List No. 88

superseding List 52.

PHYSICAL INSTRUMENTS

THE CAMBRIDGE
SCIENTIFIC INSTRUMENT COMPANY LTD.,
CAMBRIDGE, ENGLAND.

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JANUARY, 1919.

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For general purposes the A.B.C. Code book, Eden Fisher & Co., 5th edition, 1901, and the Western Union Code are used. The following phrases may also be found useful.

What is the price, time of delivery, and best terms for — *Gabardine.*
Quote price f.o.b. London of — *Gabionage.*
Please deliver at once the following apparatus, we are writing by this mail — *Galoche.*

Standardization at National Physical Laboratory.

We shall be glad to send any of our apparatus to the National Physical Laboratory at Teddington, Middlesex, for Standardization or test. A small charge will be made for the carriage of the instruments to and from the Laboratory but the actual verification fees will be charged for at cost price.

Alterations without notice may be made by us in prices, designs, weights, or materials, at any time.

All our previous lists on this subject are hereby cancelled.

Postal Address. All correspondence should be addressed

The Instrument Company,

Cambridge,

England.

Note. The Works of the Company are off the Chesterton Road, just opposite Jesus Lock.

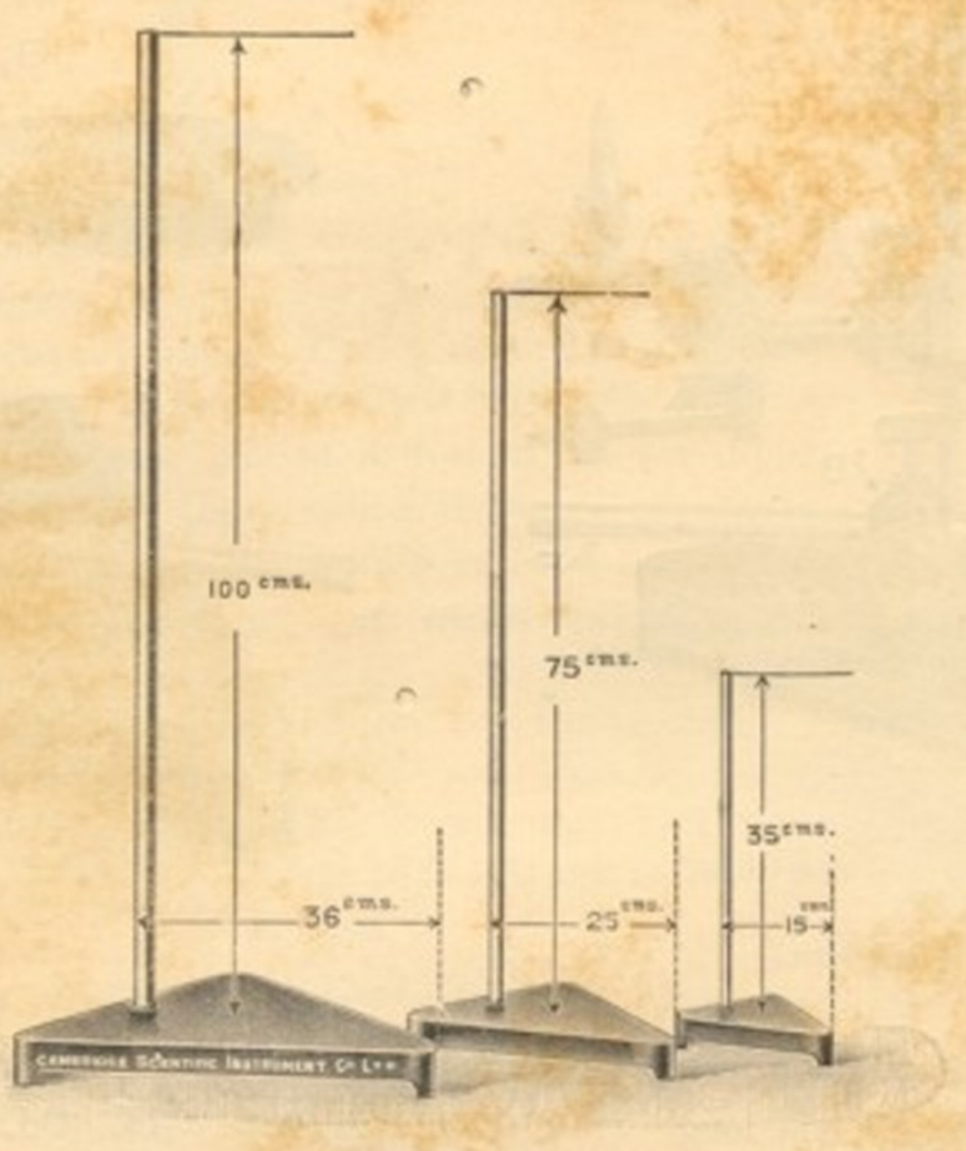
PREFACE.

This list includes most of the Physical Instruments, other than Electrical and Thermometric Instruments, which we are regularly making at the present time. A schedule of the other lists which we publish is given on the inner page of the back cover.

It may be pointed out, moreover, that the regular types of instruments catalogued in these various lists represent only a portion of our output. We are constantly called upon to construct special instruments and apparatus for research in laboratory and observatory, for investigating and controlling industrial operations, and for educational purposes. In many cases we have also furnished the designs for such special instruments, and several examples of these are described and illustrated in our supplementary list entitled "Some special Physical Instruments." This latter list, which we shall be pleased to send to those interested, also covers a few of the more expensive instruments which we supply to order.

CONTENTS.

GENERAL LABORATORY EQUIPMENT



No. 8800.

Laboratory Stands, in three sizes (see illustration). The stands in general use in the majority of Laboratories are, we believe, far too weak and lacking in rigidity, this being especially noticeable when arranging apparatus for a lecture table experiment. We have therefore designed a series of stands and clamps which will firmly support a considerable weight at fairly large distances from the centre of support. The bases are drilled and countersunk, so that they can be screwed down if desired.

	Diam. of Pillar	Height of Pillar	*Net Weight*	Price	Code Word
8800 a.	$\frac{3}{8}$″ (10 mm.)	35 cm.	5 *lbs.*	**3s. 9d.**	*Pabulum*
8800 b.	$\frac{5}{8}$″ (16 mm.)	75 cm.	11 *lbs.*	**6s. 6d.**	*Pacha*
8800 c.	1″ (25 mm.)	100 cm.	55 *lbs.*	**9s. 6d.**	*Pachalic*

Longer pillars can be fitted at a small additional cost.

Laboratory Stand Fittings, for use with laboratory stands Nos. 8800 a, b and c.

8801 A. **Pillar Block,** for clamping upon the pillar; drilled with three mutually perpendicular holes with set-screws for holding clamps, etc. (*Net weight* = $1\frac{3}{4}$ *lbs.*)
4s. 6d. *Packstaff*

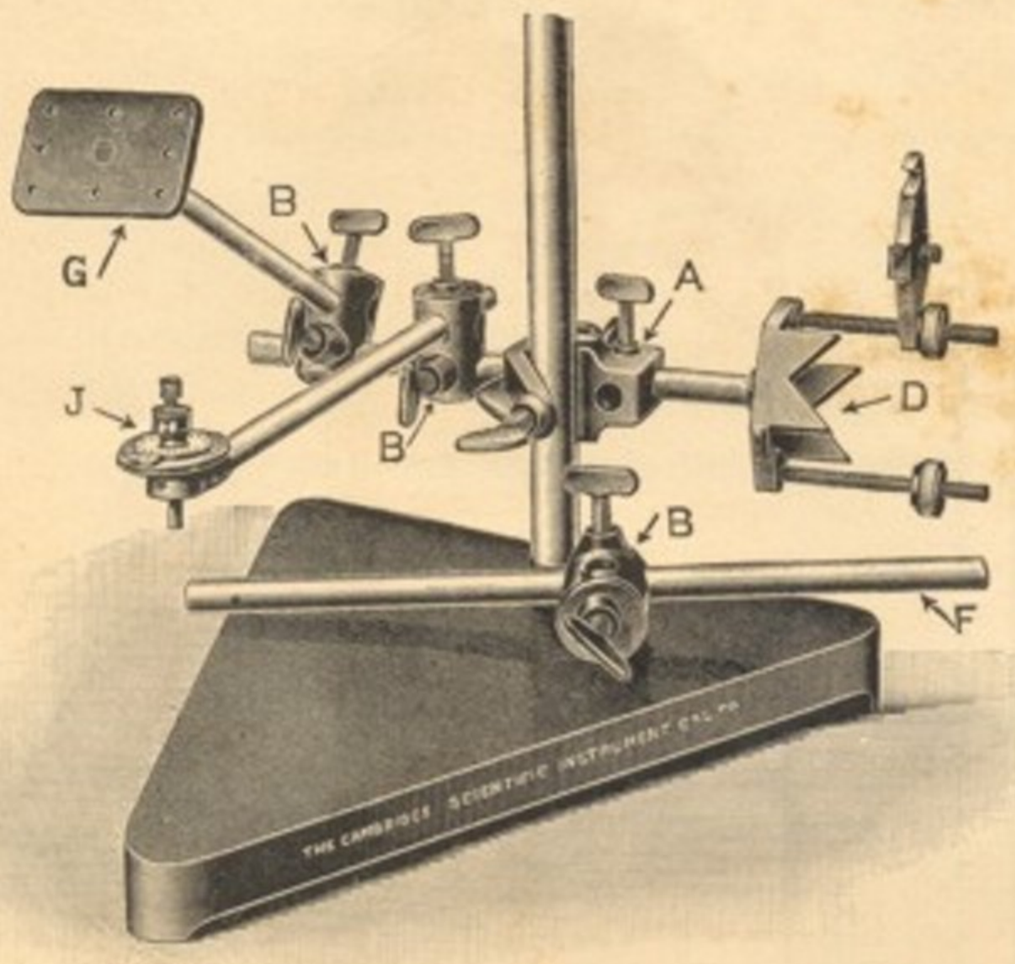
8801 B. **Connector,** drilled with three holes (two parallel, the third perpendicular to them), for use especially with the plain lengths of rod (*E* and *F*), and enabling any of the clamps, etc. belonging to this set to be held firmly at any inclination. These connectors are also useful for clamping two lengths of rod together so as to form practically one long piece. (*Net weight* = $\frac{3}{4}$ *lb.*)

3s. 0d. *Padder*

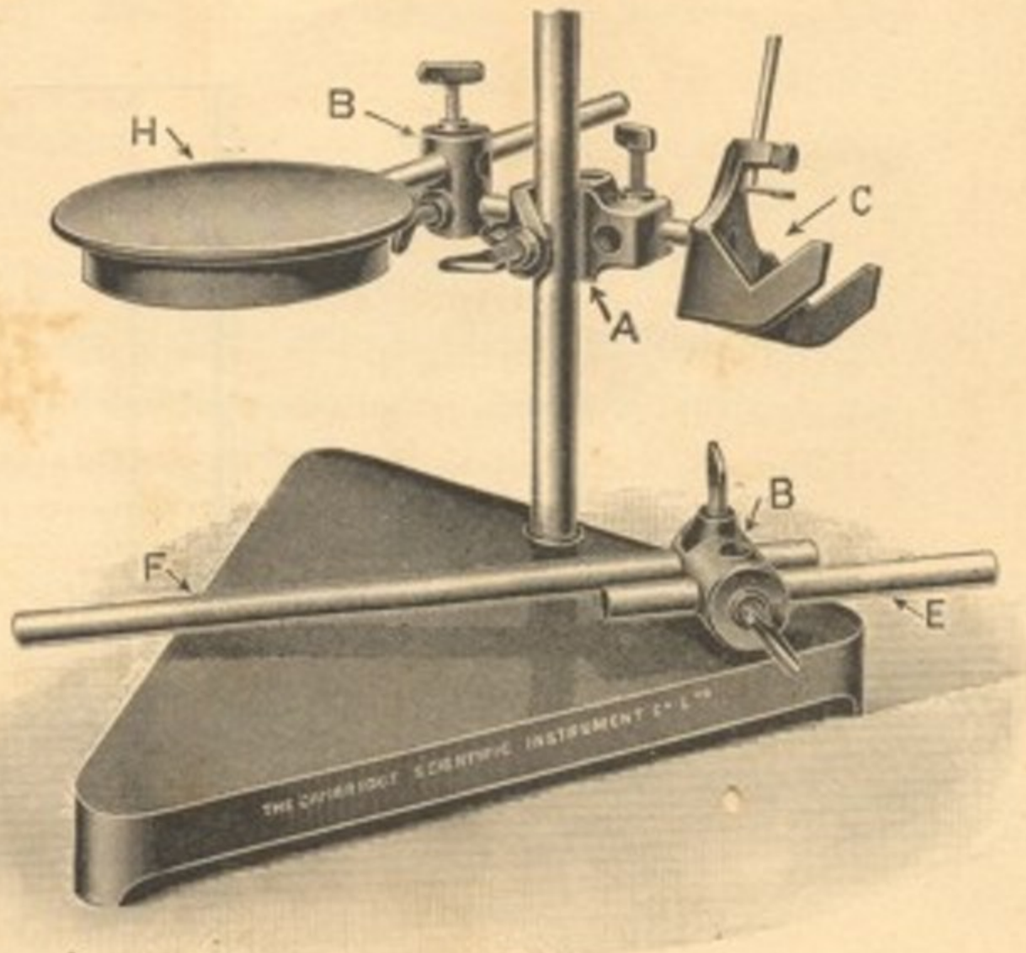
8801 C. **Vee-bracket,** for holding firmly, but without undue strain, a telescope or any such instrument as requires to be sighted in a definite direction. (*Net weight* = $1\frac{3}{4}$ *lbs.*)

4s. 6d. *Paddock*

8801 D. **Clamp,** for holding firmly at any inclination pieces from 60 mm. diameter down to nothing. (*Net weight* = 3 *lbs.*) ... ... **6s. 6d.** *Paginal*



No. 8801. $\frac{1}{6}$ full size.



No. 8801. $\frac{1}{6}$ full size.

