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Pages 1- (scan numbers)

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PHYSIOLOGICAL INSTRUMENTS

MANUFACTURED BY

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

GOLD MEDAL, International Inventions Exhibition, London, 1885.

DIPLOMA OF HONOUR, International Exhibition of Medicine and Hygiene, Rome, 1894.

CAMBRIDGE:
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1899

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C17
1899

PREFACE.

THIS Catalogue describes some of the Instruments manufactured by us at our Workshops in Cambridge, more especially those useful to Physiologists and Biologists.

The prices have in many cases been reduced and the list enlarged.

Every care is taken that only the highest class of work leaves our hands. We are prepared to make any of the instruments described in recent scientific papers or in advanced Text Books, in many cases Instruments required for original investigations have been supplied by us; either these were made from the designs of the experimenter, or the Company designed the instrument to suit the case. We think that we are in an exceptionally good position to carry out this class of work.

We are prepared to supply Scientific Apparatus of every description at the catalogue price of the various makers, except in the case of Foreign manufacture, when, in most cases, the cost of carriage will be charged in addition.

In order to facilitate the transaction of business with our clients, we have given a telegraphic code word to every article in the Catalogue, and have also added a list of code words for dates and numerals.

We shall shortly publish a catalogue of Physical and General Apparatus.

94426

DIRECTIONS FOR FILLING ORDERS.

Terms :—Cash with Order or good English reference.

Foreign Orders must be accompanied by either a remittance, or instructions for payment in London, on delivery of Bills of Lading, &c.

Cheques and Post Office Orders to be drawn payable to "Scientific Instrument Co. Ltd." and crossed London and County Bank, Cambridge.

The greatest care is exercised in packing, but we cannot hold ourselves responsible for breakages in transit. In the event of any damage occurring, application should be made at once to the Railway Company or carrier.

Two-thirds allowed for returned packing cases, when actually received, carriage paid.

This list cancels all previous ones, and is subject to alteration without notice.

Trunk Line Telephone. "Cambridge, No. 6."

A B C Code used.

Telegraphic Address. "Instrument, Cambridge."

The Cambridge Scientific Instrument Company, Ltd.

Carlyle Road,

Cambridge,

England.

March, 1899.

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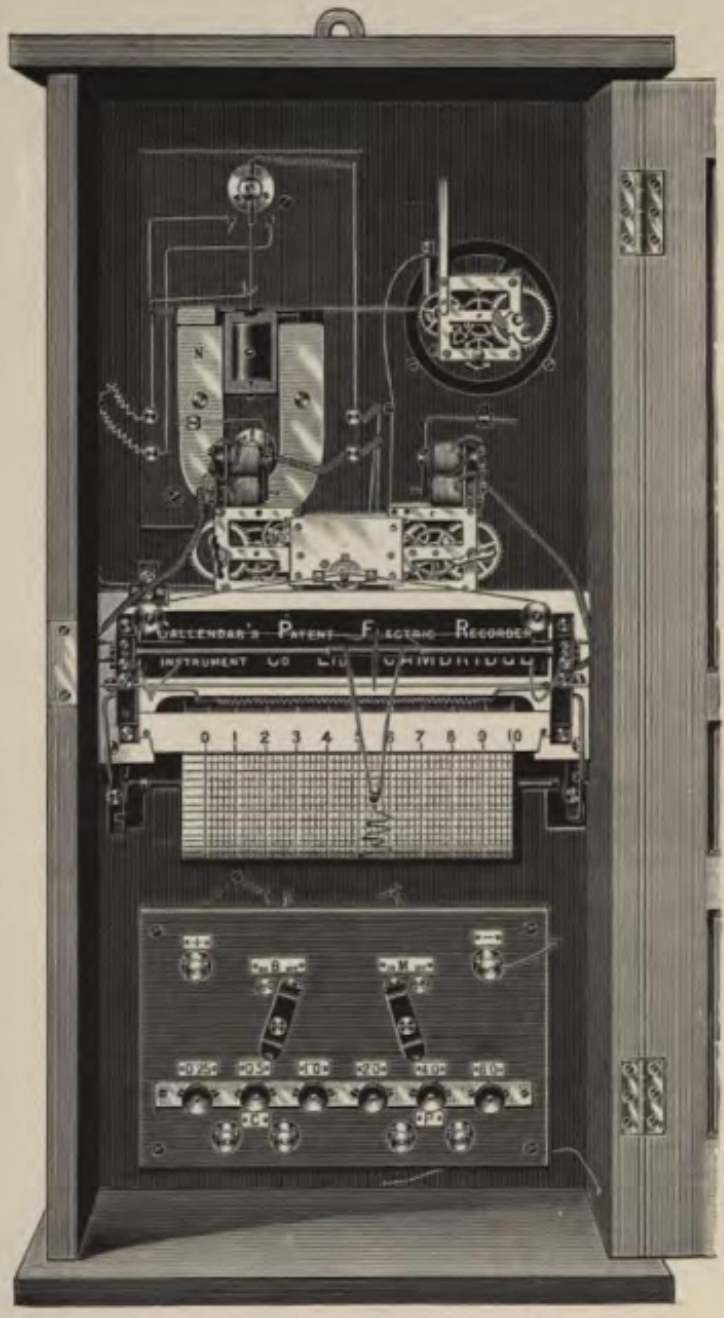
CALLENDAR'S
ELECTRIC RECORDER.



Descriptive pamphlet sent post free on application.

Telegraphic Address "INSTRUMENT, CAMBRIDGE."

TELEGRAPHIC CODE.

For general purposes the A B C Code Book, Eden Fisher & Co., 1883, is used, from which we have by permission extracted the Code-table of Numerals. The other code words have been specially selected for this list.

What is the price of	*Gaban.*
What is the price, time of delivery and best terms for	*Gabardine.*
Quote price f. o. b. London of	*Gabionage.*
How soon could you deliver?	*Gaelic.*
Have you in Stock?	*Gainage.*
Must be delivered by	*Gainsayers.*
Could deliver the order in	*Gainstand.*
We could deliver in one month from receipt of order	*Gainstrive.*
We could deliver in two months from receipt of order	*Galangal.*
We could deliver in months from receipt of order	*Galeated*
We have the instruments in Stock	*Galeopois.*
We have none of the order in Stock	*Gallant.*
We have part of the order in Stock, delivery of whole amount on	*Galleas.*
Order received	*Gallinule.*
Order has not been received	*Gallnut.*
Add to our order of	*Gracecup.*
Please deliver at once the following apparatus, we are writing by this mail	*Galoche.*
We have not heard from you in reply to our letter of	*Gamagrass.*
Wait our next letter before doing anything further	*Gambrel.*
Waiting your further instructions regarding	*Gambroon.*
What you suggest will do quite well	*Gamekeeper.*
We cannot understand what you mean, send full particulars	*Gammoning.*
We are sending full particulars by this mail	*Gangliform.*
Extra expense will be	*Gangtooth.*
Letter received	*Gangweek.*
Reply by cable	*Gardenplot.*
Kindly refer us to your bankers or agents for payment	*Gardenware.*
How were goods sent?	*Garfish.*
When did goods leave?	*Gargoyle.*

We will ship by	*Garnier.*
Goods have been duly received	*Garrotting.*
Ship by Grande Vitesse	*Gaseous.*
Ship by Petite Vitesse	*Gaslight.*
Ship care of	*Gasmain.*
If goods have not left, await our next letter	*Gasoscope.*
Goods have arrived damaged, please inform carriers	*Gasretort.*
Insure for amount of Invoice	*Gastric.*
Shall we insure goods to your order?	*Gateman.*
Please send a copy of your latest catalogue	*Gatherable.*
Please forward at once one of your £3. 15*s.* Microtomes	*Gaugeable.*
Please forward at once one of your £8. 10*s.* Microtomes	*Gavelkind.*

TABLE OF DATES.

To obtain the code-word for any particular date, add the word for the month to the word for the date, thus the 16th March = *nameless.*

Date	Code-word	Date	Code-word
First	*Mad*	Seventeenth	*Near*
Second	*Main*	Eighteenth	*Neat*
Third	*Make*	Nineteenth	*New*
Fourth	*Mail*	Twentieth	*Night*
Fifth	*Man*	Twenty-first	*Noon*
Sixth	*Map*	Twenty-second	*Odd*
Seventh	*Mar*	Twenty-third	*Oil*
Eighth	*Mat*	Twenty-fourth	*One*
Ninth	*Meet*	Twenty-fifth	*Otter*
Tenth	*Mid*	Twenty-sixth	*Out*
Eleventh	*Milk*	Twenty-seventh	*Pack*
Twelfth	*Mine*	Twenty-eighth	*Page*
Thirteenth	*Moss*	Twenty-ninth	*Pick*
Fourteenth	*Mount*	Thirtieth	*Pin*
Fifteenth	*Mull*	Thirty-first	*Pill*
Sixteenth	*Name*		

Month	Code-word	Month	Code-word
January	*Dust*	July	*Root*
February	*Head*	August	*Star*
March	*Less*	September	*Stone*
April	*Ling*	October	*Town*
May	*Peg*	November	*Wards*
June	*Rice*	December	*Well*

