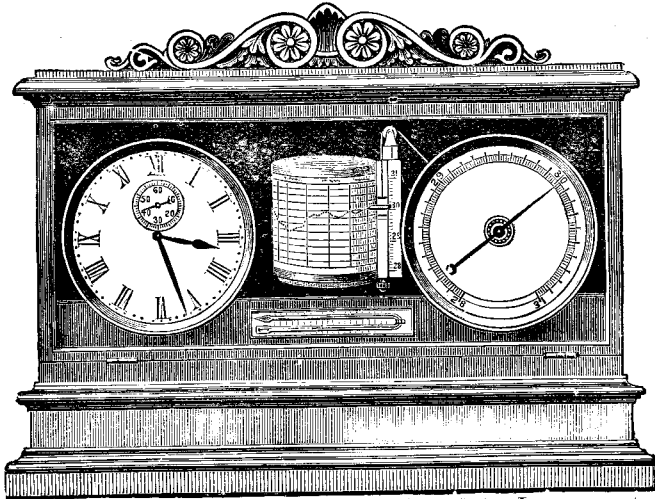
### Barometers, Pediment (Portable).

57. Wheel Barometer, with portable travelling screw, in oak, walnut, or mahogany, with Thermometer	£1 1 0
58. Ditto, better make, carved case	1 5 0
59. Handsome portable Barometer, in oak, glass-covered face, 2 verniers, square top (see plate)	3 0 0
60. Handsomely carved Barometer, in oak, very bold bore, 2 verniers (see plate)	6 16 0
61. Comparative Standard Barometer, bronzed Metal, mounted on bracket, mahogany back	4 15 0
62. Standard Barometer, bronzed Metal, mounted on brackets, silver scales, vernier readings to $\frac{1}{16}$ of an inch, bore of tube 6 inch, thermometer of extreme sensitiveness, guaranteed, Fig. 62	12 0 0
63. Ditto, ditto but tube, 6 inch bore	9 9 0
Glass case for Standard Barometer, of ebonyed mahogany, recommended	3 10 0

### Fitzroy Barometers.

75. Fitzroy Barometer, Oxford frame with thermometer and storm glass	1 1 0
76. Ditto carved oak frame, ditto and storm glass, superior	30/-, 50/-, 63/- to 5 0 0
77. Ditto, Ionic ditto	5 5 0
78. Ditto, massive Greek Corinthian	6 6 0

## SELF-RECORDING ANEROID BAROMETERS.

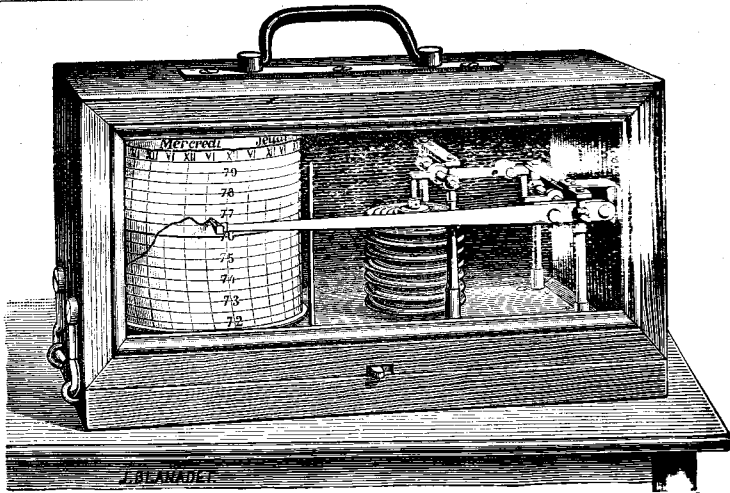


This Illustration is one-eighth the size of the Instrument.

Price of Recording Aneroid, in handsome walnut, mahogany or oak case, with Thermometer, £24 0 0

This Instrument is designed to show at a glance the various fluctuations that have taken place in the Barometer. It consists of a large and powerful Aneroid and an eight-day clock, each with eight-inch dials; between these is placed, in a vertical position, a cylinder five inches in diameter, having a paper attached to it ruled to coincide with the Barometer scale. Near to this paper, a pencil, guided by a rod of metal, is moved up and down as the action takes place in the Aneroid, and at every hour the pencil is made to mark the paper by simple mechanism connected with the Clock.

By this means a black dotted curved line is produced, showing at a glance the height of the Barometer—whether it is falling or rising—for how long it has been doing so, and at what rate the change is taking place—whether it is falling at the rate of one-tenth per hour, or one-tenth in twenty-four hours; all of which are particulars most essential to know when pre-judging the weather, and which can only be obtained from an ordinary Barometer by very frequent and regular observation.



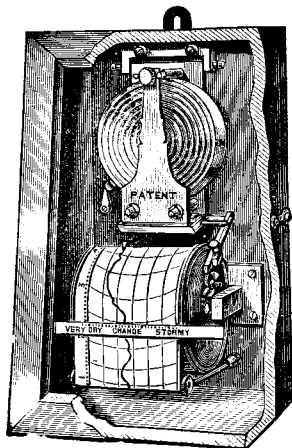
Price complete with 55 Chart forms, Bottle of Ink and Pen.

Self-Registering Barometer ... £5 15 0 | Self-Registering Thermometer ... £6 6 0  
 Self-Registering Steam Gauge (any pressure to 300 lbs) ... £ 0 10 0

## THE SELF-REGISTERING THERMOMETER, BAROMETER, OR STEAM GAUGE.

These instruments are designed to show at a glance the various fluctuations which have taken place in the Thermometer, Barometer, and Steam (or Vacuum) Gauge respectively; the Paper Chart Forms attached to the Drums—which revolve by clockwork—automatically record the variations which have transpired during the week, indicating the precise times of occurrence and periods of duration of each change. They require but little attention, once a week.

The papers upon which the Diagrams are recorded should be changed every week. In cases where a separate record is required for every 24 hours, the paper must be changed each day, and this requirement should be specified in ordering.



(PATENTED.)

## SELF-RECORDING BAROMETER.

This is a very compact form of Self-Recording Aneroid Barometer; made to hang up. The dimensions are 10 in. by 6 in., and it is contained in a mahogany case with glass front. It is fitted with an eight day movement, and the atmospheric pressure is recorded three times an hour.

Particularly adapted for travelling.

Price complete with 55 Charts and Ink ... £4 4 0