8801 E. **Plain rod,** 200 mm. long. (*Net weight* = $\frac{3}{4}$ *lb.*) **6d.** *Painim*

8801 F. **Plain rod,** 400 mm. long. (*Net weight* = $1\frac{1}{2}$ *lbs.*) **1s. 0d.** *Palatial*

8801 F a. **Plain rod,** 1000 mm. long—this may be used as a bridge piece between two stands forming a simple optical bench (*Net weight* = $3\frac{1}{2}$ *lbs.*)

2s. 6d. *Palatic*

8801 G. **Face plate,** drilled and countersunk so that a board or other woodwork may be screwed to it. In setting up apparatus for temporary use, this fitting is often most convenient. (*Net weight* = $1\frac{3}{4}$ *lbs.*) ... ... **2s. 9d.** *Pallor*

8801 H. **Flat circular iron table,** 180 mm. in diameter. (*Net weight* = $3\frac{3}{4}$ *lbs.*)

4s. 0d. *Palfrey*

8801 J. **Torsion head,** with circle divided into 10 degree divisions. (*Net weight* = $1\frac{1}{2}$ *lbs.*)

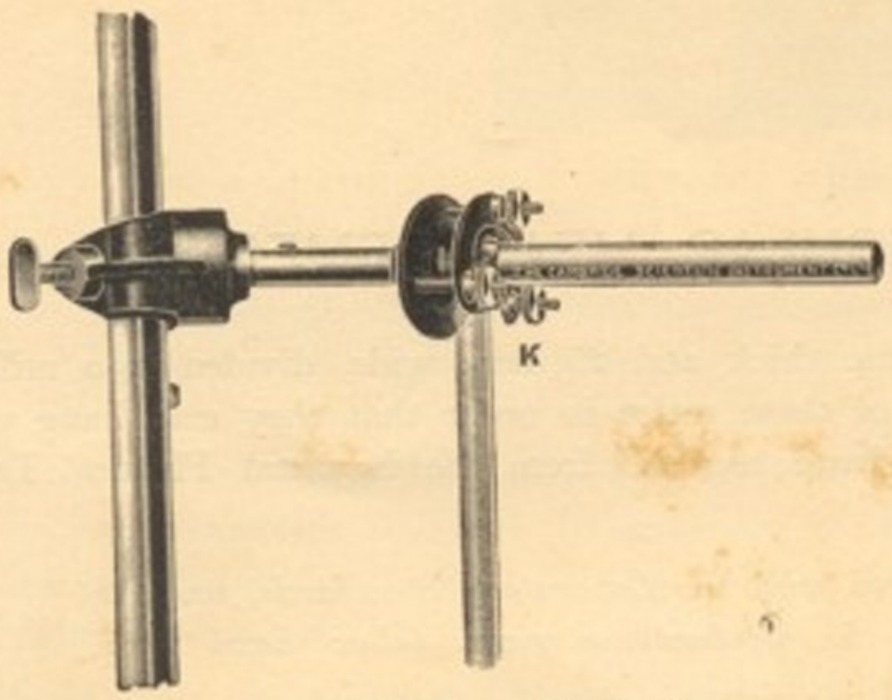
£1. 1s. 6d. *Palinode*

8801 K. **Universal joint.** This joint is connected to two arms 16 mm. in diameter. One arm can be clamped to a supporting stand, the other being used to support a small piece of apparatus. The ghost in the illustration shows the arm moved through a right angle. The joint will be found a useful accessory for holding things at any angle. (*Net weight* = $1\frac{1}{2}$ *lbs.*)

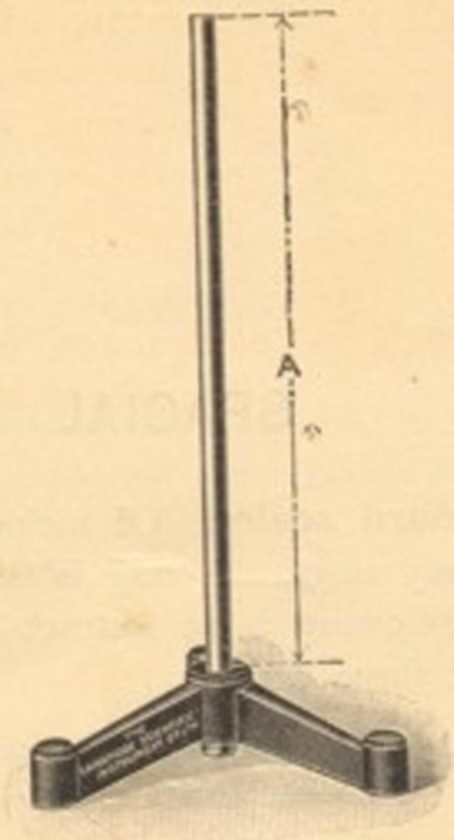
8s. 6d. *Palmary*

8803. Tripod pillar stand, as illustrated. The pillar is $\frac{5}{8}''$ (16 mm.) in diameter, its length (*A*) being 38 cm. Similar stands of other dimensions can be supplied to order. (*Net weight* = $4\frac{1}{2}$ *lbs.*)

5s. 0d. *Pamper*



No. 8801 K. ½ full size.



No. 8803. ½ full size.

Geometric tripod stands. These stands, designed by Mr C. V. Boys, F.R.S., are especially adapted for supporting pieces of apparatus, such as galvanometers, lamps, etc. By their means a stand of any desired height may be made, each tripod making geometric contact with the one immediately below it. A triangular groove is formed on the upper surface of the tripods into which the levelling screws of an instrument may be placed. The stands are supplied in two sizes:—

Small Size: Distance from centre of tripod to centres of feet 75 mm.

A set of 1 dozen consists of
- 9 stands, 50 mm. high,
- 2 stands, 25 mm. high,
- 1 stand, 25 mm. high, to which a metal table 170 mm. in diameter is fixed.

8805. In Iron, per set of 1 doz. (*Net weight* = 12 *lbs.*)
10s. 6d. *Panacea*

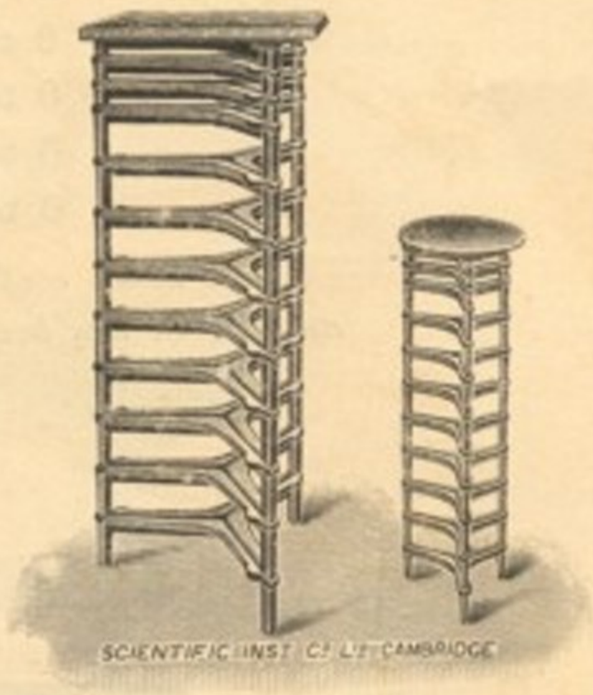
8806. In **Aluminium**, per set of 1 doz. (*Net weight* = 4 *lbs.*)
14s. 0d. *Pandect*

Large size: Distance from centre of tripod to centres of feet 175 mm.

A set of 1 dozen consists of
- 9 stands, 76 mm. high,
- 2 stands, 36 mm. high,
- 1 stand, 36 mm. high, to which a wooden table 33 cm. square is fixed.

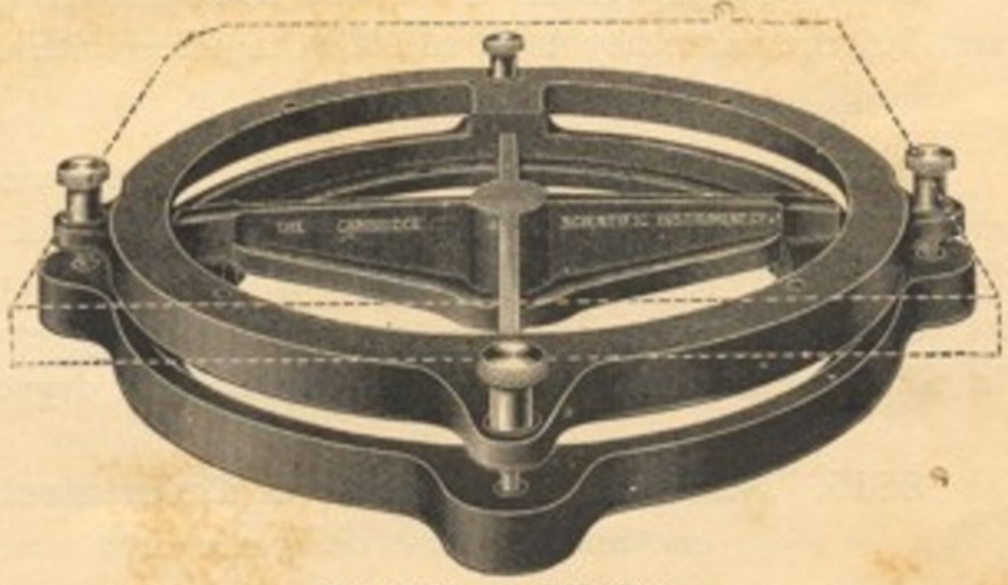
8807. In Iron, per set of 1 doz. (*Net weight* = 72 *lbs.*) **£2. 5s. 6d.** *Pandore*

8808. In **Aluminium,** per set of 1 doz. (*Net weight* = 25 *lbs.*)
£3. 10s. 0d. *Paneless*



Nos. 8805–8. $\frac{1}{12}$ full size.

8810. Burton's levelling stand, of geometric design (see illustration). This rests upon three solid toes, either on a table or on a pile of Boys' geometric tripod stands (large size, see No. 8807). A gimbal construction provides for **independent** levelling adjustment about two **mutually perpendicular axes.** The table (indicated by dotted lines in the figure) measures 30 × 30 cms. (*Net weight* = 17 *lbs.*)
£1. 7s. 6d. *Pannage*



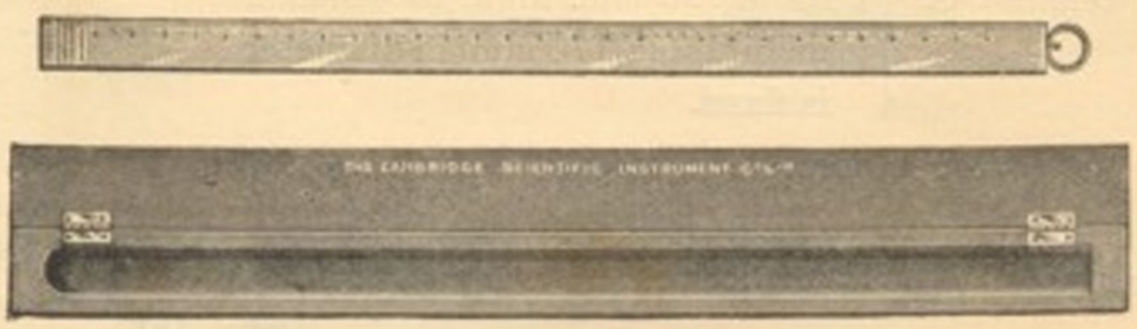
No. 8810. ¼ full size.

SPACIAL AND ANGULAR MEASUREMENT

Standard scales. Of nickel steel, 6 mm. thick and 25 mm. wide, divided into millimetres; in mahogany cases. A ring is fitted to each of these scales in order that they may hang vertically.

The following is an extract from a certificate received from the National Physical Laboratory for one of these scales:

> *"This scale has been compared with the Laboratory Standards, and its length at 0° Centigrade between the graduations given below have been found to be:—*
>
> | *Graduations* | *Actual Lengths* |
> |---|---|
> | 0 to 10 | 9·998 centimetres |
> | 0 to 20 | 19·995 ,, |
> | 0 to 30 | 29·995 ,, |
> | 0 to 40 | 39·996 ,, |
> | 0 to 50 | 49·996 ,, |
>
> *The mean coefficient of linear dilatation between the temperatures of* 0° *and* 30° C. *has been found to be* 0·000,000,8 *per degree Centigrade."*
>
> (*Signed*) R. T. GLAZEBROOK,
> *Director.*



No. 8812. ¼ full size.

8812. 50 cm. long. (*Net weight = 2 lbs.*) ... **£3. 10s. 0d.** *Pansophy*

Additional charge for National Physical Laboratory certificate giving length at 10, 20, 30, 40 and 50 cm. (accuracy 1 in 100,000) together with temperature coefficient; including carriage to Laboratory. ... ... **£1. 15s. 0d.**

8813. 100 cm. long. (*Net weight = 7 lbs.*) ... **£6. 10s. 0d.** *Pantable*

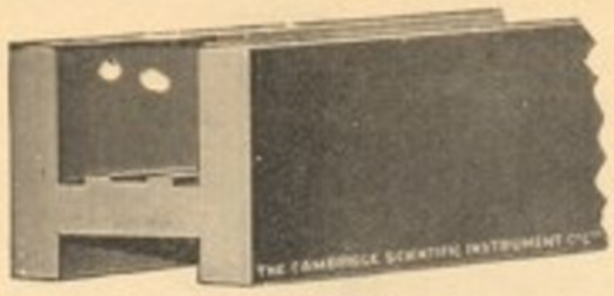
Additional charge for N. P. L. certificate giving length at 10, 20, 30, 40, 50, 60, 70, 80, 90, and 100 cm. (accuracy 1 in 100,000) together with temperature coefficient.

£2. 7s. 6d.

Standard metres of Invar steel. These are made of an alloy of steel containing 36°/₀ of nickel, introduced into Metrology as the result of experiments made at the Sèvres International Bureau of Weights and Measures by Dr Guilleaume. The principal advantage of this alloy is its very slight expansion with temperature, being between one-fifth and one-tenth of that of platinum. It takes a fine polish, and is non-oxidisable in dry or moist air.

***8815. Standard metre scale of Invar steel,** 10 mm. thick and 20 mm. wide divided every cm. and the first decimetre into mm. Specularly polished. (*Net weight = 9 lbs.*)

£11. 0s. 0d. *Papaw*



No. 8816. ⅔ full size.

8816. Standard metre scale of Invar steel, H form, divided in the neutral zone (see illustration). The divisions are millimetres, the first and last mm. being subdivided into tenths. Specularly polished. (*Net weight* = 9 *lbs.*)

£14. 10s. 0d. *Papilio*

This form of scale was first suggested by the "Bureau International des Poids et Mesures." It possesses the advantages that the divisions are on a surface in the neutral axis of the system and will not be affected by flexion. It also offers a maximum resistance to flexion for a minimum mass and maximum surface.

Certificates from the National Physical Laboratory can be supplied, at cost price, with either of the above scales. When telegraphing, the addition of the word "Certificate" after the code word will be taken to mean that a N.P.L. Certificate is required.