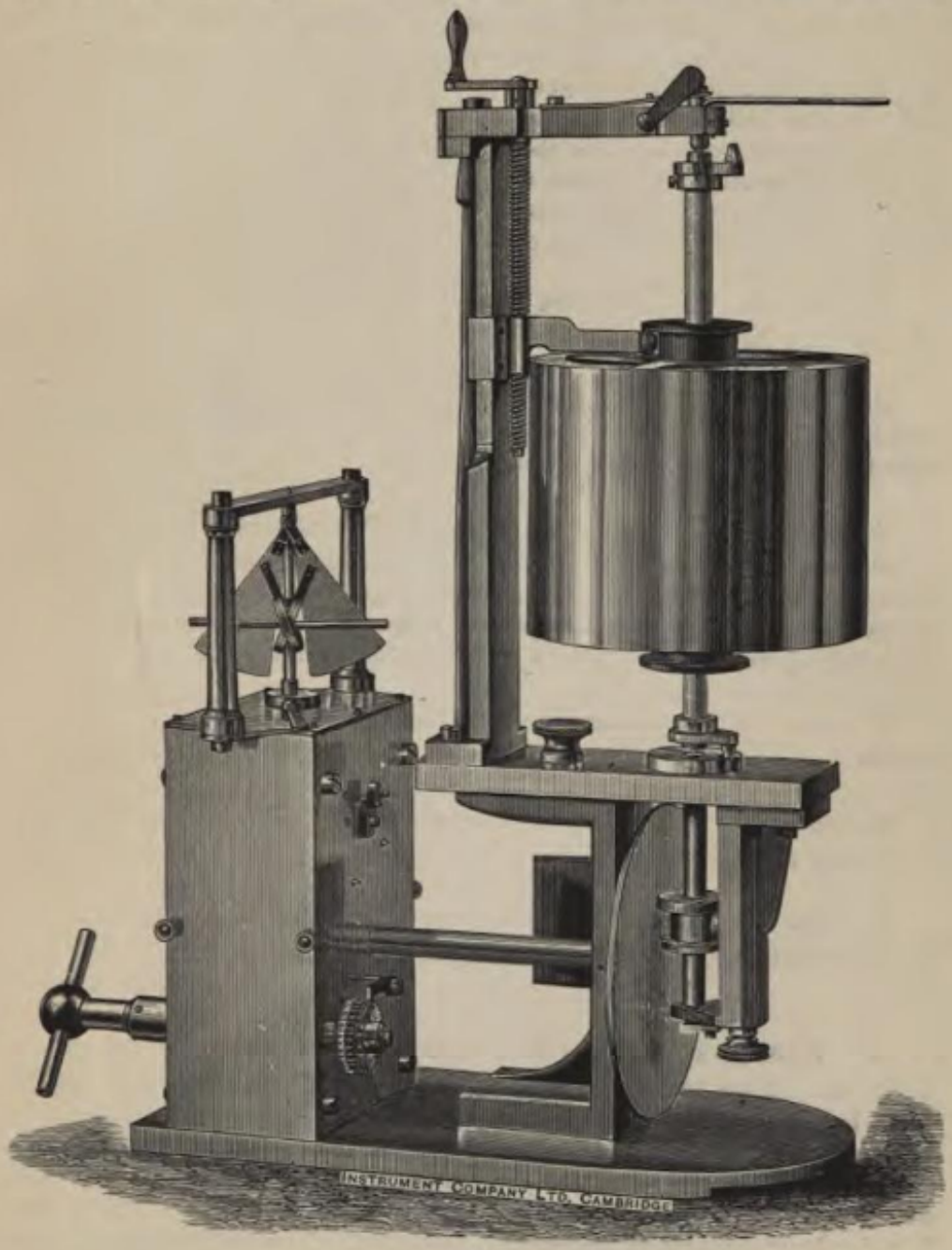
TABLE OF NUMERALS.

1 *Rompermos*
2 *Rompicapo*
3 *Rompitura*
4 *Roncaria*
5 *Roncavate*
6 *Ronchasen*
7 *Ronciglia*
8 *Rondaccio*
9 *Rondinette*
10 *Ronflante*
11 *Rongigata*
12 *Rorasteis*
13 *Roriferous*
14 *Rosolavate*
15 *Roupagem*
16 *Roventate*
17 *Rovinatore*
18 *Rubagione*
19 *Rubefacio*
20 *Rubellate*
21 *Rubiginous*
22 *Ruedecitas*
23 *Ruemperas*
24 *Rufescent*
25 *Rugumasti*
26 *Ruisenores*
27 *Rumorcitos*
28 *Rupestral*
29 *Rupicabra*
30 *Ruscarius*
31 *Sabbatum*
32 *Sabbiavate*
33 *Sabedoria*
34 *Sabeliano*
35 *Saberetes*
36 *Sablecitos*
37 *Sabogales*
38 *Saborguen*
39 *Sabrosico*
40 *Sacadinero*
41 *Sacafondo*
42 *Sacamolero*
43 *Sacamuelas*
44 *Sacapotras*
45 *Sacatapon*
46 *Sacrarium*
47 *Sacrosanct*
48 *Safarias*
49 *Safradeira*
50 *Sagapeno*
51 *Sagiscano*
52 *Sagrativo*
53 *Sagrestia*
54 *Sahornaste*
55 *Sahumaba*
56 *Sahumerio*
57 *Sainetillo*
58 *Salacismo*
59 *Salamalec*
60 *Salassero*
61 *Salbader*
62 *Salcochada*
63 *Soldatori*
64 *Saleratus*
65 *Salicastro*
66 *Saliditas*
67 *Saliscendo*
68 *Salmantino*
69 *Salmeggia*
70 *Salmuerado*
71 *Saloncillo*
72 *Salpavate*
73 *Salperemo*
74 *Salpetrig*
75 *Salpicamos*
76 *Salpicola*
77 *Salpinga*
78 *Salsedine*
79 *Saltaleme*
80 *Saltativo*
81 *Salteriaba*
82 *Salticaba*
83 *Salticaron*
84 *Saludasen*
85 *Salutirend*
86 *Salvajitos*
87 *Salvaroba*
88 *Salvatiche*
89 *Salvigia*
90 *Sambladura*
91 *Samenader*
92 *Sampognino*
93 *Sanaresso*
94 *Sanchinas*
95 *Sanfonina*
96 *Sangioveto*
97 *Sangonedo*
98 *Sangrentes*
99 *Sanguifero*
100 *Sanicato*
150 *Soaponito*
200 *Scogliera*
250 *Sembievole*
300 *Silabeaba*

RECORDING CYLINDERS, MYOGRAPHS, MOTORS, ETC.

Section 1.

1. **Kymograph.** *Ludwig's model, driven by friction wheels.* The brass cylinder is 130 mm. high and 165 mm. in diameter and can be used with its axis



1

either vertical or horizontal, thus allowing vertical or horizontal movements to be recorded. By turning a handle fixed to a screw the cylinder can be moved along its axis through a distance equal to its length. This can be done without interfering with its rotation, and enables a tracing of great length to be taken in the form of a helix on the surface of the cylinder. The clockwork is driven by a spring, and the speed maintained constant by a fan governor; the clockwork can be stopped or started with ease. The surface speed of the cylinder is anything between 100 mm. per second and 10 mm. in about one minute. Rotation is given to the cylinder by a friction wheel which is pressed against the face of a disc driven by the clockwork; as the friction wheel can be moved so as to press against the disc at varying distances from its centre, the speed of the cylinder can be varied. As this does not give enough range of speed, the velocity of rotation of the disc itself can be altered by slipping a pair of wheels in the clockwork along their axis, and thus making them engage in a different manner ... ... **£32. 0s. 0d.** *Abacus.*

2. Do. do. with clockwork gearing to automatically move the cylinder laterally along its axis ... ... **£37. 0s. 0d.** *Abandon.*

3. Do. do. with clockwork gearing to automatically move the cylinder laterally along its axis and with arrangement for placing the cylinder at any desired angle between the vertical and horizontal positions ... ... **£40. 0s. 0d.** *Abased.*

4. **Kymograph** *driven by clockwork.* The cylinder is 130 mm. high and 165 mm. in diameter. The cylinder in this instrument is driven by clockwork gearing and not by friction wheels. A constant speed is maintained by means of an isochronous governor with three ranges of speed. When ordering please state whether the cylinder is to rotate on a vertical or horizontal axis ... **£32. 0s. 0d.** *Abashmen*

5. Do. do. with gearing to automatically move the cylinder laterally along its axis ... ... **£37. 0s. 0d.** *Abatemen.*

6. Do. do. with fittings to allow of the same cylinder being used either horizontally or vertically ... ... **£36. 0s. 0d.** *Abator.*

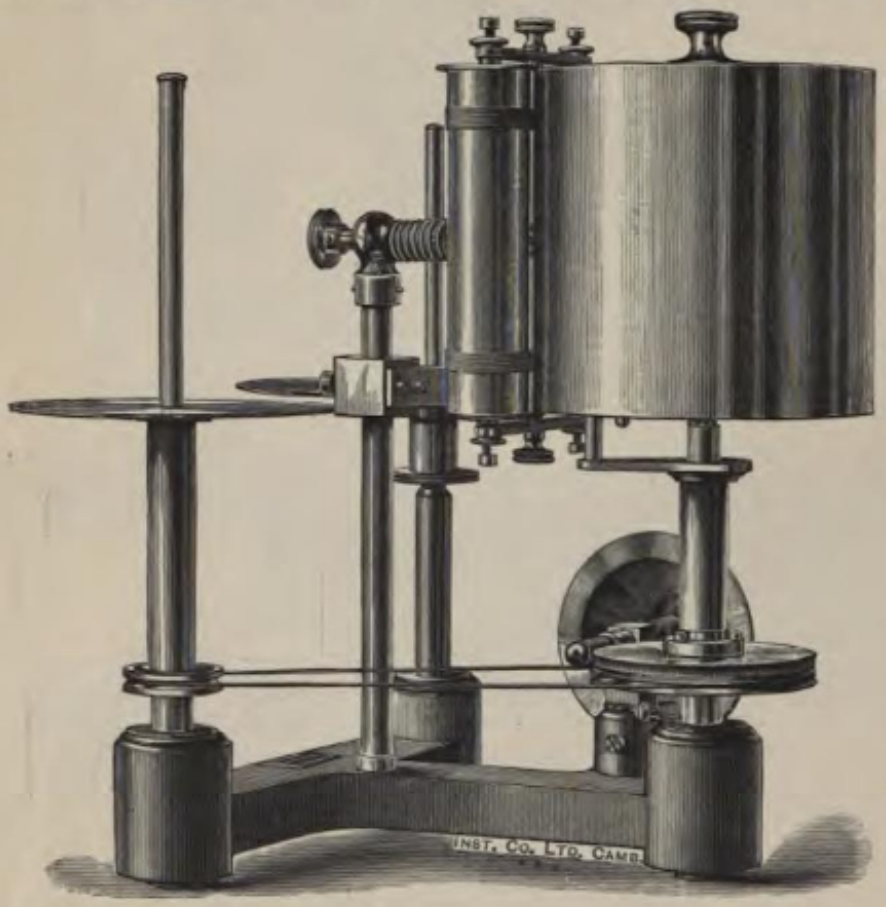
7. Do. do. with fittings to allow of the cylinder being used either horizontally or vertically, and automatic gearing to move it along its axis ... ... **£40. 0s. 0d.** *Abdicant.*