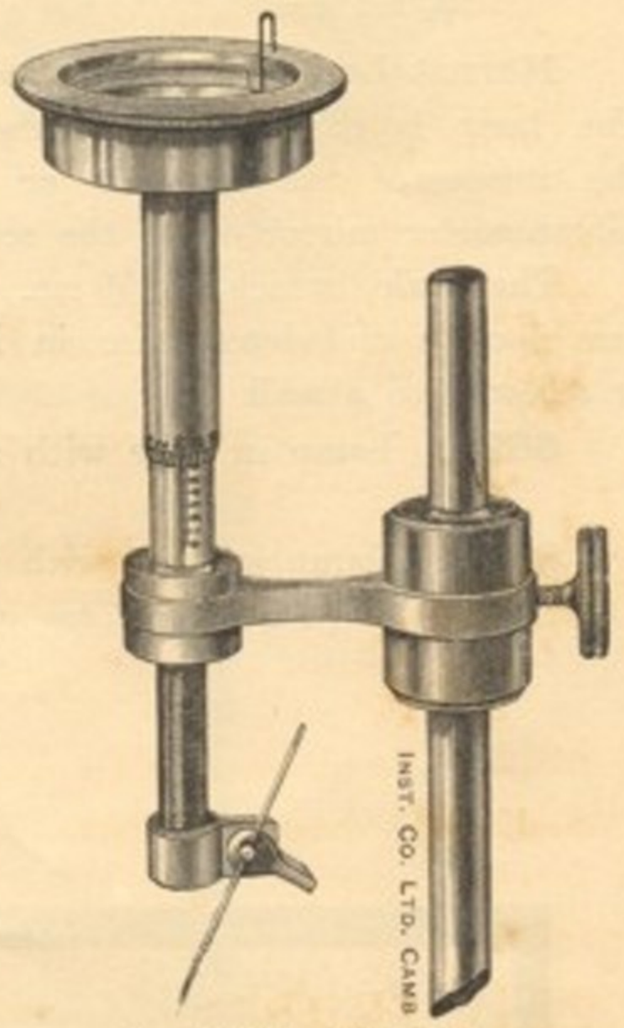
8818. Millimetre paper scales, 500 mm. long. To avoid the error due to shrinkage, these are *printed dry* on stout paper from a carefully divided copper plate.

Each ... **6d.** *Paradigm*

Ditto Per doz. ... **4s. 6d.** *Paradox*

8820. Cup micrometer, for measuring small vertical movements, to one-hundredth of a millimetre. Useful in many cases where a cathetometer is commonly used. A cup is fixed to the upper end of the micrometer screw and is partially filled with oil. A needle is then attached to the object whose movement is to be measured. It should be vertical, with the point downward, and directly over the oil cup. The micrometer screw is turned and the reading taken when the needle point is seen to touch the surface of the oil; the image of any object reflected in the surface of the oil being distorted at the moment of contact. It is sometimes more convenient to place the oil cup on the object to be measured and to fix the needle to the lower end of the micrometer screw as shown in the figure. In case. (*Net weight* = 2 *lbs.*) ... **£5. 5s. 0d.** *Parallel*

Stand extra (see No. 8800 a).



No. 8820. ½ full size.

8822. Micrometer telescope, for reading thermometers (see illustration on next page). The telescope is supported by a carriage sliding on a vertical steel rod fixed to a cast-iron tripod foot. Total Height 92 cm.

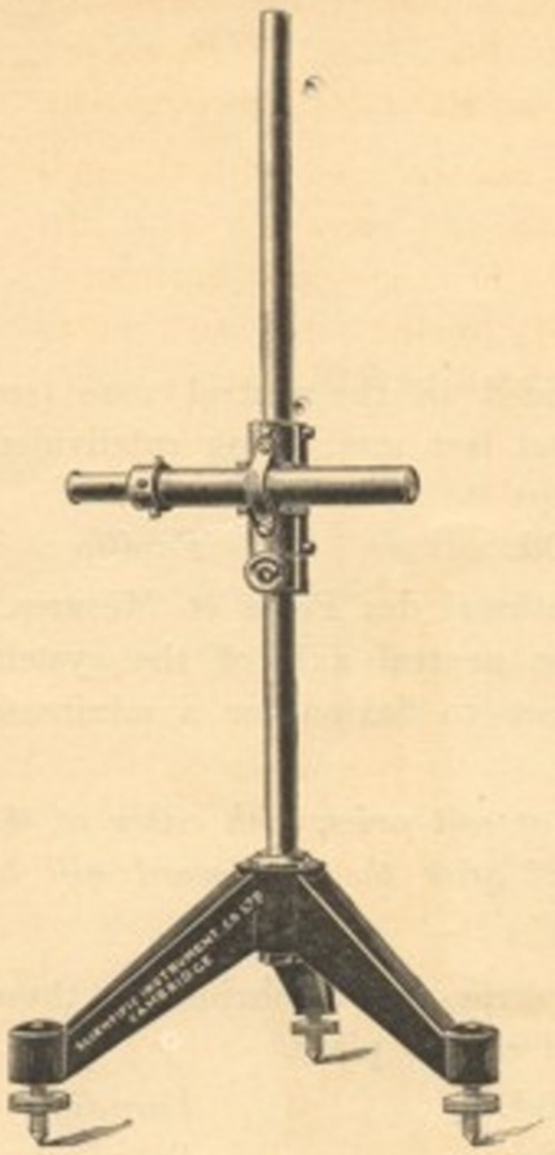
The telescope has an object glass of very short focal length and may be described as a very low-power microscope. A finely ruled glass scale, ruled to 0·1 mm., is fixed at the focus of the eye-piece, and the draw tube should be adjusted so that 10 divisions of this scale correspond to one millimetre or one scale division of the object examined. (*Net weight* = 23 *lbs.*)

£6. 10s. 0d. *Paralogy*

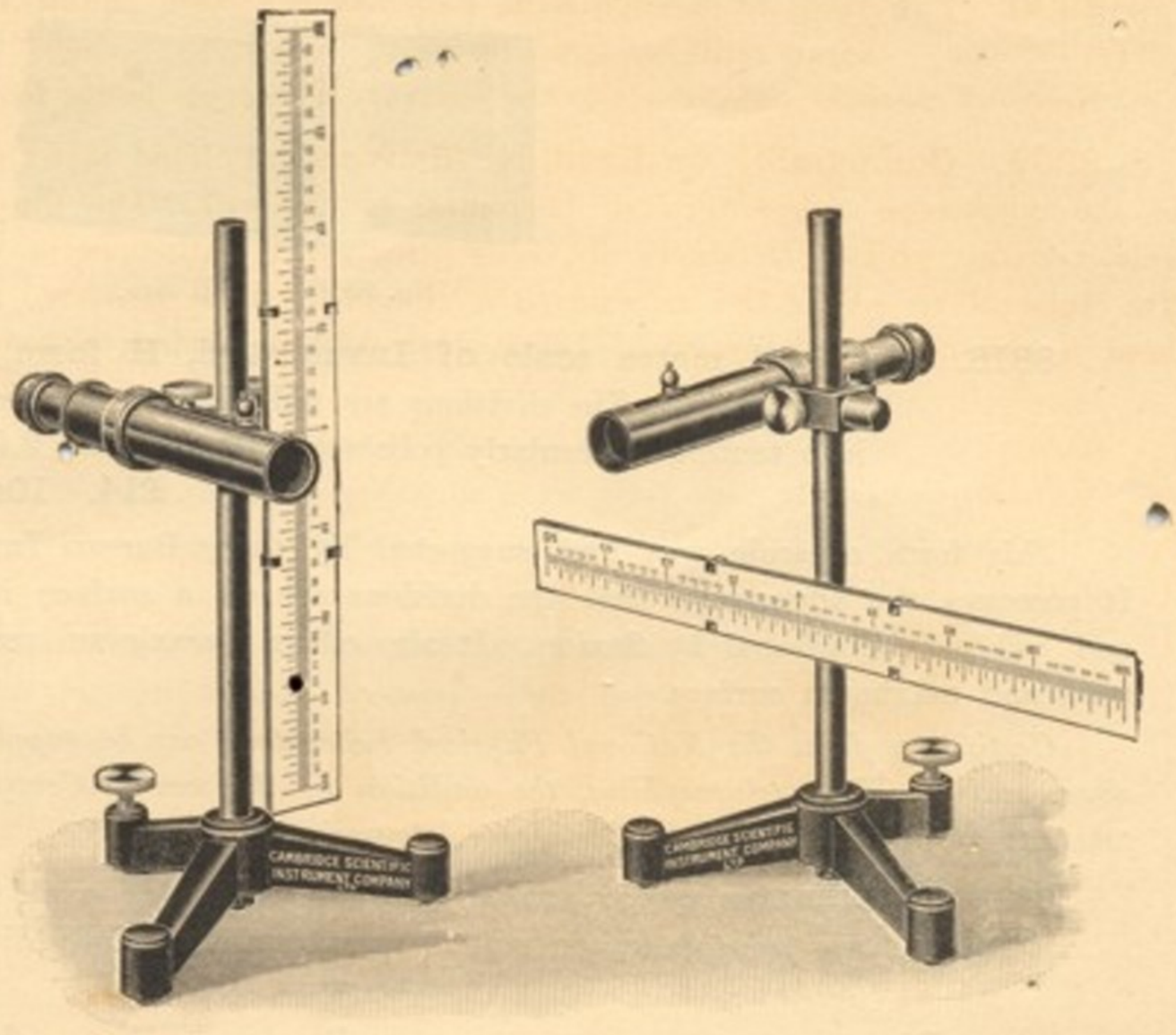
8824. Telescope and Scale (see illustration on next page). The scale is 40 cm. long, divided in millimetres and figured; it can be placed either horizontally or vertically and adjusted to horizontality or verticality by means of a foot screw; it can also be slid lengthwise in its clip.

The telescope has a magnification of about four, it can be tilted, and clamped at any inclination. Both telescope and scale can be swivelled round or adjusted in height upon the vertical stem.

Price complete, with brass stand. (*Net weight* = 6 *lbs.*) **£4. 10s. 0d.** *Parapegm*



Micrometer Telescope. No. 8822.
$\frac{1}{10}$ full size.



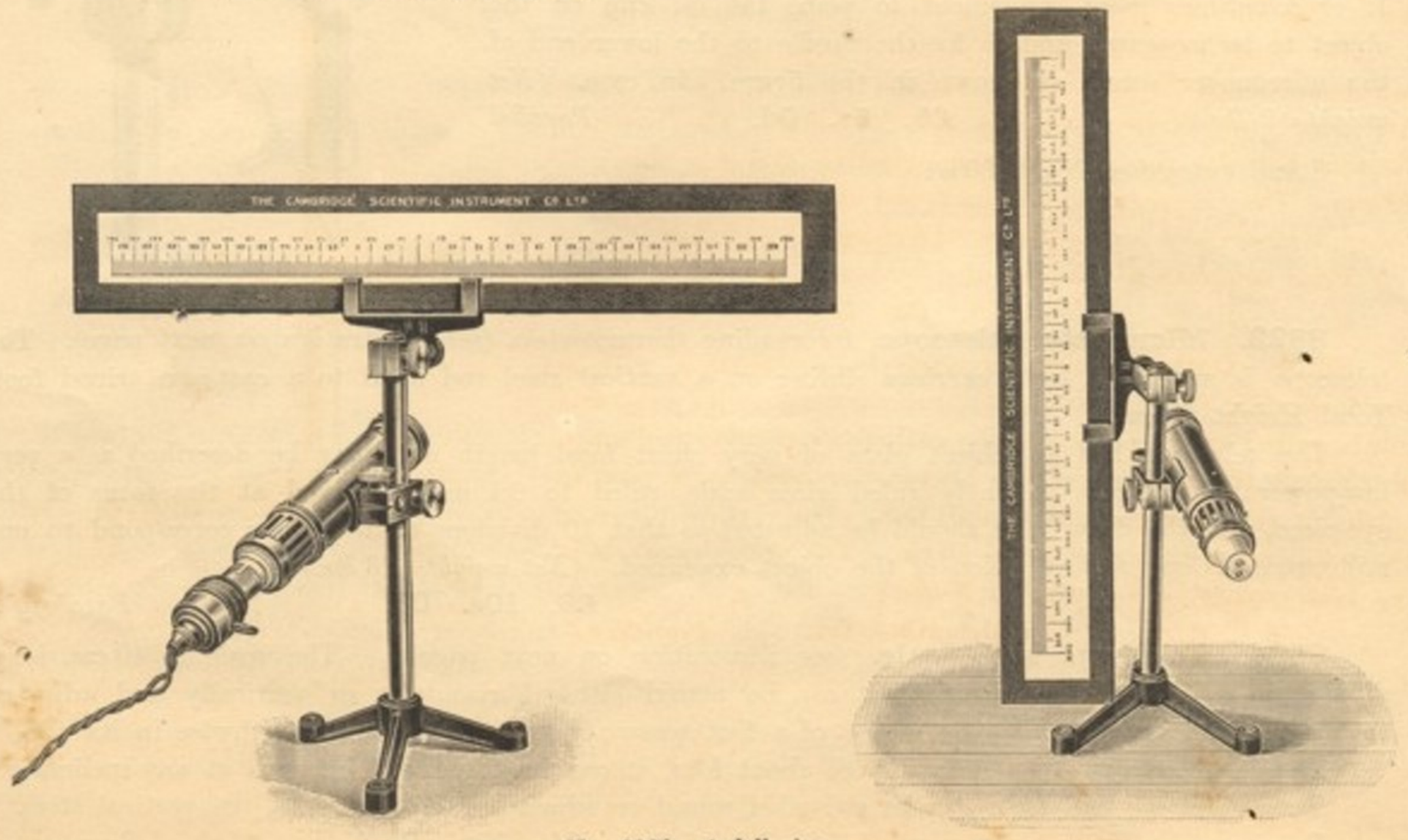
Telescope and Scale. No. 8824. $\frac{1}{8}$ full size.

Nernst Lamp and Transparent Scale, for use with galvanometer or any reflecting instrument. The lamp is enclosed in a tube which is readily adjustable as to height and direction. Either the image of the filament or that of a wire stretched across the lens is projected from the galvanometer mirror on to the scale, an extremely bright image being obtained by this means.

The scale, which is 50 cm. long and translucent, can be placed horizontally or vertically; it can also be slid lengthwise in its clips, and then clamped. The stand can be used on a table or screwed to a wall.

8826. Lamp in tube with scale and brass stand but no leads. (*Net weight = 5 lbs.*)
£2. 10s. 0d. *Parasang*

8828. Lamp in tube with brass stand but no scale or leads. (*Net weight = 4½ lbs.*)
(*See note at top of page* 9.)
£1. 15s. 0d. *Paravail*

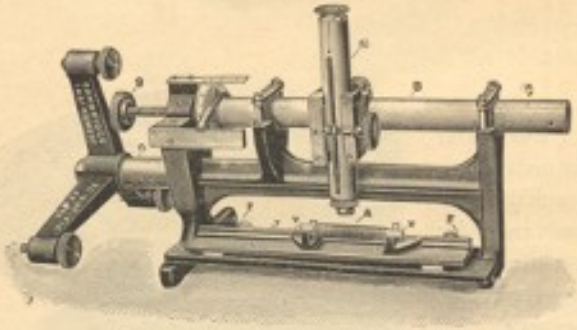


No. 8826. $\frac{1}{4}$ full size.

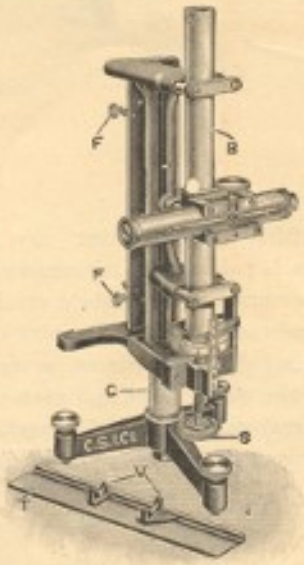
8830. Two yards of flexible leads with bayonet catch holder and plug adapter for connecting to an ordinary lamp fitting ... ... **3s. 6d.** *Parcener*

Note. Unless the order reads to the contrary we supply lamps for use on 100 volts direct current.

8832. Comparator or Reading Microscope. This instrument can be used with the axis of the microscope either vertical, horizontal or inclined. The illustration (*A*) shows it with the axis vertical whilst (*B*) shows it being used as a cathetometer with the microscope horizontal. The tube *B* to which the microscope is clamped can be traversed slowly, by the screw and milled head *S*, through 40 mm., readings being taken on the divided micrometer head to 0·01 mm.



A
½ full size.



B
½ full size.

No. 8832.

For supporting the object under examination a small sliding table *T* resting on geometric fittings is provided. This is fitted with centring adjustments controlled by the screws *F*, *F*. Small V blocks are also provided to take screws etc. For the focusing mechanism on the microscope Lucas's Patent Slow Motion Mechanism is used which gives a much smoother movement than the ordinary rack and pinion and is also free from backlash. The illustration *A* shows a screw under examination.

The microscope *M*, which is fitted with cross lines and can be clamped at any point on the tube *B*, has a Zeiss Achromatic objective a_2, and a No. 2 Ocular. The working distance between the nose of the objective and the object is 30 mm. The Comparator will be found of very general use in either a laboratory or workshop. (*Net weight* = 17 *lbs.*)

Price complete as illustrated

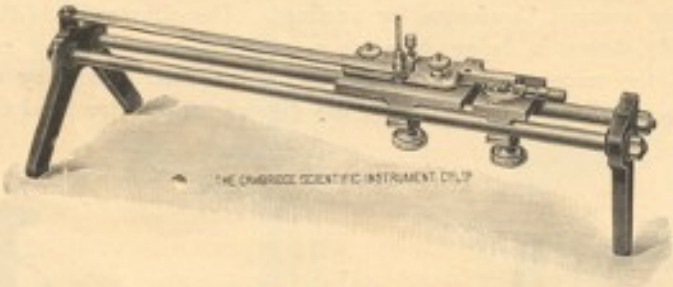
£15. 0s. 0d. *Parental*

8834. Cathetometer, for use in conjunction with a standard scale. The whole pillar can turn about its axis, and can be raised or lowered micrometrically through a vertical range of 25 mm.; the readings of the micrometer head being used to subdivide the scale readings to 0·01 mm. The vertical range of the telescope upon the pillar is 50 cm. The optical work is of the best quality. (*Net weight* = 35 *lbs.*)

£19. 10s. 0d. *Parhelion*

No. 8834. $\frac{1}{10}$ full size.

8836. Step by step dividing machine, useful for dividing verniers and short scales. The graving tool is carried at the end of a long arm, and the scale to be divided is mounted on a carriage whose advance at each step is determined by means of a micrometer screw (see illustration). (*Net weight* = 13 *lbs.*) ... ... **£7. 10s. 0d.** *Parity*



No. 8836. ¼ full size.

8838. Spherometer (see illustration). Particular attention is paid to the micrometer screw in this instrument and its accuracy is the highest attainable. For each division of the micrometer head the point of the screw advances by 0·002 mm. The feet lie on a circle of 3 cm. radius. In reading the whole turns and parts of a turn, engraved lines (not edges) serve as the respective reading marks. In mahogany case. (*Net weight* = 2 *lbs.*)

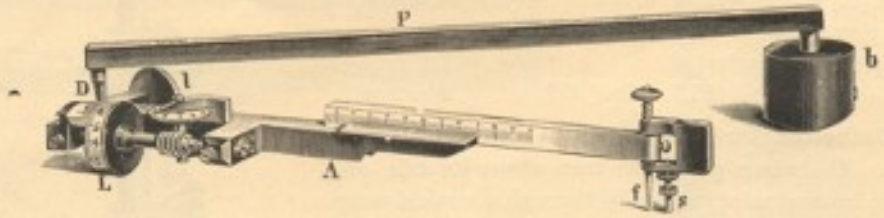
£5. 0s. 0d. *Parlous*

No. 8838. Full size.

8839. Glass Plate, for use with above spherometer, 8 cm. diam., 6 mm. thick, with surface flat to an accuracy of 0·001 mm. ... **£1. 10s. 0d.** *Parole*

8840. Amsler's planimeter, "compensation" type (see illustration). The pole arm can be placed on either side of the tracer arm, so that by taking the mean of the measurements made in these two cases, any small error due to imperfect alignment of the axis of the roller may be eliminated. Adjusted for 1 vernier unit *only*, between 8 and 10 square mm., length of pole arm 19 cm., length of tracer arm 16 cm.; the adjustable piece carrying the tracer is made of German silver and screwed on the tracer arm from underneath, it has a graduation in ½ mm., on which an index mark indicates the length of the tracer arm. Roller of hardened steel, graduation of the roller and counting wheel on celluloid; convenient winged handle and support with testing rule with two points for 8 and 4 cm. Complete in case. (*Net weight* = 1½ *lbs.*)

£2. 5s. 0d. *Paroquet*



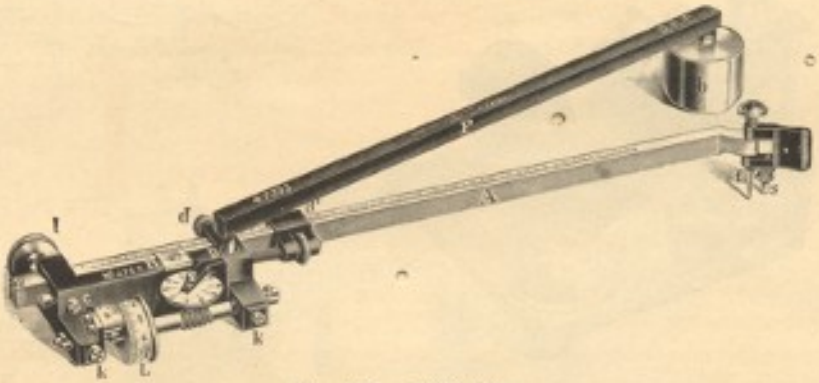
No. 8840. ½ full size.

8842. Amsler's planimeter, "compensation" type, with graduated tracer arm provided with vernier and micrometer adjustment, adjustable for values of the vernier unit between 10 and 2 square mm., adjusted for 4 to 6 vernier units or settings of the tracer arm. Measuring roller and counting wheel as for No. 8840, table in the case, showing the values of the vernier unit, settings of tracer arm and constants, pole arm 19 cm. long, winged handle and support, with neat

case and testing rule with four points for radii of 2, 4, 6 or 8 cm. Has a convenient adjustment for placing the axis of the roller and tracer arm parallel (see illustration). (*Net weight* = 1¼ *lbs.*)

£3. 7s. 0d. *Partage*

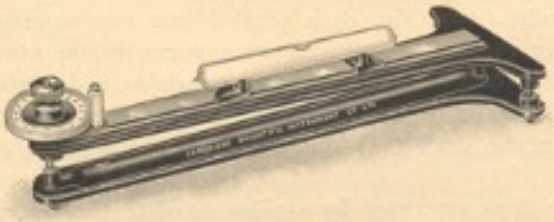
8844. Amsler's Planimeter as No. 8842 but adjusted for both metric and English units. (*Net weight* = 1¼ *lbs.*) ... ... **£3. 11s. 0d.** *Partisan*



No. 8842. ½ full size.

8846. Spirit-level tester (see illustration). This instrument is of a new and improved form of very great simplicity, and is capable of taking any size of level tube up to 1 ft. in length. The tube is placed in two V's both of which lie geometrically on a slide; this slide is arranged to be tilted by an accurate screw, provided with a micrometer head divided on celluloid, each division of which corresponds to a tilt of one second. (*Net weight* = 8 *lbs.*)

£4. 10s. 0d. *Partially*

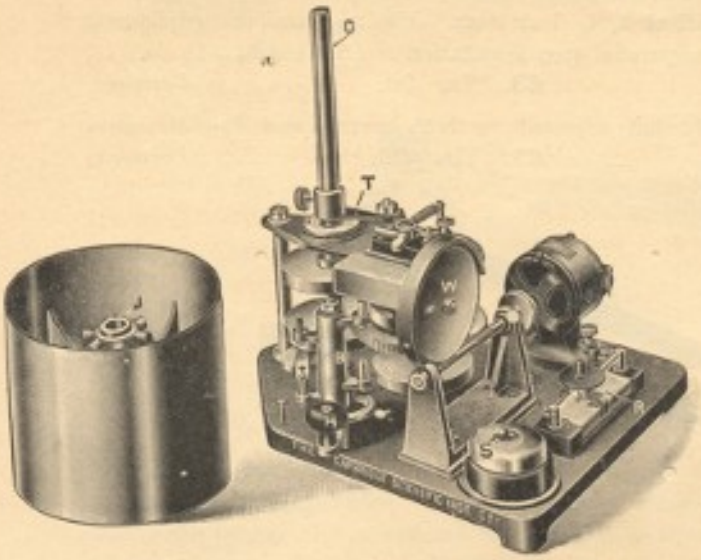


No. 8846. ½ full size.

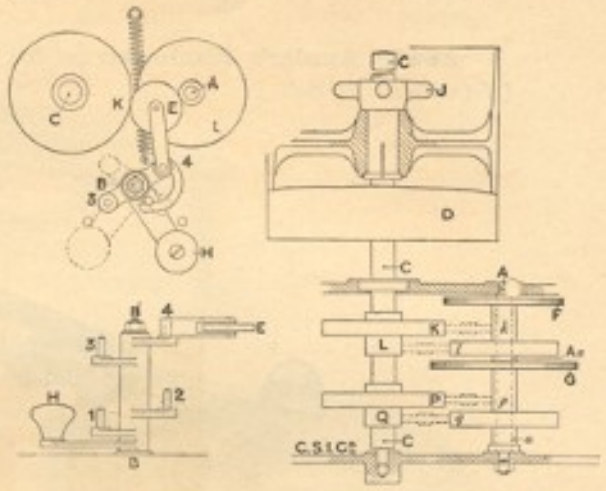
The following instruments will be found in our supplementary list entitled "Some Special Physical Instruments." The prices given here are only approximate.

Star-Photograph Micrometers (£50 and upwards).
Co-ordinate Comparator (£20).
Screw Measuring Machines (from £57).
High Grade Dividing Machines (from £62).
A brief description of the Comparators we have supplied for comparing the standards of length in the Geodetic Survey of India.
A 10 Link Comparator for the Government of New Zealand.

8850. Kymograph. Motor-driven, Variable Speed pattern.



A
About ½th full size.



B
½th full size.

The special feature of this Kymograph, which is driven by a small electric motor of about $\frac{1}{150}$th H.P., is the unusually wide range of speeds which can be obtained on the recording drum. This is due to a novel and compact arrangement of gears.

Adjustment of Drum Speed. A general view of the Kymograph is presented in Fig. A; and Fig. B diagrammatically shows details of the working parts. The small motor is controlled by the switch *S* and variable rheostat *R*, by means of which a range of speeds from 1 to 4 can be obtained. This motor is coupled directly to a worm shaft, which drives the worm wheels *G* (Fig. B) and *W* (Fig. A). The shaft *AAaa* (Fig. B) is divided into two separate parts at *Aa*. The worm wheel *F*, fixed to the upper shaft *AA*, is driven by a worm on the same shaft as the intermediate wheel *W* (Fig. A); whilst the wheel *G*, fixed to the lower shaft *aa*, is driven direct from the motor worm. Due to this arrangement the speed of the shaft *aa* is 160 times as great as that of the shaft *AA*.

The drum *D* carried on the shaft *C* is clamped by the hand screw *J* and can be quickly raised or lowered on the shaft.

An independent sleeve *B* is supported by a pillar fixed to the bed-plate, and can be moved by the handle *H* working between two stop pins. Four upright pins 1, 2, 3, 4 (see Fig. B) are mounted on this sleeve, and an arm carrying a loose wheel *E* can be dropped on to any one of them.

Speeds obtainable. If the arm carrying the friction wheel *E* is placed on one or other of the pins 1, 2, 3, 4 and caused to engage with the pulleys as shown by the dotted positions in Fig. B, the drum shaft *C* will then be driven—the speed depending on the position of the wheel *E*.

The following table shows the ranges of drum speeds obtainable; it must be understood that the figures given depend upon the voltage of the supply circuit, and will vary somewhat in the case of each motor supplied.

Position of wheel *E*: Pin No. . .	1	2	3	4
Maximum drum speed: in mm. per sec. .	480	32	3	0·2
Minimum drum speed: in mm. per sec. .	120	8	0·75	0·05

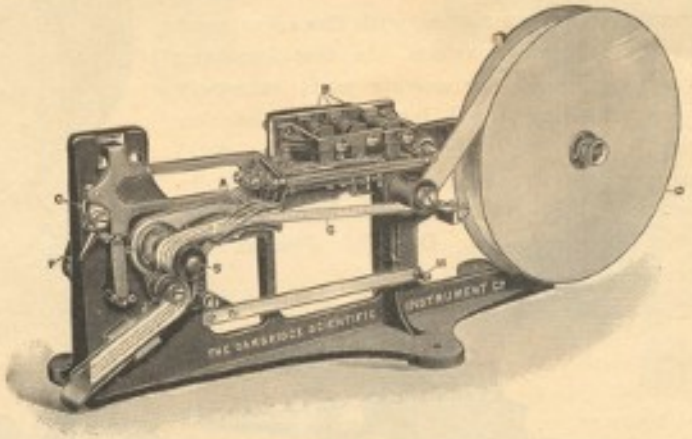
The drum may be stopped either by switching off the motor current at *S*, or by using the handle *H* to disconnect the gearing between the drum shaft *C* and the motor. An electric cut-out *T* is arranged immediately below the drum to automatically break the current passing through the time-marker after the drum has made one revolution.

For a detailed description see our special leaflet.

Price of Kymograph, complete with motor* (for 110 volts D.C.), switch, rheostat, and automatic current breaker mounted on the same bed-plate. (*Nett weight* = 21 *lbs.*) **£25. 0s. 0d.** *Particle.*

* Motors for other voltages can be supplied, but usually an extra charge must be made in such cases.

8854. Chronograph for Laboratory use (see illustration). In this chronograph, which is intended to be driven by a belt or small motor, a band of paper 1" (25 mm.) wide is drawn under three pens *A* attached to the armatures of three electromagnets *B*. These armatures are made very light. The paper band *C* is drawn off the reel *D* between the two pulleys *J* and *S*. The pulley *S* is driven by gearing from the main cone-pulleys *P*, whilst *J* is a loose jockey-pulley. When the lever *H* is moved the pulley *J* is caused either to press the paper on to the pulley *S* or to release it. The motion of the paper can therefore be started or stopped at will although the driving pulleys run continuously. The lever *G* enables the three pens to be raised from, or lowered on to, the paper.