8. **Kymograph** *for use with a motor or quick running cord.* The cylinder is 130 mm. high and 165 mm. in diameter and rotates on a vertical axis from which it can be easily removed when it is required to attach and smoke the paper. A pulley with five grooves in it is fixed to a horizontal spindle and is driven by a loop of cotton cord. At the other end two screws of different pitch are cut; there are two worm wheels fixed together and turning on the axis carrying the cylinder. By a simple arrangement either screw on the pulley spindle can be made to engage with its corresponding worm wheel. The worm wheels, screws and pulleys are

arranged so as to give ten different velocities forming a geometrical series, each velocity being 40 per cent. greater than the preceding one. If the cylinder is driven by the quick running cord and a driving pulley, twenty different cylinder surface speeds are possible ranging from 50 mm. per minute to 250 mm. per second. The cylinder will rotate in either direction ... ... **£10. 10s. 0d.** *Abditory*

9. Do. do. with vertical adjustment. Whilst the cylinder is rotating it can be moved up and down and held in any position by a clamping screw.
Figure 32 shews this instrument ... ... **£12. 0s. 0d.** *Abductor*

10. Do. do. with vertical adjustment as in the above instrument, it can also be made to have a screw motion thus giving a *helical tracing*. The cylinder is raised to its highest position and at any moment the arrangement for allowing it to fall an equal amount at each revolution can be thrown into gear. It is useful for making long tracings with the cylinder turning quickly ... **£13. 0s. 0d.** *Abettor.*



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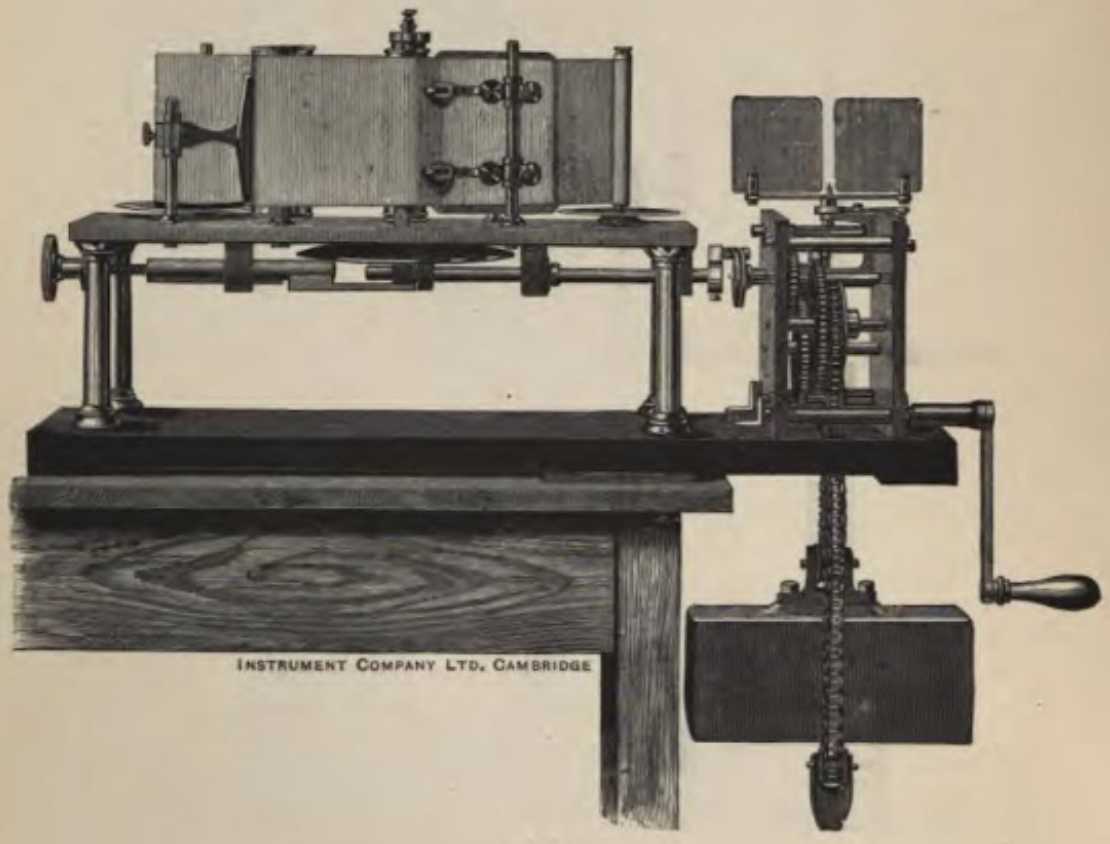
11. **Kymograph** *for recording on continuous paper.* It is similar in design to No. 8, except that it has fewer speeds, and unrolls the continuous paper,

which, after passing the position for recording, is rolled up again in a separate roll. This instrument has no vertical movement to the cylinder ... **£17. 0s. 0d.** *Abhorren*

Instruments Nos. 1, 4, 6 and 8 can be supplied with an arrangement for carrying a long sheet of smoked paper at an additional cost of £3. 10s. 0d. or for continuous paper at an extra cost of £4. 5s. 0d.

12. **Kymograph.** *Ludwig's original pattern for recording on continuous paper.* This consists of a strong clock driven by a weight, which unwinds the paper from the continuous roll and re-winds it on another roller, the paper meanwhile passing over a cylinder on which the tracing is made with a syphon pen and ink. The clock is provided with a simple governor, and with a friction wheel and disc, which allow the paper to travel within a wide range of speed. The clockwork can be stopped or started with ease, and the weight wound up without interfering with the movement of the paper. For tracings lasting over a considerable time, this is the best form of self-contained recording apparatus ... ... **£35. 0s. 0d.** *Abjureme*

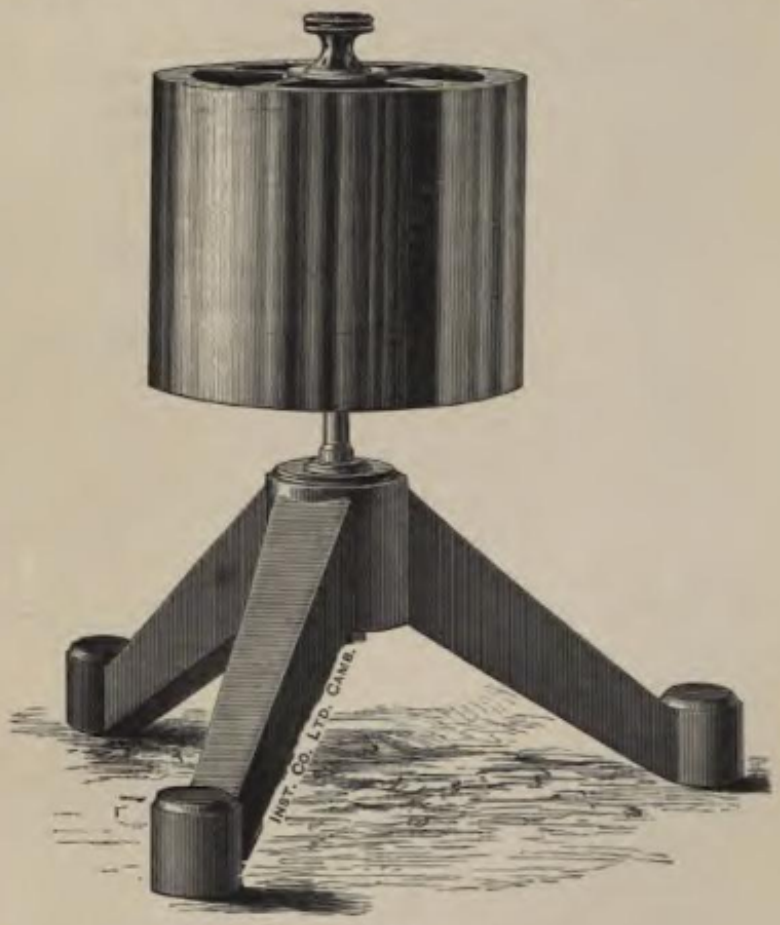


12

13. **Large Drum.** A cylinder 152 mm. high and 610 mm. in diameter, capable of turning on a vertical axis. This form of cylinder is useful for obtaining

long tracings with the paper moving at a high speed. Any form of motor can be used to give the requisite rotation by means of a cord and a pulley fixed to the cylinder ... ... **£7. 0s. 0d.** *Ablocate.*

14. Do. do. with arrangement for driving at a slower speed by a pulley, tangent screw and worm wheel ... ... **£10. 0s. 0d.** *Abnodation*



15

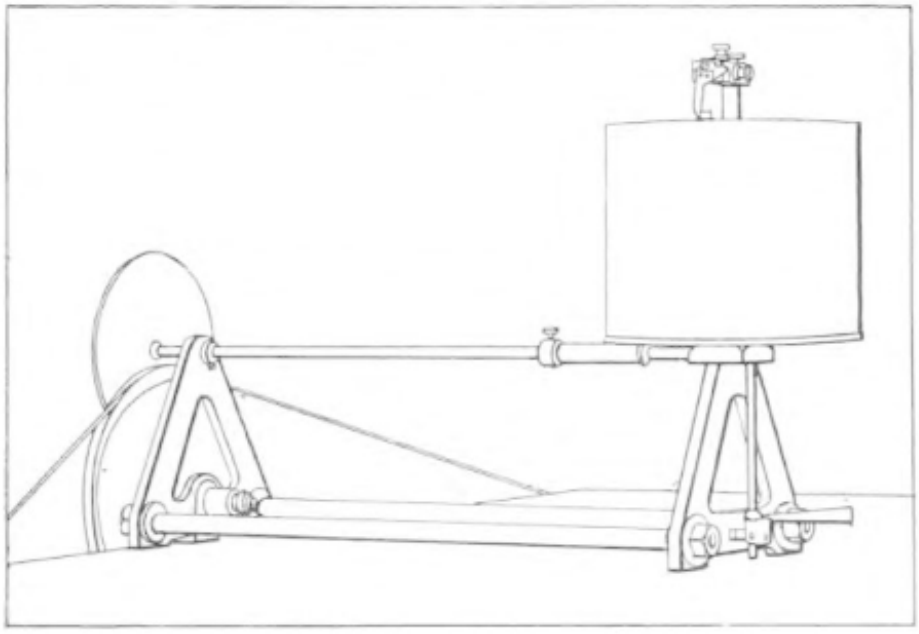
15. **Student's Drum.** The cylinder is 130 mm. high and 165 mm. in diameter. It is rotated by hand and is useful for obtaining tracings of all kinds not requiring a uniform velocity ... ... **£3. 10s. 0d.** *Abnormous.*

16. Do. do. with pulley attached by means of which it can be driven by a motor ... ... **£4. 0s. 0d.** *Aboard.*

17. Do. do. with weight driving arrangement ... ... **£5. 5s. 0d.** *Abolete.*

18. **Recording Cylinder,** *friction gear pattern.* This instrument is of a design simpler than those above described, and can be driven directly by any motor. The cylinder turns on a vertical spindle and is 130 mm. high and 165 mm. in diameter. The bottom of the cylinder is formed by a brass disc and it can slide on the vertical spindle. Its weight is supported by the disc resting on a small wheel on a horizontal shaft. When the shaft revolves the cylinder is driven by the friction between the wheel and the disc; the wheel can be shifted along the shaft and the speed of the cylinder thus varied. To stop the cylinder a handle is moved which lifts it and the disc no longer rests on the small wheel. A key is arranged to clamp to the top of the spindle on which the cylinder rotates; a projecting piece on the top of the cylinder knocks it open and breaks an electric circuit. The velocity of the surface of the cylinder can be varied from 4 mm. to 100 mm. per second.