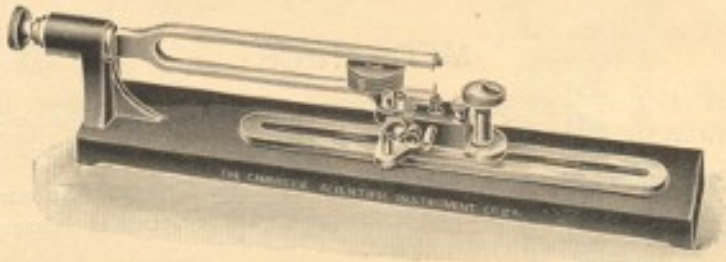
No. 8854. ½ full size.

Price of Chronograph including 1 reel of paper but without driving motor. (*Net weight* = 10 *lbs.*)
£16. 10s. 0d. *Passible*

8855. Spare Reels of paper for Chronograph. Each reel contains about 550 feet (170 metres), per reel ... ... **3s. 6d.** *Pastern*

8856. Small motor, 110 volts direct current, suitable for driving Chronograph. Complete with driving belt. (*Net weight* = 2 *lbs.*) **£1. 16s. 0d.** *Patness*

8858. Tuning-fork stand, as illustrated, for holding any of our electrically maintained tuning-forks. Complete with electromagnet and mercury-cup contact breaker, which are fully and conveniently adjustable. 2 volts is sufficient to operate these stands, although when used in series with one of our time-markers 4 volts should be used. Without fork. (*Net weight* = 12 *lbs.*)
£2. 10s. 0d. *Pathless*



No. 8858. ½ full size.

Tuning-forks to fit the above stand. These forks are most carefully adjusted with the platinum contact wire in position and can be relied on for accurate work. A nut and washer is included for clamping the fork in the stand.

8860. Fork making 50 vibrations per second. (*Net weight* = 1¾ *lbs.*)
£3. 12s. 0d. *Patiently*

8861. Fork making 100 vibrations per second. (*Net weight* = 1¾ *lbs.*)
£3. 4s. 0d. *Patrician*

8862. Fork making 200 vibrations per second. (*Net weight* = 1 *lb.*)
£2. 16s. 0d. *Patronal*

8864. Clock, for making an electric contact at each half second by means of a platinum tipped contact on the pallet arbor. (*Net weight* = 4 *lbs.*)

£2. 10s. 0d. *Paucity*

8866. Laboratory seconds clock, in brass case, as per illustration. Runs for 24 hours, ticks 5 times a second. Dial is $3\frac{3}{4}$" (9·5 cm.) diameter. (*Net weight* = 2 *lbs.*)

£2. 10s. 0d. *Peaceable*

No. 8866. ½ full size.

8868. Time-marker, Deprez signal, with fine adjustment for approximating to the recording surface. In this form the electromagnets are very small and the moving parts extremely light. It is useful for recording small intervals of time on smoked paper and can be used with the tuning-fork No. 8860 making 50 vibrations per second. It can also, when carefully adjusted, be used with the fork No. 8861. In box complete. (*Net weight* = 1 *lb.*) **£2. 5s. 0d.** *Pearled*

No. 8869. ¾ full size.

8869. Double time-marker, Deprez signal (see illustration), exactly as No. 8868 but with two small electromagnets whose styles have their writing points close together. In box complete. (*Net weight* = $1\frac{1}{4}$ *lbs.*) **£4. 0s. 0d.** *Pebbled*

For price of stand for supporting the time-markers, see No. 8800 a.

MECHANICS

Instruments with the letter "E" placed after the number are of the form originally designed by Sir James Ewing, K.C.B., F.R.S., for use in Mechanical Engineering Laboratories.

The Cambridge Patent Extensometer. U.K. Patent No. 2983/08. No mirrors or microscopes are used for magnifying the movement, but the extension of the test-piece is measured by a micrometer screw and a modified form of contact measurement.

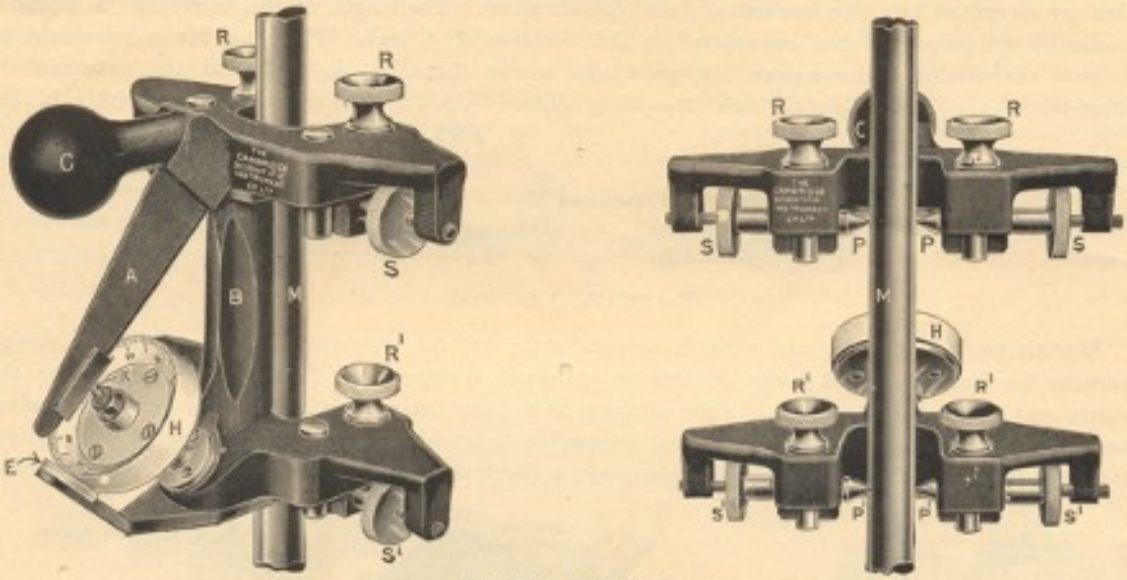
The instrument has no delicate parts likely to get out of order and can be roughly handled without any danger of it becoming damaged, and in this respect is more like a workshop tool than a delicate scientific instrument.

The instrument is made in two separate pieces; the lower piece carries the micrometer head *H*, and the upper piece carries the spring tongue *A*. The two pieces work together about a hardened steel knife-edge fixed on the top of the arm *B*. Thus any extension of the specimen causes the tongue *A* to move towards the point of the micrometer screw *X*. The arms of the lever are such that the hardened steel knife-edge on the tongue opposite the point on the micrometer head moves five times the amount of the extension of the test-piece.

To take a reading the flexible steel tongue *A* is caused to vibrate through an amplitude of 6 or 8 mm. and, whilst vibrating, the micrometer head *H* is turned until the point *X* just touches

the vibrating tongue. This method has proved to be a most accurate way of setting the micrometer, and extensions of the test-piece can be measured to an accuracy of one-thousandth of a millimetre.

A more detailed description is given in our Leaflet No. 75 which will be sent post free on request.



No. 8872. ¼ full size.

8872. Cambridge Extensometer in mahogany case complete with centring gauge. For centres 100 mm. apart. (*Net weight* = 7½ *lbs.*)

£10. 0s. 0d. *Pectinal*

8874. Cambridge Extensometer in mahogany case complete with centring gauge. For centres 2 in. apart. (*Net weight* = 6½ *lbs.*)

£10. 0s. 0d. *Pedagogy*

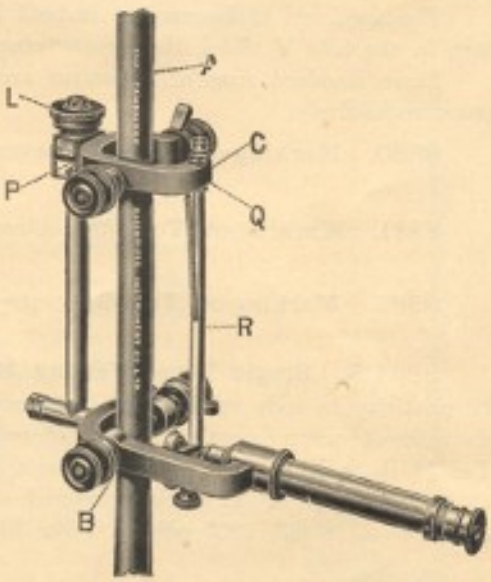
8876 E. Extensometer (Ewing's Microscope Type) (see illustration), for measuring the elastic extension and Modulus of Elasticity of specimens of metal under tensile tests. This instrument can be quickly applied to any test-piece, and no part of it has to be touched whilst the test is being made.

The illustration shows the usual form of the complete instrument. The centres *B* and *C* are set at 8 inches apart; instruments to take specimens of other lengths are constructed to order.

The displacement is read by means of a micrometer scale in the eye-piece of the microscope, each division corresponding to $\frac{1}{1000}$ inch of extension so that by estimation of tenths of a division readings to $\frac{1}{10000}$ inch may be taken. The adjustment can be tested by the micrometer screw *L* which has a pitch of $\frac{1}{10}$ inch.

The screw *L* further serves to bring the sighted mark to a convenient point on the micrometer scale and also to bring the mark back if the strain is so large as to carry it out of the field of view.

The instrument is applicable to large or small test-pieces, and can be used on testing machines of either the vertical or the horizontal type. (See Ewing's *Strength of Materials*, p. 81, 1903 edition, University Press, Cambridge.)



No. 8876 E. ⅛ full size.

In polished mahogany case, complete for 8″ centres. (*Net weight* = 17 *lbs.*)

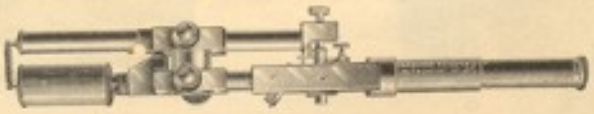
£27. 10s. 0d. *Pedantic*

8877 E. Ewing Extensometer for both 8″ and 2″ centres. This instrument is exactly like No. 8876 but is also supplied with extra parts enabling it to be converted into an instrument suitable for use on specimens with centres 2″ apart. (*Net weight* = 22 *lbs.*)

£30. 0s. 0d. *Peerless*

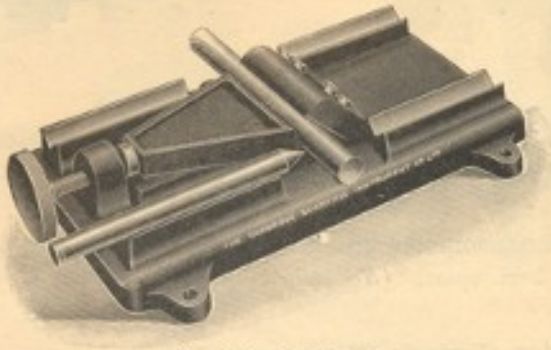
8878 E. Ewing's Compression Extensometer (see illustration). Special form for measuring the elastic compression of short blocks, centres 2 inches apart. In this instrument the lever arms are arranged to magnify the movement 5 times and the object sighted on is a small glass slip on which are engraved two fine horizontal lines $\frac{1}{10}$ inch apart. The length of the microscope is adjusted to make 50 eye-piece divisions correspond to this division of $\frac{1}{10}$ inch. Therefore for a movement of one scale division of the eye-piece the glass slip moves through $\frac{1}{2500}$ inch and the extensometer centres move $\frac{1}{12500}$ inch. See Ewing's *Strength of Materials*, p. 82, 1903 edition. (*Net weight* = 12 *lbs.*)

£25. 0s. 0d. *Pelagian*



No. 8878 E. ½ full size.

Marking-off Tools for use with Extensometers. Several attempts have been made to design apparatus for readily marking the centres at standard distances on Test-Pieces intended for the measurement of Elastic Extension. None of these have been entirely satisfactory, as owing to various constructional difficulties it has been almost impossible to avoid errors in the placing of the centres of at least 0·05 to 0·1 %. The simple arrangement illustrated entirely obviates these uncertainties.



No. 8881. ½ full size.

The specimen to be marked is held by a rigid geometric clamp; a centre punch is placed in turn in the four V slides, the punch being struck with a hammer in each of the four positions.

Three standard sizes of apparatus are constructed with centres 2 inches, 100 mm. and 8 inches apart respectively.

8880. Marking-off Tool for centres 2 inches apart. (*Net weight* = 11½ *lbs.*)

£2. 2s. 6d. *Pelisse*

8881. Marking-off Tool for centres 100 mm. apart. (*Net weight* = 13 *lbs.*)

£2. 2s. 6d. *Pellucid*

8882. Marking-off Tool for centres 8 inches apart. (*Net weight* = 19 *lbs.*)

£2. 10s. 0d. *Pelting*

8884 E. Single Lever Testing Machine for use with Extensometer in measuring modulus of elasticity in rods up to ⅜ in. (10 mm.) diameter. Provided with assortment of four rods ⅜ in. diameter of various metals. Length of rods 50 cm. The maximum total load provided for is 1·2 tons. Ten 10 lb. weights, each equivalent to a load of $\frac{1}{10}$ ton, and four 5 lb. weights, each equivalent to $\frac{1}{20}$ ton, are supplied. If specially ordered, metric weights can be supplied instead. See Ewing's *Strength of Materials*, p. 83, 1903 edition. (See illustration on next page.) (*Net weight* = 346 *lbs.*)

£18. 10s. 0d. *Penality*

8885. Slotted Weights for use with Single Lever Testing Machine, No. 8884 E., etc.

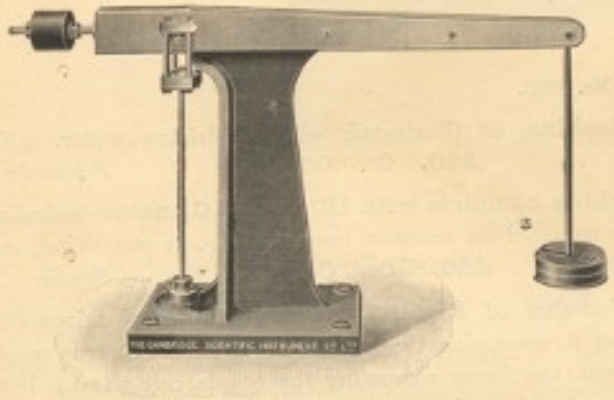
	s.	d.		s.	d.
1 lb. each		9	0·5 Kilo, each	1	0
2 „ „	1	3	1 „ „	1	3
5 „ „	2	6	2 „ „	2	6
10 „ „	4	6	5 „ „	5	0

8886. Hanger for carrying Slotted Weights. (*Net weight* = ½ *lb.*)

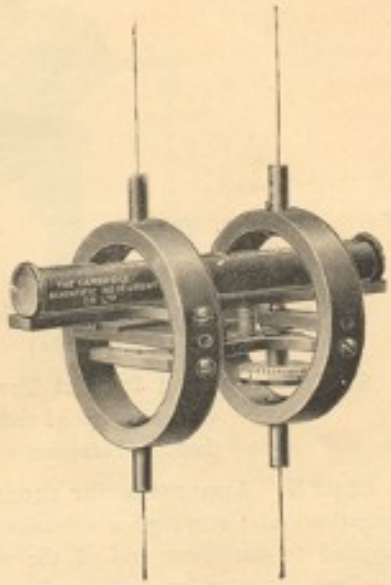
3s. 0d. *Penetrant*

8887. Searle's Apparatus for Determining Young's Modulus of Wires, and also the deviations from Hooke's Law (see illustration).