£10. 10s. 0d. *Abhorrin*



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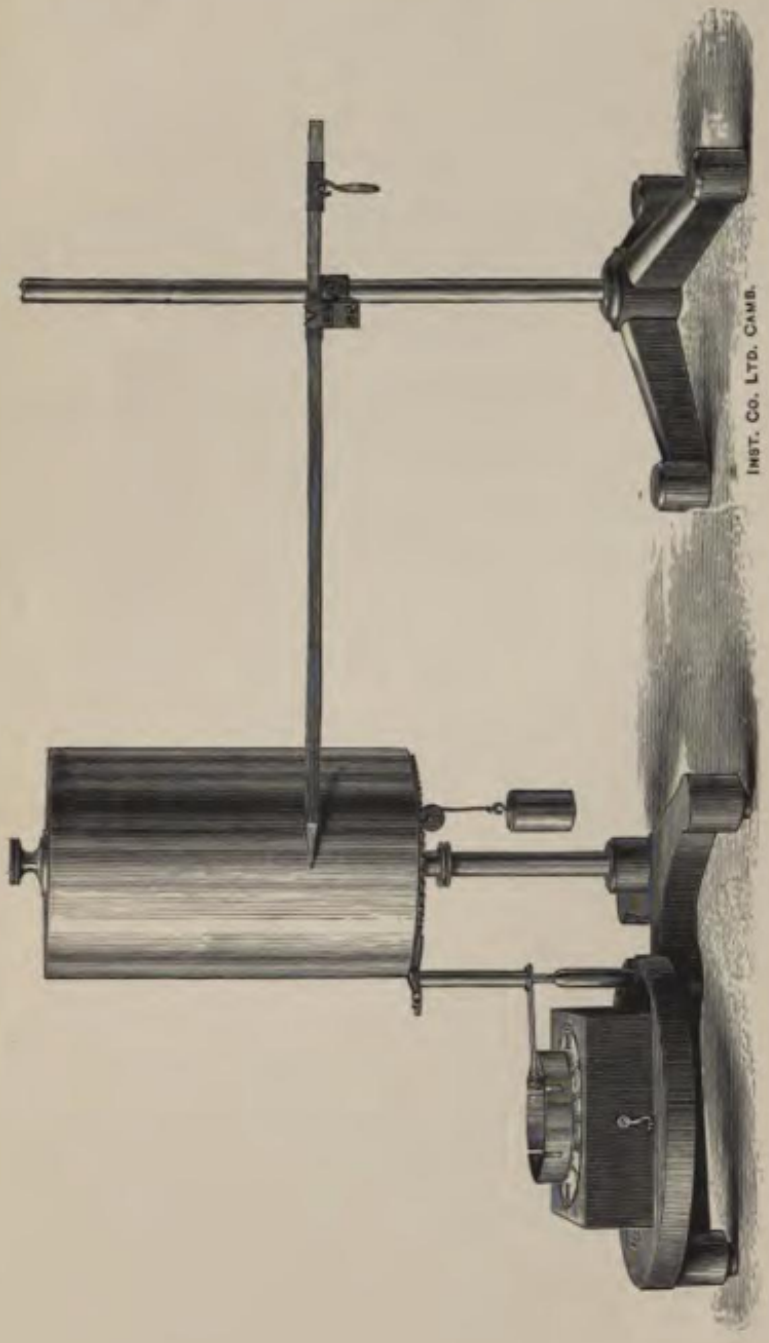
19. **Auxanometer.** This instrument is used for recording any slow vertical movements, for long periods, such as the growth of plants. The cylinder is 255 mm. high and 160 mm. in diameter. At equal intervals of time a clock-movement releases an escapement, which allows the cylinder to turn through a small part of a revolution. The tracing produced is a zigzag, formed of alternate vertical and horizontal lines; the distance between two consecutive horizontal lines is equal to the vertical movement in the corresponding period of time. The advantage of this form of tracing is that the time is marked in the tracing itself, and thus, if a lever is used for writing on the cylinder, no error is introduced, on account of the

point of the lever moving in a circle. The machine is arranged so that each step in the tracing may be made to correspond to every fifteen, thirty, or sixty minutes ...

£15. 0s. 0d. *Abolish.*

[For the price and particulars of the Growth Lever and Stand shown in Fig. 19 see page 104.]



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20. **Slowly Rotating Cylinder.** This was first designed for Mr F. Darwin for recording the slow movements of plants, lasting over many hours. It is similar to the Student's Drum, except that it rotates once in 12 hours, 1 hour or 20 minutes as desired by means of a special clockwork arrangement ... **£5. 10s. 0d.** *Abominable*

In ordering state which speed is required.

ACCESSORIES FOR USE WITH KYMOGRAPHS OR RECORDING CYLINDERS.

21. Wooden handle for holding the cylinder when smoking the paper ... **10s. 0d.** *Aboriginal.*

22. Wooden stand for holding the cylinder when it is not in use. (This is very useful for holding a spare cylinder) ... ... **12s. 6d.** *Aborsement.*

23. Shellac varnish for fixing the tracings, per kilo ... ... **3s. 6d.** *Abortively.*

24. Zinc Bath for varnishing tracings ... ... **12s. 0d.** *Abreast.*

25. Hürthle's smoke-spray for smoking the sheets ... **£1. 0s. 0d.** *Abricock.*

26. Glazed paper accurately cut to size and one end gummed ready for use with our Kymograph cylinders 130 mm. high and 165 mm. in diameter:

100 sheets		**5s. 0d.**	*Abroad.*
500 „		**17s. 6d.**	*Absciss.*
1000 „	**£1.**	**12s. 6d.**	*Abscond.*
100 „ —stouter and better quality than above		**6s. 0d.**	*Absolver.*
500 „ „ „ „ „	**£1.**	**1s. 0d.**	*Abstrude.*
1000 „ „ „ „ „	**£2.**	**0s. 0d.**	*Abstruisty.*

27. Glazed paper for use with Auxanometer cylinders 250 mm. high and 165 mm. in diameter:

100 sheets		**7s. 6d.**	*Absurdly.*
500 „	**£1.**	**15s. 0d.**	*Abundance.*
1000 „	**£3.**	**7s. 6d.**	*Abuse.*

28. Glazed paper for use with large recording cylinders 610 mm. in diameter and 152 mm. high.

100 sheets		**12s. 0d.**	*Academic.*
500 „	**£2.**	**17s. 6d.**	*Accept.*
1000 „	**£5.**	**12s. 6d.**	*Accident.*

29. Unglazed paper for Continuous Paper Kymographs 127 mm. wide in rolls about 250 metres long, per roll ... ... **5s. 6d.** *Accompany.*

30. Unglazed paper 127 mm. wide in rolls about 10 metres long, per roll **10d.** *Accomplish.*

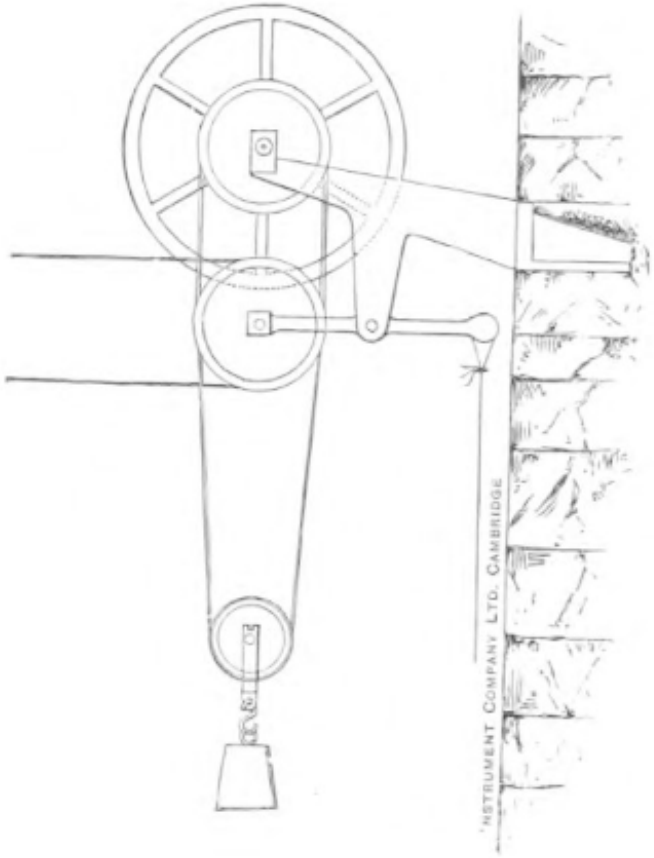
" " " " " " " per 100 rolls **£3. 10s. 0d.** *Accompt.*

31. Glazed paper 127 mm. wide in rolls about 10 metres long, per roll **1s. 0d.** *Accordable.*

" " " " " " per 100 rolls **£4. 4s. 0d.** *Accordance.*

Driving Gear.

We have introduced a convenient arrangement by which many instruments in a laboratory may be driven from one motor by a quick running cord. The method consists in driving a cotton cord at a considerable speed by means of a grooved pulley placed on the shaft of a gas engine or water motor and leading it to the table on which are situated the instruments to be driven. In one part of its course the cord passes round a pulley supporting a weight; by this arrangement a uniform tension is maintained, as the cord changes its length by stretching. The cord runs



along the back of the table, and consequently causes no inconvenience or loss of space. The following are the advantages which this system has over shafting: The power can be easily carried to a great distance; the system is cheaper; it can be applied in any laboratory with very little cutting of brickwork, and in positions where it would be impossible to fix shafting; it is less noisy and requires less attention; the instruments can be driven whilst standing in any position on the table.

A Gas Engine placed in the Cellar is used as the Motor in the Physiological Laboratory in Cambridge. A cord leads from it to the Distributing Shaft placed near the ceiling of a room at a considerable distance away and on the first floor. This Distributing Shaft is shown on p. 9 and the power is taken from it to the various places where it is required. The power is thus divided among many systems and the Shaft is arranged so that each system can be stopped and started independently.

For a full description of our driving gear fitted in the Physiological Laboratory, Cambridge, see *Nature*, Jan. 14, 1886.

Prices for fitting a laboratory with this system of driving gear will be given on application.

32. **Driving Pulley.** From which any instrument can be driven by the system of quick running cord as described above. It is clamped to the back of the table over the quick running cord, a loop of this cord is taken and guided round a large pulley by two small pulleys. The pulley thus driven is fixed to a horizontal spindle, carrying another pulley which drives the instrument by means of a loop of cotton cord. The tension on this cord is kept uniform by leading it over a guide pulley and down to a pulley attached to a weight hanging at the back of the table. This also allows the instrument to be placed at different distances from the Driving Pulley without altering the length of the loop of cord. As the Driving Pulley can be clamped at any point along the edge of the table the instrument can be driven when standing at any position on the table; these movements can be made whilst the cords are moving. The instrument can be stopped and started by moving a handle on the Driving Pulley ... ... **£10. 10s. 0d.** *Accordin*

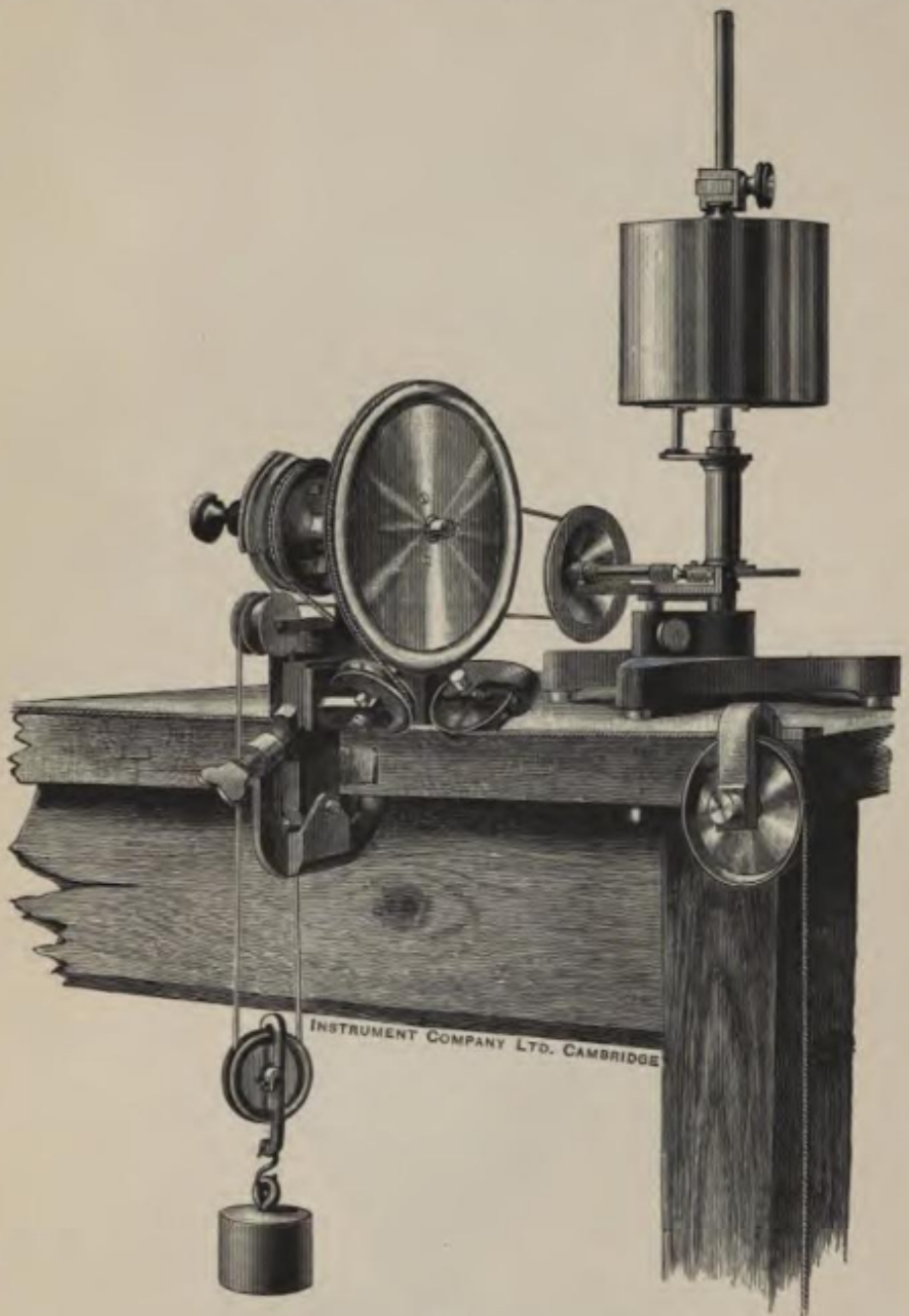
33. **High Speed Driving Pulley.** This is arranged to drive an instrument at a high speed from the quick running cord.

The axis to which the two pulleys are fixed can be removed and replaced in the reverse position, when it can be used for driving at slow speed **£3. 10s. 0d.** *Accostabl*

34. **Small Hanging Pulley,** for altering the direction of motion of the cord in a vertical plane. There are oil reservoirs to the bearings of the pulley, allowing it to run a long time without trouble ... ... **£1. 5s. 0d.** *Account.*

35. **Table Pulleys.** Two pulleys are screwed to the table itself, between which the cord runs along its edge and just below its surface. The direction of the cord is either vertically upwards or downwards from the corners of the table and

consequently causes no inconvenience. There are oil reservoirs to these pulleys also. *See fig.* 32 ... ... *each* **£1. 5s. 0d.** *Accumben*



32

36. **Horizontal Pulleys,** for altering the direction of the cord in a horizontal plane. A plate is bolted to the ceiling and carries a rod projecting

downwards, to which two or more pulleys turning on a vertical axis are fixed. The pulley frames are in the form of small brackets which can be fixed in any position on this vertical rod. They will run a long time without requiring oiling. *Per pair* **£2. 10s. 0d.** *Accurate.*

37. **Oil Can.** An oil can is fixed to the top of a wooden rod for conveniently oiling the pulleys. An air ball at the lower end of the rod is connected by a small tube with the top of the oil vessel; if it is pressed a small quantity of oil is squirted through a tube into the oil reservoirs ... ... **10s. 6d.** *Accusant.*

38. **Cotton Cord,** useful for driving recording cylinders &c.

2 mm. in diameter, especially useful for making the loops to connect an instrument with a driving pulley, per 100 metres ... ... **1s. 6d.** *Acephali.*

6 mm. in diameter, per 10 metres ... ... **1s. 8d.** *Acerbate.*

6·5 mm. „ per 10 metres ... ... **3s. 0d.** *Acidist.*

Motors.

39. **"Thirlmere" Patent Water Motor,** for pressures over 20 lbs. per sq. inch.

In fixing these motors it is necessary that they should run at the speed given in the list; if the speed is too great to run the recording drum or apparatus from the driving pulley of the motor, a counter-shaft must be used.



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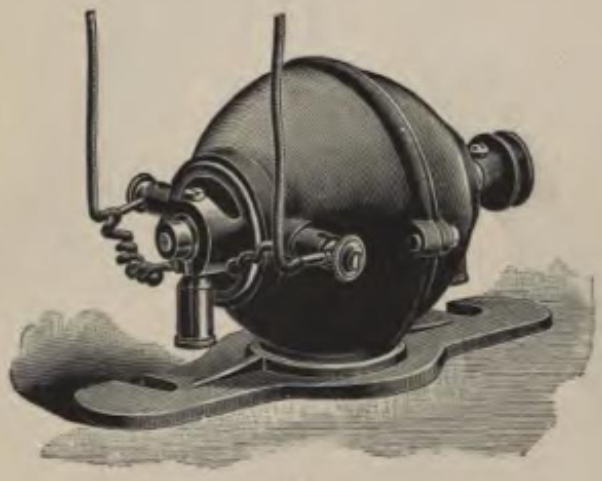
No. Size.	Approximate Brake Horse-Power at a Water pressure of 40 lbs. per sq. inch.	Approximate Consumption in Gallons per minute.	Revolutions per minute.	Diameter of driving Pulley in mm.	Size of Inlet Pipe in mm.	Price.	Extra for Regulating Valve and Lever.	
000	$\frac{1}{60}$	·8	2000	32	12	£1. 10s. 0d.	10s. 0d.	*Afteract.*
00	$\frac{1}{40}$	1·1	1900	32	12	£2. 2s. 0d.	10s. 0d.	*Against.*
0	$\frac{1}{16}$	2·75	1200	54	16	£3. 3s. 0d.	12s. 6d.	*Agarick.*
1	$\frac{1}{8}$	5·5	800	76	19	£5. 5s. 0d.	15s. 0d.	*Agazed.*
2	$\frac{1}{4}$	11	600	82	25	£8. 10s. 0d.	20s. 0d.	*Agency.*
3	$\frac{1}{2}$	22	400	108	38	£12. 10s. 0d.	30s. 0d.	*Aggrate.*
3 D	1	44	400	108	51	£16. 0s. 0d.	40s. 0d.	*Aggressor.*
3 T	$1\frac{1}{2}$	66	400	152	51	£22. 0s. 0d.	50s. 0d.	*Agnate.*

The first four sizes have grooved pulleys for cord.
The larger sizes have ordinary pulleys for belt.

40. Electric Motors. Lundell Pattern. These motors are very suitable for driving Recording Drums, Bottle shakers &c.; they are compact and practically noiseless. It will be noticed that those of $\frac{1}{16}$th and $\frac{1}{8}$th horse-power can be driven by a small battery. The motors develop their maximum efficiency when driven at 115 volts (direct current) but they will work well on any circuit between 90 and 140 volts.