The upper ends of two wires, each about 3 metres long, are securely fixed to a beam, and from the lower ends hang two brass frames supporting the two ends of a sensitive level. One end of the level is pivoted to one of the frames; the other end of the level rests upon the end of a micrometer screw; divided and figured on celluloid. The load on one wire is kept constant whilst the load on the other is varied as desired. The extension of this latter can be measured to an accuracy of 0·01 mm. by means of the micrometer screw and level. The apparatus possesses the great advantages that, owing to the use of two similar wires, the readings obtained are independent of changes in the temperature of the wires or of sagging of the supporting beam. We are now making this apparatus so that the wires can be readily removed and others substituted in their places. (*Net weight = 2 lbs.*) ... ... **£3. 10s. 0d.** *Penguin*



No. 8884 E. $\frac{1}{12}$ full size.



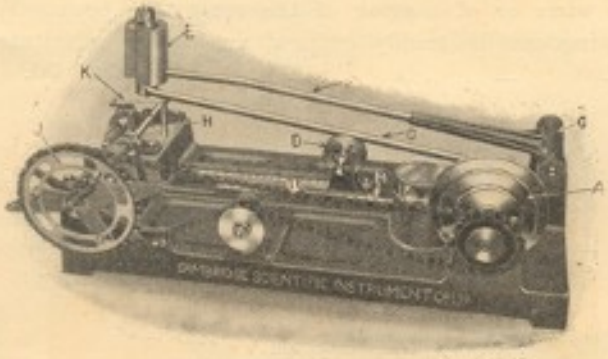
No. 8887. $\frac{1}{4}$ full size.

8888 E. Maxwell's Vibrating Needle for finding the Modulus of Torsion of a Wire. Into a horizontal brass tube four other equal tubes can slide, and thus fill up its whole length. Two of these tubes are empty and two are full of lead. By placing the full or empty tubes nearest the centre the moment of inertia is changed, and observations of the corresponding periods of swing give the data required. Clamps for working with different wires are supplied. Complete with stand as illustrated. See Ewing's *Strength of Materials*, p. 92, 1903 edition. (*Net weight = 22 lbs.*) ... **£3. 10s. 0d.** *Penitent*

No. 8888 E. $\frac{1}{12}$ full size.

Repeated Impact Testing Machine (see illustration). This is a modified form of the impact testing machine originally designed by Dr Stanton of The National Physical Laboratory. It subjects small notched bars to repeated transverse blows of a definite amount. In the illustration *H* is the specimen, *E* the hammer-head and *C* the lifting bar which continually raises the hammer and then allows it to fall freely on to the specimen. The mechanism at *J* is designed to hold the specimen still whilst it is being struck and to turn it through 180° between each two successive blows. A counter records the number of blows struck and a trip switch is fitted to stop the driving motor when the specimen breaks.

A full description is given in our special Leaflet No. 84.



No. 8889.

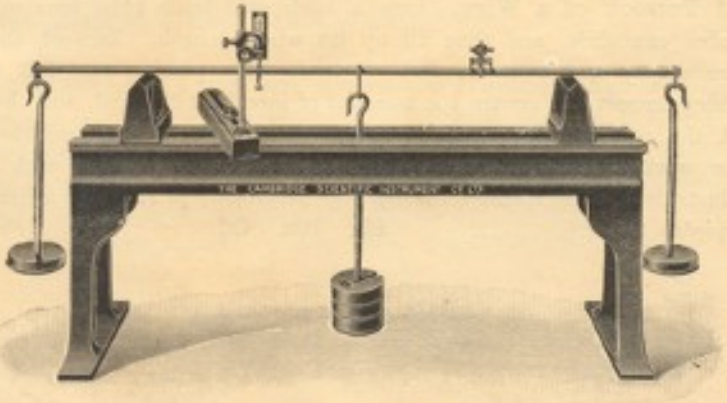
8889. Repeated Impact Testing Machine, as illustrated, without driving motor. (*Net weight* = 165 *lbs.*) ... ... **£40. 0s. 0d.** *Pentarchy*

8890. Repeated Impact Testing Machine complete with 110 volt D.C. motor, including necessary speed reducing gear mounted on common base with double pole switch and fuse. (*Total net weight* = 190 *lbs.*) **£50. 10s. 0d.** *Pentice*

8891 E. Apparatus for measuring Modulus of Rigidity by the torsion of wires (see illustration), also serving for vibration experiment in measuring the modulus of torsion. A true couple is applied to the lower end of the wire examined, the forces composing the couple being transmitted by pulleys mounted on ball bearings, and the angle of torsion read off by means of a pointer on a scale divided in degrees. See Ewing's *Strength of Materials*, p. 89, 1903 edition. (*Net weight* = 28 *lbs.*)

£10. 10s. 0d. *Peptic*

No. 8891 E. $\frac{1}{7}$ full size.

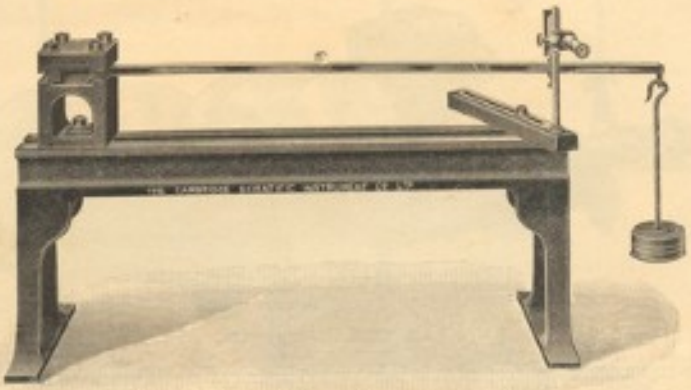


No. 8892 E. $\frac{1}{4}$ full size.

8892 E. Lathe-bed Apparatus for Experiments on the Elastic Bending of rods. The rods, which are 125 cm. long, can be arranged either as beams or cantilevers (see illustrations). The supporting knife-edges can be clamped at any distance apart on a stiff frame like a lathe bed. The deflection is measured by sighting a finely divided glass scale, clamped to the beam, through a reading microscope of low power. A small mirror is also included which can be set astride the beam at any place for the purpose of observing the angle of slope there, the tilting of this mirror when the beam is loaded being observed from a distance by means of a reading telescope and scale. See Ewing's *Strength of Materials*, p. 86, 1903 edition.

The outfit supplied includes the reading microscope with micrometer eye-piece, jockey mirror, assortment of rods consisting of one $\frac{5}{8}$" square and three round rods $\frac{5}{8}$", $\frac{1}{2}$" and $\frac{3}{4}$" (approximately 9, 12·5 and 19 mm.) diameter respectively, and the following weights; 2—1 lb., 2—2 lbs., 1—5 lbs., and 3—10 lbs. If specially ordered metric weights can be supplied instead. (*Net weight* = 364 *lbs.*)

£18. 10s. 0d. *Percolate*



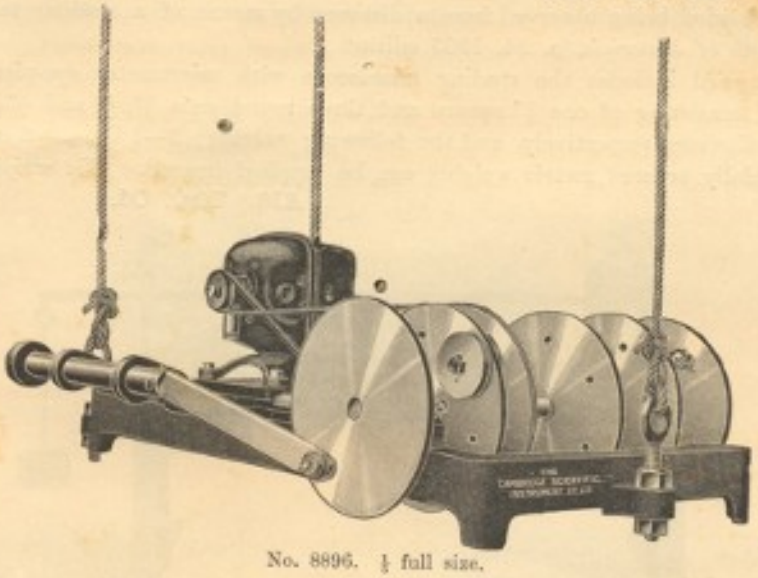
No. 8892 E. $\frac{1}{12}$ full size.

8894. Compound Ballistic Balance, for impact experiments with falling bodies. Of very substantial construction; the knife-edges being so constructed that the Balance is adapted for receiving either a vertical or horizontal blow and works without perceptible friction. To communicate a vertical blow one of the masses provided is placed in one bucket and balanced by an equivalent mass of shot or other material in the other bucket. The mass is then lifted out while the beam is prevented by a catch from tilting. The mass so removed is then allowed to fall into the bucket from a measured height and the deflection observed. A little sawdust should be used in the buckets. With the apparatus three masses are provided, these being phosphor bronze balls of $\frac{3}{8}$", $\frac{1}{2}$" and $\frac{5}{8}$" (approximately 9, 12·5 and 16 mm.) diameter respectively. (*Net weight* = 42 *lbs.*)

£9. 10s. 0d. *Peregrine*

No. 8894. $\frac{1}{12}$ full size.

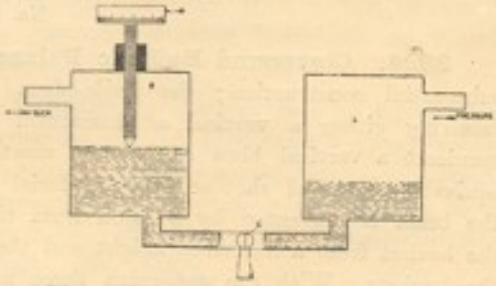
8896. Apparatus for Experiments on the Balance of Revolving Machinery. In a frame which can be suspended, runs a shaft carrying 5 loaded discs and driven by an electric motor. The loads on the discs may be varied, as well as their angular positions and their distances apart. Two outside discs carry crank-pins from which loaded plungers are driven by means of connecting rods. Complete with 110 volt direct current electric motor, on cast-iron base, as illustrated. (*Net weight* = 80 *lbs.*) ... ... **£23. 0s. 0d.** *Perflate*



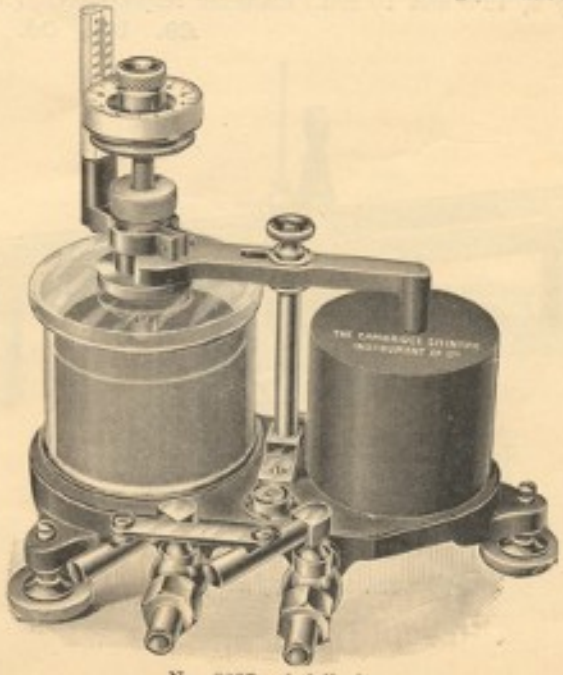
No. 8896. ¼ full size.

8897. Micro-manometer for measuring micrometrically differences in pressure up to 100 mm. head of water. The instrument was originally designed by Mr R. Threlfall, F.R.S., for measuring by means of a Pitot-tube and side gauge the velocity of gas-streams in pipes.

The essential part of the instrument (see diagram) is in effect a U-tube containing oil or water in which one limb *A* of the tube is sealed, the other limb *B* being also closed to the atmosphere, but containing a micrometer screw *M* whose point may be adjusted to touch the liquid surface. Tubes are connected to the air spaces



Diagrammatic section of Micro-manometer.



No. 8897. ¼ full size.

above the liquid in the two limbs in order that they may be connected to the Pitot-tube and side gauge respectively, so that the velocity of the gas-stream may be deduced from the observed difference of pressure. The micrometer head is so divided that this difference is given directly by the reading of the head. A cock *C* is provided so that both chambers (the limbs of the U-tube) may be placed at atmospheric pressure for the determination of the zero reading. (See Stanton, *Minutes Proc. Civil Engineers*, Vol. 145; Threlfall, *Minutes of Proceedings Institution of Mechanical Engineers*, Vol. 33, page 28.) As illustrated. (*Net weight* = 12 *lbs.*)

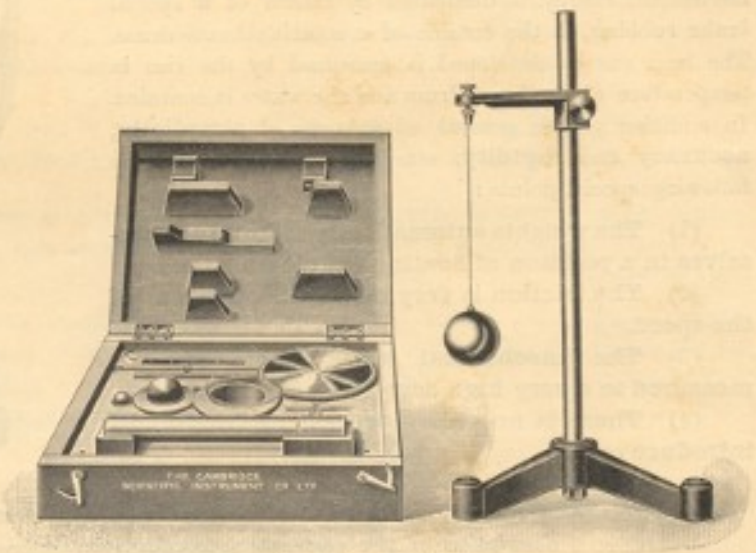
£13. 10s. 0d. *Periapt*

8898. Pitot-tube and side gauge for use with the micro-manometer. These are of brass designed for screwing into the side of a pipe, a $\frac{1}{4}$" gas pipe thread being used. The Pitot-tube is fitted with a stuffing-box and is adjustable so that it may be made to project into the pipe any distance from $3\frac{1}{2}$" to 9". Both tubes have unions at their outer ends for connecting to the piping which leads to the manometer. (*Net weight* = $2\frac{1}{2}$ *lbs.*)

Price, per pair **£1. 15s. 0d.** *Pericarp*

8899. Inertia of Solids, designed by Mr C. V. Boys, F.R.S. Masses of brass and gunmetal of various accurate geometrical shapes, such as spheres, discs, tubes, etc., are so arranged that a small clamp may be fixed to various parts of them; they may thus be suspended, each in turn, from the end of a fine wire. Torsional oscillations being then set up, the moments of inertia may be compared by noting the periods of oscillation. Complete with stand as illustrated. (*Net weight* = 13 *lbs.*)

£4. 0s. 0d. *Perigree*



No. 8899. $\frac{1}{8}$ full size.

Recorder for Variable Speed of Crank Shafts, etc. £32. See our supplementary list entitled "Some Special Physical Instruments."

HEAT

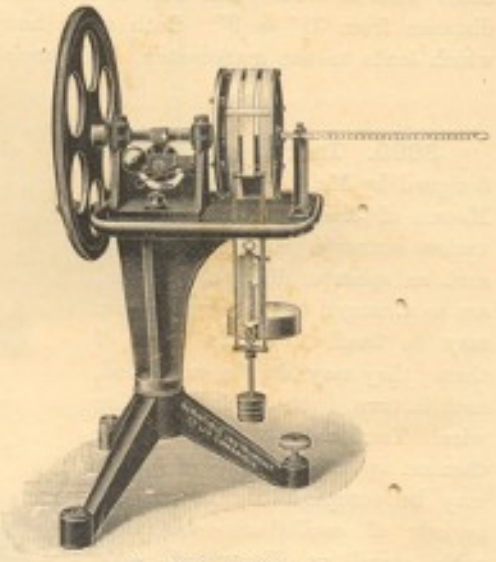
Callendar's Apparatus for determining the Mechanical Equivalent of Heat. This apparatus has been designed by Prof H. L. Callendar, F.R.S., to provide a rapid and ready means of determining "J," the Mechanical Equivalent of Heat. In it mechanical energy is dissipated by means of a special brake rubbing on the outside of a rotating brass drum. The heat energy developed is measured by the rise in temperature of the brass drum and the water it contains. In addition to the general advantages of **simplicity, accuracy** and **rapidity**, attention is drawn to the following special points:

(1) **The weights automatically maintain themselves in a position of floating equilibrium.**

(2) **The friction is very nearly independent of the speed.**

(3) **The mechanical work done can be measured to a very high degree of accuracy.**

(4) **There is no pulley or bearing friction to introduce errors.**



No. 9000. ¼ full size.

Our Leaflet No. 90, which we shall be pleased to send post free on request, gives a full description of this instrument together with instructions for using it.

PRICES.

9000. **Callendar's Apparatus for Determining the Mechanical Equivalent of Heat. Complete with thermometer (range 10–30° C.)* and two silk belts (one being a spare).** See illustration. (*Total net weight* = 44 *lbs.*)
£8. 10s. 0d. *Periodic*

9002. Callendar's Apparatus complete as in No. 9000, but with the addition of a 110 volt† D.C. motor mounted on base with reduction gearing, double-pole switch and fuse, and driving belt. (*Total net weight* = 69 *lbs.*)
£17. 10s. 0d. *Periphery*

9006. Spare Silk Belt ... ... **4s. 0d.** *Periplus*

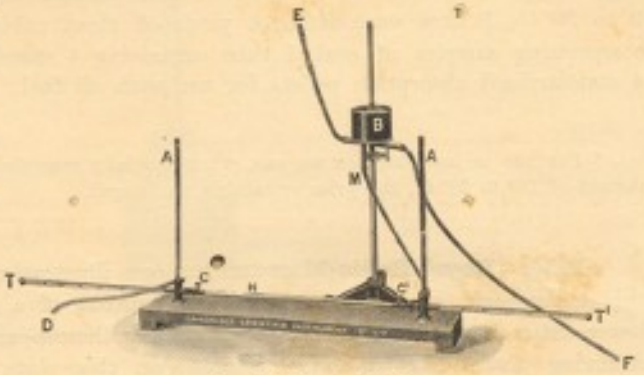
9008. Spare Thermometer 10–30°C., divided every 0·2°C., special bent pattern for use with above ... ... **7s. 6d.** *Peristyle*

9010. Spare bent pattern thermometer, range 25–45°C., suitable for hot climates.
7s. 6d. *Perplexly*

* This is the range of thermometer we usually supply although, for use in hot countries such as India, we can supply instead a higher range instrument as listed under No. 9010.

† Motors for other voltages can be supplied, though usually a slight extra charge will have to be made in such cases.

Callendar and Barnes' Continuous Flow Calorimeter for measuring the Electrical Equivalent of Heat (see illustration). This instrument has been designed by Professors Callendar and Barnes for the rapid and very fairly accurate determination of the Heat Equivalent of Electric Energy. A current of water passes through a glass tube *H*, 44 cm. long, through which a silk covered manganin wire is wound in the form of a helix. The temperature of the water at the inlet and outlet is taken by means of the mercury thermometers *T* and *T'*. Knowing the electrical energy dissipated in the wire and the volume of water passed through the tube, it is easy to determine the Heat Equivalent of the Electrical Energy. A small cistern *B* with an overflow arrangement is provided in order that the flow of water through the tube may be kept constant, the head of water being varied by altering the height of the cistern on the stand.



No. 9022. $\frac{1}{12}$ full size.

Our Leaflet No. 90, which we shall be pleased to send post free on request, gives a full description of this instrument together with instructions for using it.

9020. Callendar and Barnes' Continuous Flow Calorimeter, complete with water cistern on stand, but without rubber tubing or thermometers.
£3. 0s. 0d. *Personage*

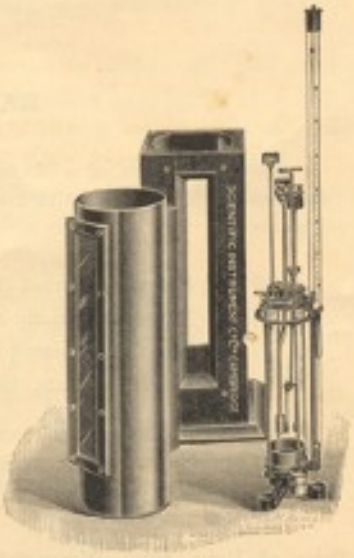
9022. Calorimeter as above but including 4 yards of rubber tubing and two mercurial thermometers reading 0–50° C. and divided every 0·1° C., as illustrated. (*Net weight* = 12 *lbs.*) ... ... **£4. 3s. 0d.** *Perspicil*

9024. Spare mercury Thermometer, 0–50° C., divided every 0·1° C.
9s. 6d. *Perusal*

Rosenhain's Fuel Calorimeter, for determining the calorific value of coal or liquid fuel (see illustration). The sample is compressed from powdered coal, or is a weighed combustible pellet soaked in liquid fuel. It is burnt in a current of oxygen within a glass vessel completely immersed in water, to which latter the heat evolved is very completely imparted. The rise of temperature is read by a delicate thermometer. The sample to be tested is supported on a fused silica tray and is fired by means of a fine platinum wire which can be heated electrically.

The water is agitated by the gas bubbling through it whilst after the combustion is completed the valve is opened and the whole of the inside of the calorimeter flooded with water. The glass vessel used is an ordinary incandescent gas-light chimney. The standardized coal briquettes are useful for finding the water-equivalent of the apparatus.

A more detailed description is given in our special Leaflet No. 31.



9030. $\frac{1}{3}$ full size.

9030. Rosenhain's Calorimeter complete with ball-valve, fused silica tray, brass vessel and outer wooden case but without thermometers or other accessories. (*Net weight* = 11½ *lbs.*)
£6. 10s. 0d. *Pervious*

9031. Rosenhain's Calorimeter as in No. 9030 but with the addition of accessories as follows:—Accurate thermometer* 10° to 25° C. and divided to 0·05° C., thermometer for use in wash-bottle 0 to 50° C., ½ litre wash-bottle, 4 yards of stout rubber tubing, glass measuring vessel, mortar for compressing samples of coal, 1 tube containing 4 standardized coal briquettes and 1 tube containing 4 standardized absorption pellets for use with oil fuel. (*Total net weight* = 20 *lbs.*)

£9. 5s. 0d. *Petalism*

* For use in hot climates we can, when specially requested to, supply a thermometer of range 20° to 35° C., instead of 10° to 25° C., the price remaining unchanged.

9034. Boys' Radio-Micrometer (see illustration on next page). The suspended system in this instrument is extremely light and consists of a single loop of silver wire connected at its lower extremity to a small bismuth antimony thermo-junction. This thermo-junction carries a copper receiving plate. The radiation received on this plate raises the temperature of that end of the junction to which it is attached and therefore a small current is caused to circulate through the silver loop. The loop is suspended by a fine quartz fibre between the poles of a permanent magnet and the deflections are measured in the usual manner by means of the mirror *F* which is attached to the fibre. A suitable lamp and scale for taking the readings will be found listed under No. 8826. The mirror *F* is plane but a lens in front of it makes it suitable for use at 1 metre working distance from the scale.

In the illustration the case is shown removed from the instrument. This case is double-walled and made of thick copper so as to avoid temperature gradients in the instrument itself and secure a steady zero reading. This is also the reason for the heavy block of metal *B*.

The tube *A*, which fits into the case at *C*, should point towards the body being investigated. This can be set correctly by removing the knob *D* and sighting down the tube.

A clamping device is fitted consisting of a small screw which when screwed into position unclamps the suspension and when removed permits a spring to clamp it.

The instruments are carefully tested before being despatched and a Certificate of Test is issued with each instrument. The following is a copy of one such certificate, which will serve to show approximately the sensitivity, etc., which may be expected.

Certificate of Test

of

RADIO-MICROMETER No. 7802

The black face of a decimeter cube filled with water at a temperature of 95° C. and at a distance of 50 cm. from the instrument, produced a deflection of 8·2 cm. upon a scale at 100 cm. distance.

Room Temp. = 22° C.

Complete Period (not in magnetic field) = 5·3 seconds.

Time of reaching a steady deflection in the field = 9 seconds (approx.).

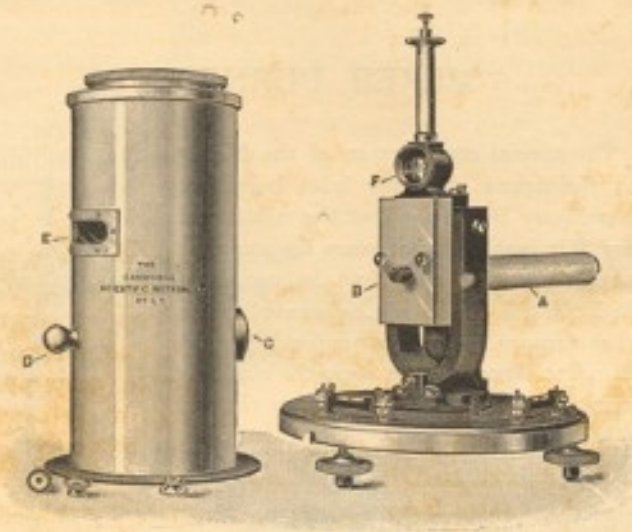
Time of coming to rest = 9 seconds (approx.).

Receiving plate, blacked copper foil 3 × 2 mm.

N.B. The above figures are only approximate and are intended to serve as a guide to show whether the instrument is working properly.

Price of Boys' Radio-Micrometer complete. (*Net weight* = 22 *lbs.*)

£15. 0s. 0d. *Peterel*



No. 9034. ½ full size.

9036. Mercury-in-steel Gas-regulator (see illustration) for maintaining Incubators, Baths, Sterilisers, etc. at a constant temperature. The regulator is made entirely of steel, the lower part which is immersed in water being protected by a copper sheath, external diameter 19 mm. Is easily adjusted to maintain the required temperature. No risk of breakage. Direct metallic connection to the gas supply is readily made, thus avoiding the use of rubber tubing and consequent risk of fire.

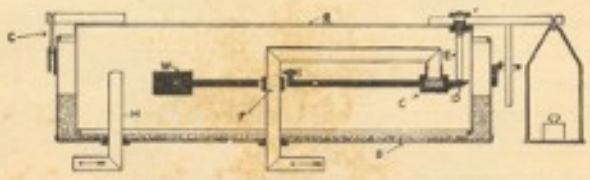
Price without mercury. (*Net weight* = 1 *lb.*)

£2. 10s. 0d. *Petronel*

No. 9036.
½ full size.

9038. Griffiths' Gas Pressure Regulator (see illustration), for maintaining constant the head of water pressure under which gas is delivered.

The apparatus consists of a gasometer *A* about 45 cm. in diameter in which the bell is hinged about the point *G*. The gas supply is controlled by means of a valve consisting of a delicately pivoted arm and counterpoise *D*, *F*, *W*, carrying a mercury cup *C* which opens or closes the gas supply. The valve is operated through the adjustable rod *E* by the vertical movement of the gasometer. In practice the regulator is found to be exceedingly satisfactory, maintaining a constant pressure to within 0·1 mm. (*Net weight* = 21 *lbs.*) ... **£6. 0s. 0d.** *Pencterer*

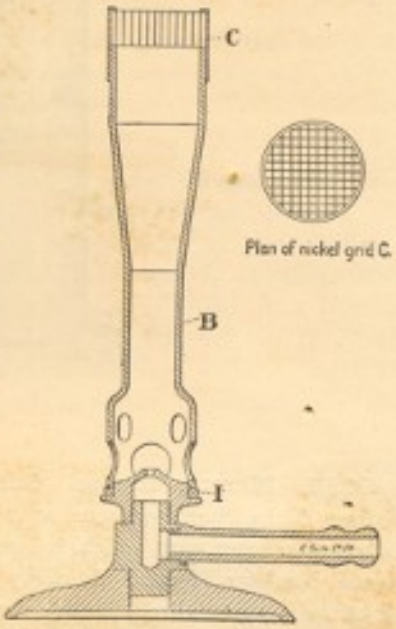


No. 9038. ½ full size, showing section through regulator.

MÉKER BURNERS

Méker Burners. The special construction of the Méker burners is illustrated by the figure. The air inlet holes are much larger than in the ordinary Bunsen so that the mixture of gas and air in the chimney *B* is just that necessary for complete combustion. "Lighting-back" is prevented by the use of a nickel grid *C*, 10 mm. deep, in the mouth of the burner. This grid always remains at a comparatively low temperature and therefore has a long life. Also since it is so deep the channels can be of large cross section and therefore do not become clogged with dust or throttle the mixture.

Size	Approximate diameter of flame at mouth of burner	Price
		£ s. d.
No. 1	16 mm.	4 0
„ 2	20 „	4 6
„ 3	24 „	5 6
„ 4	30 „	6 6
„ 5	42 „	1 2 0



Section through ordinary Méker Burner.

A discount of 10 % is allowed off the above prices when at least six of the same size are ordered at the same time.

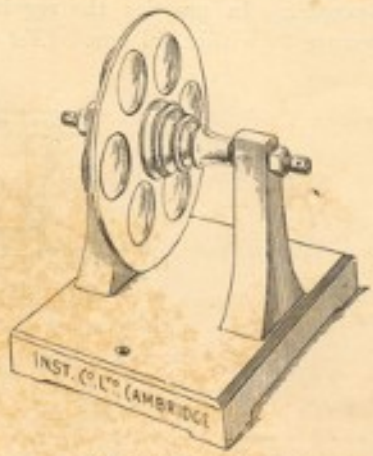
Our Leaflet No. 82 describes more fully the Méker Burners and Furnaces.