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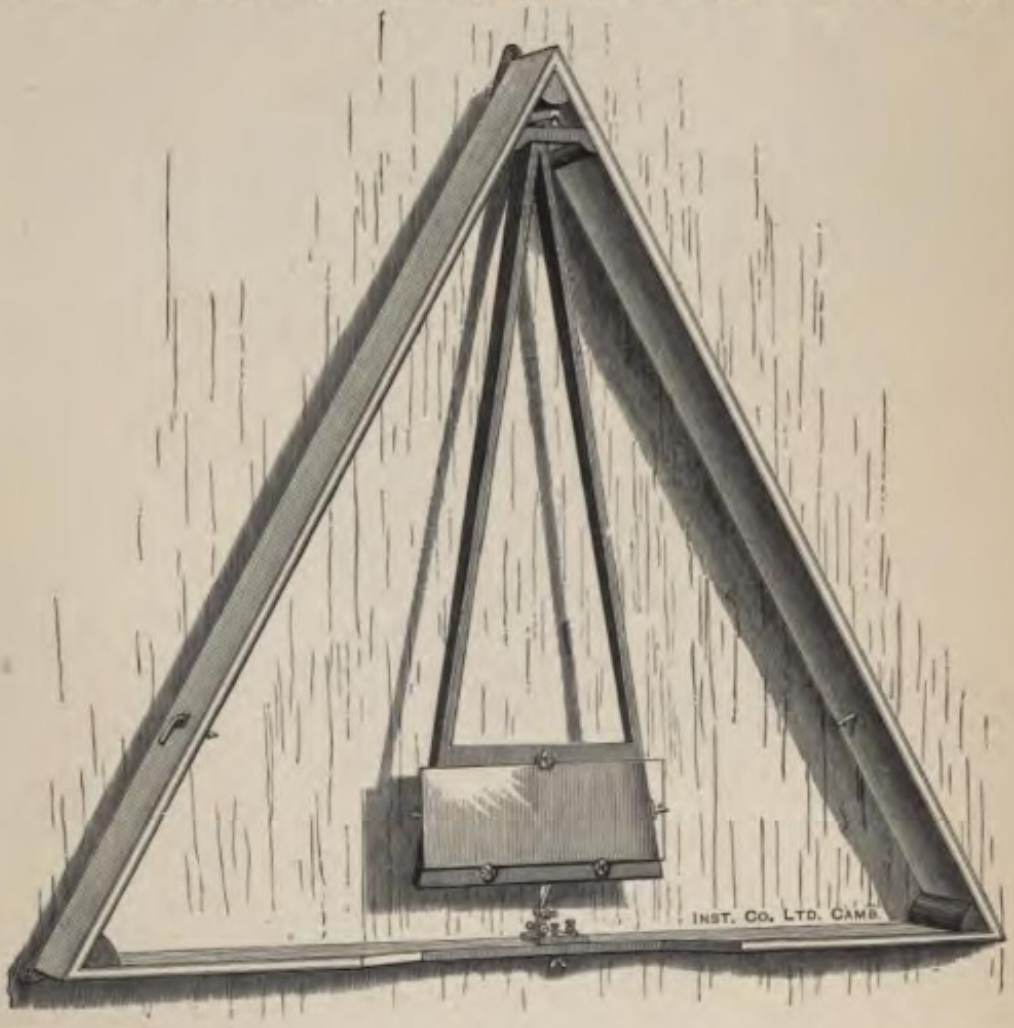
Horse-power.	Volts.	Revolutions per minute.	Diameter of Pulley in mm.	Price.	
$\frac{1}{16}$	4	1900	25	£5. 10s. 0d.	*Action.*
$\frac{1}{12}$	115	1900	25	£5. 10s. 0d.	*Actual.*
$\frac{1}{8}$	8	1800	38	£6. 10s. 0d.	*Acuity.*
$\frac{1}{8}$	115	1800	38	£8. 0s. 0d.	*Acutely.*

Motors above ¼ horse-power, inclusive, require Self-oiling bearings and a Starting Switch.

Horse-power.	Amperes at 115 Volts.	Volts.	Revolutions per minute.	Diameter of Pulley in mm.	Price of Motor.	Price of Starting Switch.	
¼	2·2	115 or 230	1700	70	**£13**	**£1. 15s. 0d.**	*Adalite.*
½	4·3	115 or 230	1500	89	**£20**	**£1. 15s. 0d.**	*Adaunt.*
1	8·7	115 or 230	1300	114	**£23**	**£3. 0s. 0d.**	*Addice.*

Myographs.

41. **Pendulum Myograph.** Simple form. The glass plate is clamped to a wooden frame which hangs on steel points, and thus forms a pendulum 100 mm. long. As it swings the plate moves past the recording points and the tracing is



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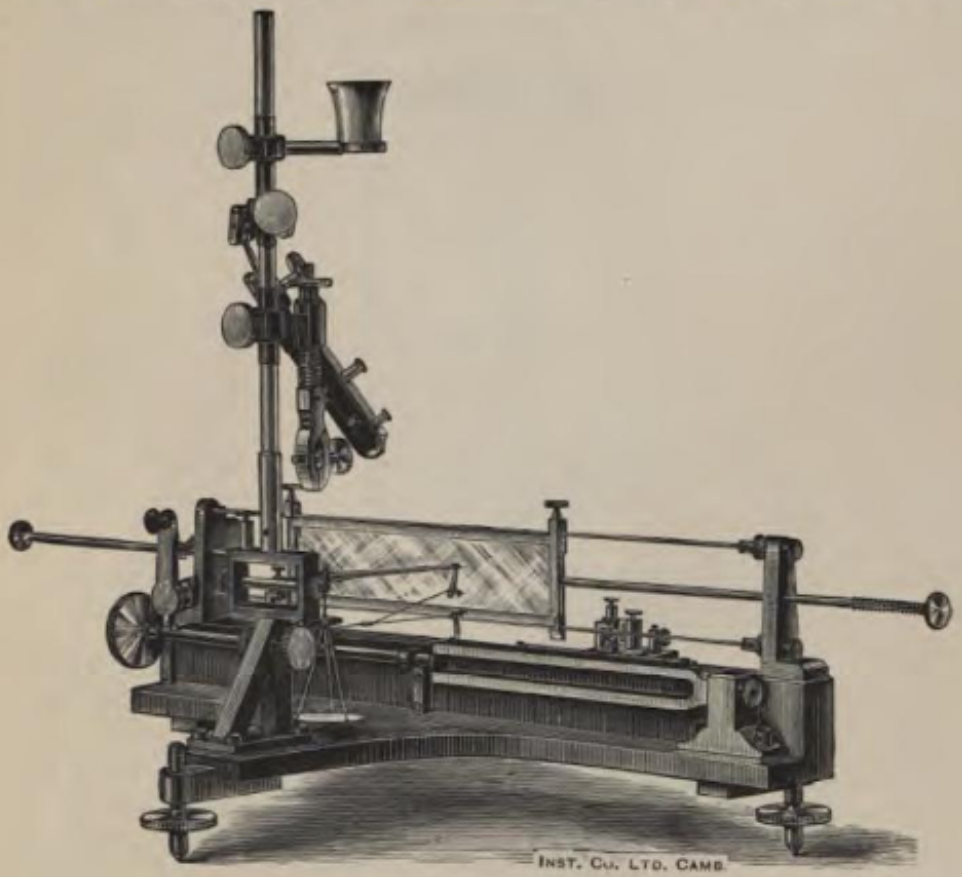
taken. The glass plate [385 mm. × 15 mm.] can be easily removed by turning three buttons which hold it in its place. The pendulum hangs in a triangular wooden frame fixed to the wall, and carrying the contact breaker, which is knocked over by a projection on the pendulum. When moving the pendulum back the projection passes the contact breaker without damaging it. A catch on the frame holds the pendulum to one side, and when this is released by pressing a lever the pendulum swings across and is caught by a similar catch on the other side. The triangular frame is sent in separate pieces for convenience in packing, the parts that come together are marked and all that has to be done is to put in the screws. Two glass plates and one contact breaker are sent with each instrument ... ... **£12. 0s. 0d.** *Action.*

Glass plates for the above ... ... *each* **6s. 0d.** *Actual.*

42. Pendulum Myograph with Adjustable Glass Plate.

This has in addition to the adjustment described in the Simple Pendulum Myograph an arrangement for raising or lowering the glass plate [385 mm. × 15 mm.] by a screw, so that several tracings can be taken one below the other without shifting the writing styles. The action which raises the frame supporting the glass plate, lowers a second frame and glass plate and the centre of gravity of the pendulum is not



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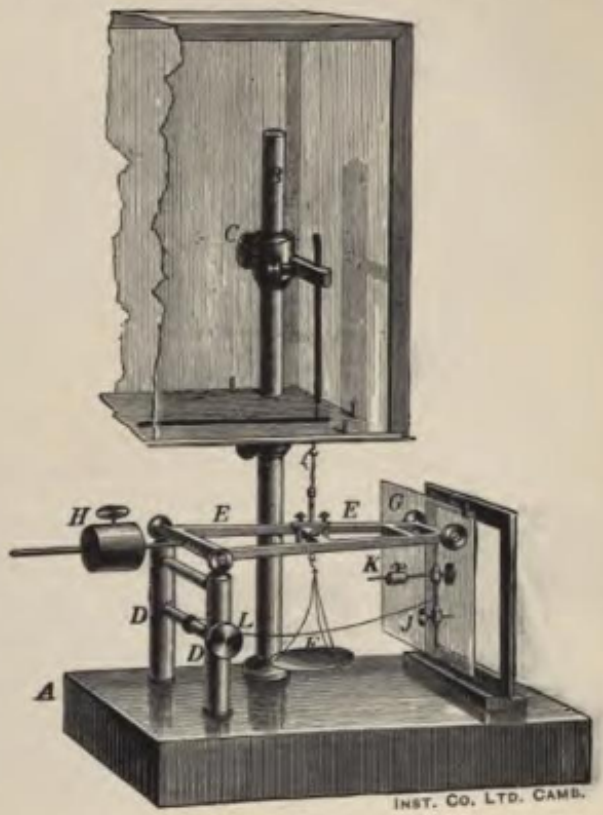
shifted; by this means the period and velocity of the pendulum remain constant. There are two contact breakers which can be moved so as to vary the time between the opening of the two circuits. The pendulum is strongly made of iron and hangs in a triangular frame which is fixed to the wall. The contact breakers and releasing levers are carried by the triangular frame. Four glass plates and one contact breaker are sent with the instrument ... ... **£45. 0s. 0d.** *Acuity.*