We make a great variety of Thermometric and Pyrometric apparatus for scientific and industrial work. Separate leaflets are issued dealing with this class of apparatus.

LIGHT

9044. Wheel of Lenses, for analysing the oscillations of an electric spark. The wheel is a brass disc containing six achromatic lenses of about 150 mm. focal length. The lenses are arranged in three pairs, each pair being opposite one another and equidistant from the axis, while the axial distances of the three respective pairs differ slightly from one another. The image of the oscillating spark, focused by the rapidly revolving wheel upon a screen or photographic plate, is drawn out into a beaded form. If the plate is large enough to take an arc of 60°, the whole record of the spark will be found upon it. A pulley with V-grooves is provided on the spindle by means of which the wheel may be rotated. See "Notes on the Oscillating Electric Spark," by C. V. Boys, F.R.S., in the *Phil. Mag.* of Sept. 1890. As illustrated. (*Net weight* = 15 *lbs.*)

£6. 0s. 0d. *Philomel*



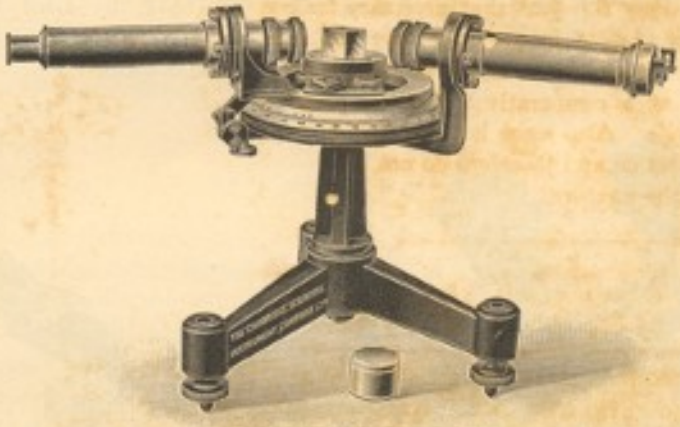
No. 9044. ¼ full size.

9046. Laboratory Spectrometer, of exceptionally rigid design. Adjustable slit, with comparison prism; collimator and telescope are of 25 mm. clear aperture and have full collimation adjustments. Telescope has clamp and slow motion in azimuth, with vernier reading to one minute on a circle 164 mm. in diameter. The collimation of the telescope cannot be disturbed by focusing the eye-piece.

Prism table has independent levelling screws mounted on azimuth circle reading in degrees.

Price complete, as illustrated, with flint prism of 35 mm. face. (*Net weight* = 24 *lbs.*)

£21. 5s. 0d. *Phonics*



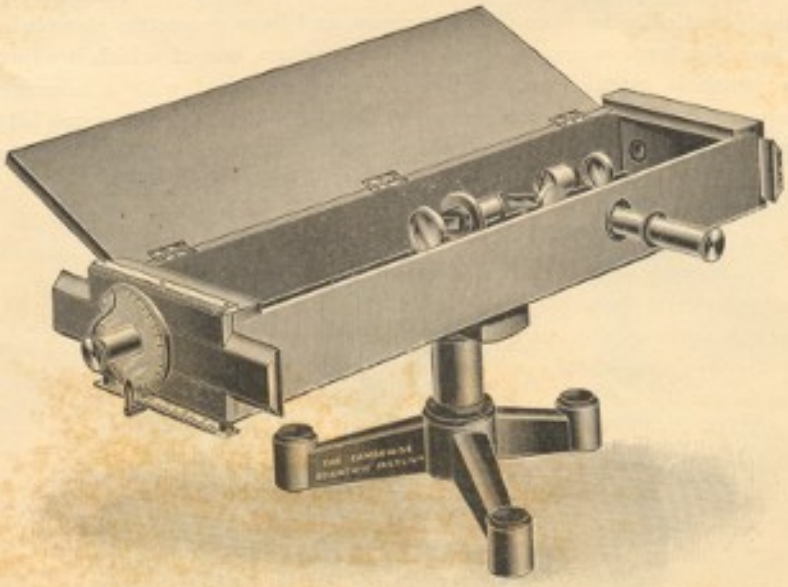
No. 9046. ½ full size.

9047. Laboratory Spectrometer as above but without prism.

£20. 0s. 0d. *Phrygian*

9050. Spectrophotometer (see illustration). A modification of the colour-box of Clerk Maxwell, which may be used for three purposes of physical and physiological interest.

I. *As a Spectrophotometer.* By means of an appropriate arrangement of prisms, lenses, and slits, two superposed polarised spectra are produced, any desired colour from which may be observed through an analysing Nicol. By rotating the Nicols the brightness of these portions of the spectra



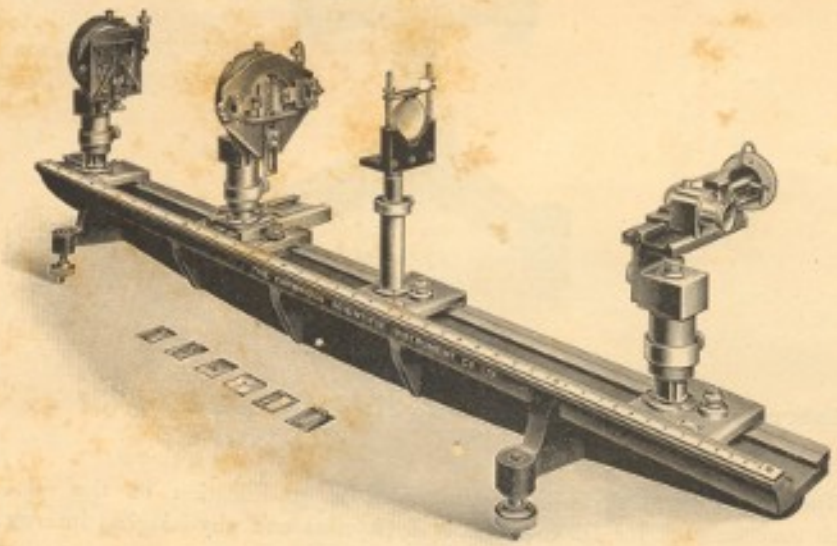
No. 9050. ¼ full size.

may be widely varied and thus the loss of intensity of light on passing through an absorbing medium may be found.

II. *As a means of detecting and estimating colour-blindness.* The light which yields one of the spectra falls, before passing through the prism, upon a mirror, by rotating which any one portion of one spectrum can be placed in juxtaposition with any other portion.

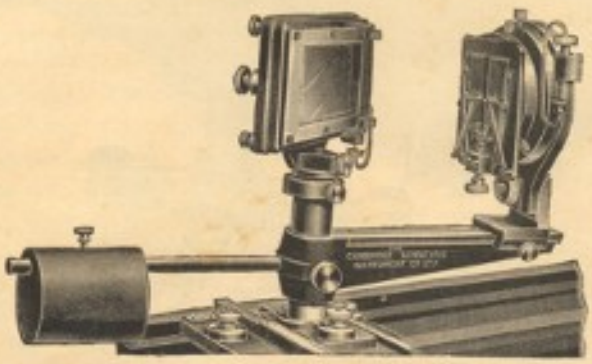
III. *As a means of matching mixed spectral colours with any one colour of a pure spectrum.* By a proper adjustment of a double image prism, any two colours of one spectrum can be seen as mixed, and by rotating the mirror, any portion of the other spectrum can be compared with the mixed colours. (See an article in *Nature*, Nov. 17, 1881, by Lord Rayleigh, and in the *Journal of Physiology*, Vol. v. Part 6, by Dr Sheridan Lea.) (*Net weight* = 21 *lbs.*)

£18. 0s. 0d. *Phytology*



No. 9052. $\frac{1}{12}$ full size.

9052. Optical Bench (see illustration). The bed is of cast-iron and very rigid. On the ways, which are scraped true, the pillar-blocks can be slid and clamped geometrically. The three main pillars are adjustable vertically by open-pitched screws, and have geometric clamping. Two swivelling cells with clamp and slow motion are provided for these pillars, one of which is adjustable transversely to the bed. The bench is supplied with a Fresnel eye-piece fitted with a micrometer head reading directly to ·005 mm., a slit with self-centring adjustment, Fresnel bi-prism, seven slides for diffraction experiments, a fourth pillar carrying a lens-holder, electric incandescent lamp, and gas burner. (*Net weight* = 104 *lbs.*) ... ... **£60. 0s. 0d.** *Pickered*



No. 9054 also illustrating slit and portion of optical bench. $\frac{1}{2}$ full size.

Fresnel Mirrors, of black glass. The reflecting faces extend up to their line of intersection, and the swivelling of the adjustable mirror takes place precisely about that line. This involves no tedious adjustment, but is secured automatically. One of the mirrors can be tilted by means of a micrometer screw of half-millimetre pitch with divided head.

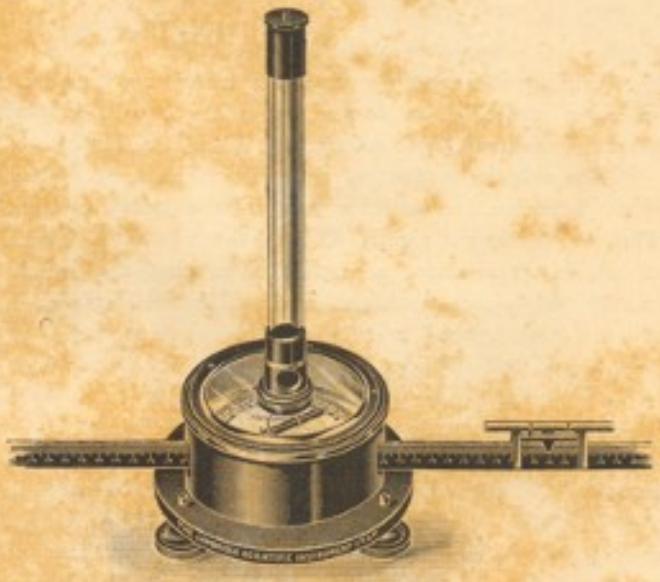
9054. Price of Fresnel Mirrors arranged for fitting on to one of the pillars of the Optical Bench and complete with bracket arm, balance weight and angle piece for carrying the slit, which latter is included with the Optical Bench (see illustration). ... **£15. 15s. 0d.** *Pictorial*

9056. Price of Fresnel Mirrors without bracket arm but mounted on a separate tripod stand. **£11. 15s. 0d.** *Pieceless*

MAGNETISM

9060. Students' Magnetometer. A wooden box is supported on three levelling screws. A boxwood scale 100 cm. long and divided in millimetres transfixes the box. A carrier for a deflecting magnet is provided, with pointer for reading its position. The deflectable magnet is hung in a brass stirrup, a pointer being fixed below, just over the scale. The suspension is readily renewed. A mirror is provided, for observation with a telescope and scale if desired. The design of the instrument has been improved since the illustration was made. The box is now rectangular in shape and is provided with removable windows at each side so that one may very easily get at the deflected magnet. (*Net weight* = 6 *lbs.*)

£4. 15s. 0d. *Pilaster*



No. 9060. ¼ full size.

9064. Dip Circle. In mahogany case with glass front and ground glass back, mounted on a circular metal base with levelling screws, and with a slow motion in azimuth, the horizontal circle being divided to degrees. The needle is 10 cms. long, the pivots resting on agate planes. A lifter is provided for arresting the needle. The vertical circle is divided to degrees. (See illustration.) (*Net weight* = 6½ *lbs.*) **£15. 0s. 0d.** *Pilosity*

No. 9064. ¼ full size

The following instruments are described in our supplementary list entitled "Some Special Physical Instruments." The prices given here are approximate, but those who are interested are invited to write for the complete list which should be of special interest to those engaged in research work.

Magnetometer, Kew pattern Unifilar. (**£64.**)

Magnetographs, as designed by Prof W. Watson, F.R.S.

(*a*) The Combined Declination and Horizontal Force Magnetographs.

(*b*) The Vertical Force Magnetograph.

Dip Inductor.

Dip Circle. Kew pattern. (**£31.**)

HIGH SPEED SENSITIVE DRILLING MACHINE FOR INSTRUMENT MAKERS

Finding it impossible to obtain a drilling machine suitable for a scientific instrument workshop we were compelled to design and make a drill for ourselves. This drill proved so successful that we have since added a second one to our equipment.

The column supporting the drill consists of a steel shaft 2 inches in diameter cast into a heavy casting. The spindle head is rigidly fixed to the column by means of set screws arranged geometrically so that the spindle can be set square with the table. The drill spindle is of cast steel, ground and lapped, the bearings being of bronze and self-aligning. A Hoffmann ball thrust with a novel gimbal device for distributing the thrust is used. A light pulley 5 inches in diameter revolves on a fixed sleeve, the drive being communicated to the spindle by means of a sleeve and long feather. A handy adjustable stop is fitted to the feed. The driving belt is of gut and passes over aluminium guide pulleys running on ball bearings; the position of the pulleys can be altered to take up slackness in the driving belt. An accurately divided circle is provided on the table support so that the position round the horizontal axis can be readily determined.

No. 9070.

The following is a brief specification of the machine:

Vertical travel of the spindle, $2\frac{1}{8}$ inches (54 mm.).

Distance from column to centre of spindle, $6\frac{3}{4}$ inches (172 mm.).

Vertical travel of the table, $12\frac{1}{2}$ inches (317 mm.).

Size of table, $6\frac{1}{2}$ inches square (165 mm.).

Diameter of central hole in table 12 mm. (approx. $\frac{1}{2}$").

Self-centring chuck taking drills from $\frac{1}{4}$ inch (6·4 mm.) downwards.

Maximum speed of drill 6000 revolutions per minute.

9070. Price of drill with self-centring chuck and with specially light and stiff countershaft fitted with Hoffmann ball bearings to both fast and loose pulleys, with striking gear. (*Net weight* = 180 *lbs.*) ... **£28. 10s. 0d.**

INDEX.

CAMBRIDGE: PRINTED BY JOHN CLAY, M.A. AT THE UNIVERSITY PRESS.
5000, September 1911.

We also publish the following lists, any of which will be sent post free on application:—

Electrical Instruments:

LIST 53. Galvanometers, Duddell Patent Thermo-ammeters, Grassot Fluxmeter, Duddell Magnetic Standard, &c.

LIST 58. Duddell Patent Oscillographs.

LIST 92. Electrometers, Weston Normal Cell, &c.

Some Special Physical Instruments. Dealing with expensive pieces of apparatus such as Dividing Machines, Magnetographs, Star-Photograph Micrometers, Screw-Measuring Machines, and apparatus made for special purposes.

Thermometers and Pyrometers. Miscellaneous leaflets dealing with:—

Féry Radiation Pyrometers.
Thermo-Electric Pyrometers.
Platinum Resistance Pyrometers.
The Joly Meldometer.
Mercury-in-Glass Thermometers for industrial uses, &c.

Microtomes and Embedding Baths. LIST No. 57 a.

Méker Burners and Furnaces. Leaflet No. 82.

The Bi-Meter CO_2 Recorder. Leaflet No. 86.

Also various descriptive Leaflets on particular instruments.