Glass plates for the above ... ... **6s. 0d.** *Acumi*

43. **Spring Myograph,** Du Bois-Reymond's Improved Form. In this instrument the frame supporting the glass plate [385 mm. × 15 mm.] slides on two horizontal steel wires. To make the instrument ready for use, the frame is moved to one side, which compresses a short spring. When the catch holding it in this position is released by the trigger, the spring which only acts for a short space gives the frame and the glass plate a rapid horizontal motion; and the momentum carries the glass plate through the rest of the distance, till stopped by the buffers. The velocity during this time is nearly constant, as the friction of the guides is small. Two keys are knocked over by pins on the frame and break electric circuits. The relative positions at which the circuits are broken can be altered by a convenient adjustment. A tuning-fork vibrating about 100 per second fixed to the base of the instrument marks the time; its prongs are sprung apart by a block between their



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ends, and the same action which releases the glass plate also frees the fork by removing the block and allows it to vibrate; a writing style then draws a sinuous line on the smoked surface of the moving glass plate. A muscle lever with a scale-pan attached also forms part of the instrument. There is a convenient arrangement for withdrawing the styles of both the lever and the tuning-fork from the surface of the glass plate. A vertical rod carries a clamp for holding the upper end of the muscle; an arrangement for warming the muscle is also carried by the rod. For Meyer's forceps for use with the above see p. 34 ... ... **£25. 0s. 0d.** *Acutely.*

Glass plates for the above ... ... *each* **1s. 6d.** *Adalite.*

44. **Spring Myograph,** Du Bois-Reymond's form, simple pattern with tuning-fork ... ... **£10. 0s. 0d.** *Adaptab*

Glass plates for the above ... ... *each* **1s. 6d.** *Adaption*

45. **Myograph, Pflüger's pattern,** for experiments in which a chronograph is not required. The glass plate rests on slides and is moved forward by hand after each contraction of the muscle. A rod rising from a wooden base carries a glass case which can be charged with moist air; the upper end of the muscle is fixed to an arm clamped to the rod and inside the case. Both the arm and the case can be clamped at the desired height. The lower end of the muscle is connected to the lever by a thread passing through the bottom of the glass case. The lever turns about a horizontal axis and can be accurately balanced by an adjustable counterweight. It also carries a scale-pan for carrying weights to increase the tension on the muscle. A weak spring presses the writing style against the glass plate, and a straight line is drawn by the vertical movements of the lever point. Complete **£5. 10s. 0d.** *Adaunt.*

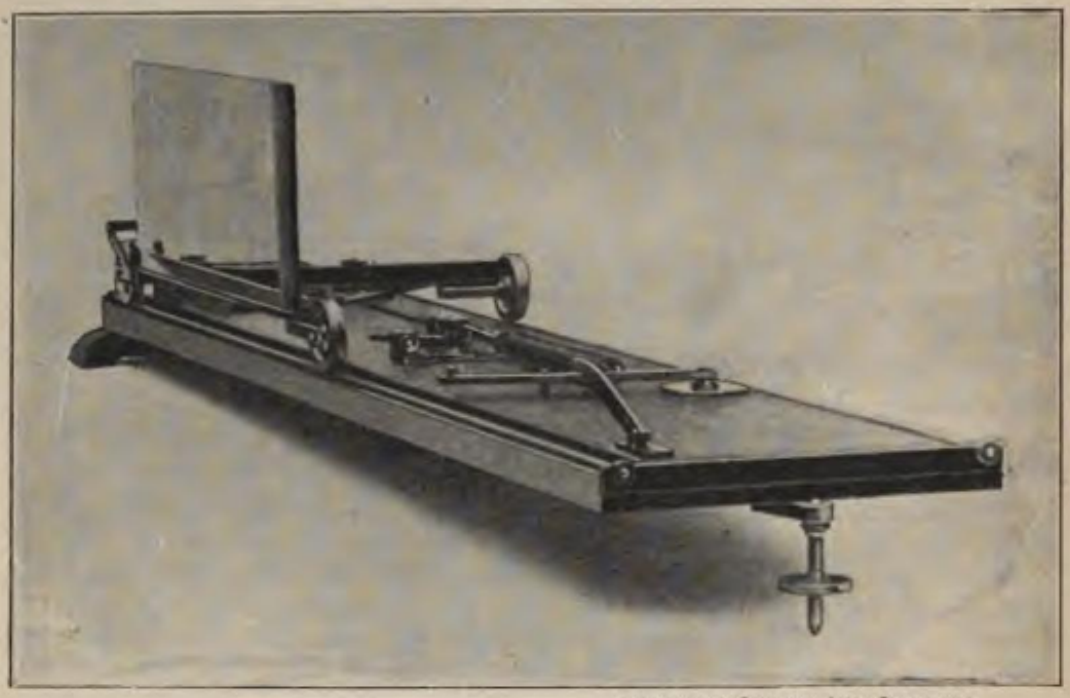
46. Do. do. without Moist Chamber ... ... **£4. 10s. 0d.** *Addice.*

Glass plates for the above ... ... *each* **1s. 0d.** *Additam*

47. **Tramway Chronograph or Myograph.** See *Life in Motion* by Prof. J. G. McKendrick, p. 60.

This instrument has the following advantages over the Pendulum Myograph: the line traced by a point at rest is straight and not part of a circle; the instrument is portable and can stand on the table instead of being fixed to a wall; the speed of the glass plate is constant; the tracing on the smoked glass plate can be projected by a lantern on the screen the moment after it is taken. The glass plate is vertical and is fixed to a carriage with three wheels running on a railway. The motion is given by means of a spring which is released by a trigger and acts only for a short distance; the momentum carries the glass plate past the scribing points. The velocity of the plate can be varied by altering the tension of the spring. Whilst the action of the spring is accelerating the speed of the glass plate, no tracing is taken; whilst the scribing points are in contact with the glass plate the speed is uniform, as the railway is given a slight inclination, sufficient to counterbalance the

small retarding effect of its friction. There is a screw at one end of the stand to vary this inclination. The glass plate is vertically over one edge of the board



INSTRUMENT COMPANY LTD. CAMBRIDGE

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carrying the railway, so that any instrument can stand on the table quite close to the glass plate. The movement of the carriage breaks an electric circuit by knocking open a key ... ... **£10. 0s. 0d.** *Addition*

Glass plates for the above ... ... *each* **6s. 0d.** *Addoom.*

48. **Marey's Simple Myograph.** In this instrument a horizontal brass plate supports the axis of a marking lever, which moves in a horizontal plane. A cork table is fixed to the brass plate and carries the electrodes for stimulating the nerve or muscle, it fits on to one of our Simple Stands ...

£3. 12s. 0d. *Addulee.*

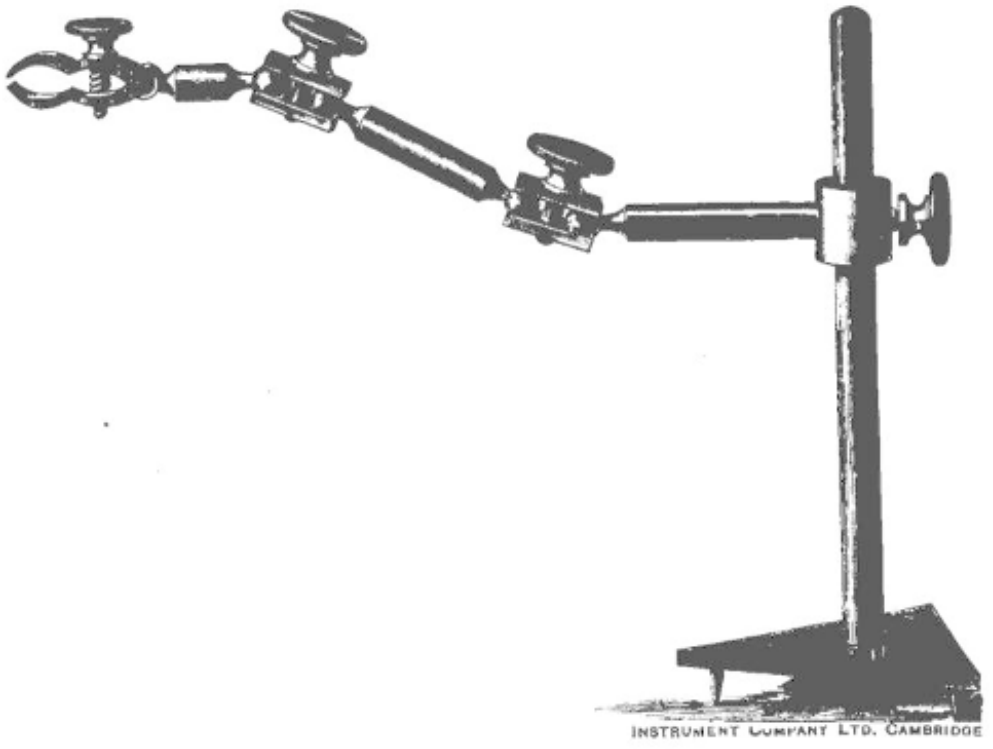
49. Do. do. on small railroad stand moved by clockwork. See *Text Book of Physiology* by Prof. McKendrick, pp. 392–393 ... ... **£15. 12s. 0d.** *Adhere.*

50. **Crank Myograph.** See page 32.

SUPPORTS FOR APPARATUS.

Section 2.

51. **Universal Holders.** Professor Roy's pattern for supporting tubes, electrodes, and other small objects. The base has three small spikes which when



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pressed into the table fix it in the desired position. The engraving is the full size of the instrument ... ... **£1. 7s. 6d.** *Adjection.*

52. **Four-Way Holder Block.** This consists of a metal block with four slots and clamping screws for holding different pieces of apparatus. The block clamps on to one of our Simple Stands. An illustration of one is given in Fig. 74 ... ... **12s. 6d.** *Adjoin.*

53. **Simple Stands.** A square cast-iron base standing on three feet, supports a vertical steel rod 30 cm. long and 10 mm. in diameter. All our smaller instruments such as Time Markers are made to clamp on a rod of this size. Longer rods supplied to order. An illustration of this Stand is given on page 60. ... ... **5s. 0d.** *Adition.*

54. Adjustable Simple Stand.

This is similar to the Simple Stand, but with a heavier base and longer vertical steel rod. It is used to support a Time marker or any small instrument which marks on the smoked paper on the Recording Cylinder. The vertical rod is capable of rotation about its own axis and thus the scribing styles of two or more instruments can be simultaneously brought into contact with the smoked paper; if the Recording Cylinder is moving quickly this arrangement is often most convenient. The rotation is given by moving a handle until it comes in contact with the point of a screw; by adjusting this screw the desired pressure between the styles and the smoked paper is obtained ... ... **£1. 10s. 0d.** *Adipous.*

55. Cheaper form of above for Students' use as designed by Prof. Gotch ... **8s. 0d.** *Adjugate*

56. **Vertical Stand.** A stiff cast-iron upright is fixed to a base board which will stand firmly on the table. A small brass platform can slide vertically in



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a guide cut in the cast-iron upright; a steady motion is given to the platform by turning a handle attached to a quick threaded screw. It is useful for supporting any small instrument in which a smooth vertical motion is required **£6. 10s. 0d.** *Adjutor.*

57. **Adjustable Glass Table,** used for Quincke's Microscope Cathetometer or for any purpose requiring a smooth level glass stand capable of vertical adjustment. A piece of plate glass is supported by a rigid vertical steel rod which is clamped to a tripod foot supported by three levelling screws. The height is easily adjustable by slackening a milled head, raising the table by hand and re-clamping when in the required position. The clamp is designed to give a perfectly rigid connection to the tripod foot with a small turn of the screw; it is impossible to dent the steel rod ... ... **£5. 0s. 0d.** *Adminicle.*

58. **Pneumatic Table,** for giving a slow vertical motion to any piece of apparatus. A small table is fixed to the top of a brass cylinder sliding inside another brass cylinder. There is air-tight packing between the cylinders; consequently as the table falls all the air in the cylinder is expelled through a valve. The



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opening of this valve can be altered, thus regulating the speed with which the table falls. It can be used for supporting apparatus for recording on a revolving cylinder;

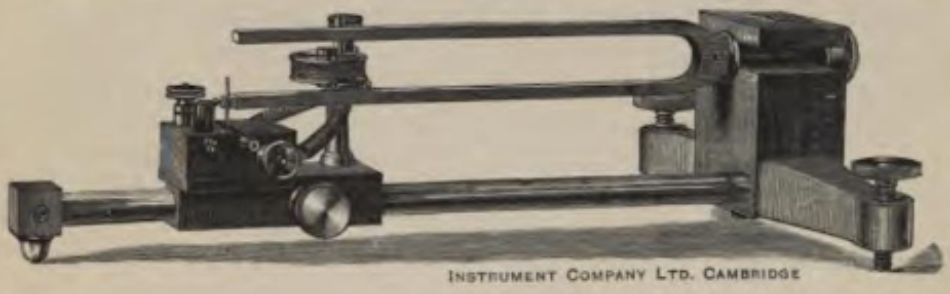
a diagram of great length is obtained in the form of the thread of a screw. The valve now supplied is slightly different to that shown in the illustration ... ...
£6. 10s. 0d. *Admirab*

59. **Insulating Stands.** Designed by Clerk Maxwell. The object to be insulated is placed on a small table which is fixed to the upper end of a glass pillar. In order to make the insulation as perfect as possible the air surrounding the pillar is kept dry by means of sulphuric acid. The lower end of the glass pillar is fixed in a boss rising from the middle of a circular glass dish, into which the acid is put. The upper part of the pillar passes through the neck of a bell-glass, and is cemented to it. The mouth of the bell-glass enters the mouth of the glass dish without touching it, and comes down nearly to the surface of the acid. The glass pillar passes through a nearly enclosed space formed by the bell-glass and the surface of the acid. The air in contact with the glass pillar is thus kept perfectly dry. See *Elementary Treatise on Electricity*, by J. C. Maxwell, p. 14 ... **£2. 10s. 0d.** *Admirer.*

TIME MARKERS.

Section 3.

60. **Tuning-fork Stand,** for holding tuning-forks in which the vibrations are electrically maintained. Any of the tuning-forks can be fixed in the slot in the heavy cast-iron block. The ebonite block supporting the electro-magnet and the mercury cup slides along a rod to suit the lengths of the various forks. The level of the mercury in the cup can be adjusted by a screw plunger. The mercury can be kept clean by passing a continuous stream of water



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over its surface. The amplitude of the vibration of the fork can be varied by a lateral adjustment of the electro-magnet; a vertical adjustment also allows the electro-magnet to be fixed at an equal distance from each prong of the fork. Suitable terminals are fixed to the instrument. The feet should stand upon three pieces of india-rubber tubing; when this is done the vibrations transmitted to the table are lessened, and the fork vibrates more readily ... ... **£6. 15s. 0d.** *Admixtio*

61. **Tuning-Fork Stand.** *Cheap form.* This stand is designed to hold the same forks as No. 60. The contact-maker and its adjustments being of much simpler construction ... ... **£4. 0s. 0d.** *Admonito*

62. **Tuning-Forks** to fit either of the above stands. These forks are calibrated most carefully and can therefore be relied on for the most accurate work.

Fork making	50	Vibrations per second	...	...	...	**£4. 0s. 0d.** *Adopt.*
" "	100	" "	...	...	...	**£4. 0s. 0d.** *Adorn.*
" "	200	" "	...	...	...	**£4. 0s. 0d.** *Adrift.*

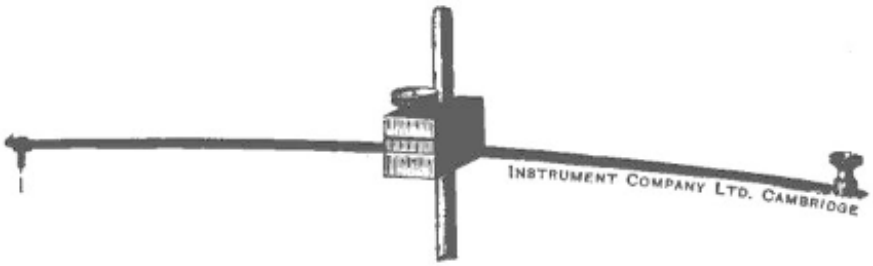
63. **Adjustable Tuning-Fork Stand.**

The vibration of the tuning-fork is electrically maintained, and the instrument is suitable for producing Lissajou's figures and for many other experiments. The vertical adjustment makes it convenient for recording on the smoked paper of a

Recording Cylinder. A gun-metal block is clamped by a screw to a vertical rod fixed to a heavy cast-iron tripod foot, giving vertical adjustment. The gun-metal frame, carrying the tuning-fork and electro-magnet, can be fixed in three different positions to the gun-metal block, by means of a milled headed screw. It can be fixed with the fork horizontal and the prongs moving in a vertical plane; with the fork horizontal and the prongs moving in a horizontal plane; or, with the fork vertical. The contact is made by a platinum wire fixed to one prong of the fork striking against the platinum faced head of a screw. A mercury cup is supplied which can be used instead of the platinum contact when the fork is horizontal. With mirrors fixed to the forks, a pair of these instruments are most suitable for making Lissajou's figures ... ... **£14. 0s. 0d.** *Advance.*

For forks for use with the above, see No. 62.

64. **Simple Tetanus Spring,** or Vibrating Contact Maker. A long straight spring is gripped in a brass block which is clamped on to one of our Simple Stands. At each vibration of the spring a platinum wire fixed to its end dips into a mercury cup and completes an electric contact. This cup may be any small vessel standing on the table; it is not supplied with the instrument, unless specially ordered. One terminal is connected to the cup and the other to the spring. The instrument is used by deflecting the spring with the finger, and then freeing it, when it will vibrate for a short time giving an intermittent current.



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The speed of vibration can be varied within wide limits by gripping the spring at different distances from its end ... ... **£1. 5s. 0d.** *Adventory*

65. Do. do., with graduated scale, in order that the spring may be set immediately to the number of vibrations required ... ... **£1. 15s. 0d.** *Adversity.*

66. **Electrically Maintained Tetanus Spring,** or Vibrating Contact Maker. This is the same instrument as the above but with the addition of a mercury cup and a small electro-magnet by means of which the vibrations can be maintained indefinitely. The electro-magnet is fixed at the end on a rod clamped to the Stand supporting the rest of the apparatus; it is capable of adjustment along the length of the spring, and also up and down so that the poles of the magnet can be placed at the right distance above the spring. The mercury cup is fixed at the end of a similar rod; it can thus be placed in the right position under the

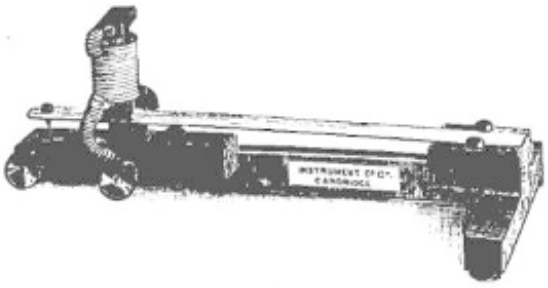
platinum wire. The instrument is thus similar in its action to an Electrically Maintained Tuning-Fork; it has a very great range of speed, at the slowest rate it will make about 5 contacts per second ... ... **£3. 5s. 0d.** *Advice.*

67. Do. do., with graduated scale, in order that the spring may be set immediately to the number of vibrations required ... ... **£3. 15s. 0d.** *Advisable.*

68. Oscillating Contact Maker.

This instrument completes an electrical circuit at equal intervals of time which can be varied as desired.

A weight is hung at the lower end of a spiral spring, the upper end of which is carried by a vertical rod fixed to a tripod stand. The weight is held down below its position of equilibrium by a catch; on releasing a trigger the weight oscillates up and down and completes an electric circuit at each oscillation. The movement will continue for several minutes ... ... **£8. 10s. 0d.** *Adviser.*



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69. **Contact Breaker,** to interrupt the current ten times per second, especially designed for Students' use.

A horizontal steel spring fixed to a cast-iron stand oscillates and completes contact by means of a wire dipping into a mercury cup at each oscillation. The intermittent current thus produced passes through an electro-magnet placed above the spring and keeps it vibrating. The electro-magnet and the mercury cup can be moved to the best position and the rate of vibration can be adjusted by slightly altering the length of the spring ... ... **17s. 6d.** *Advolition*

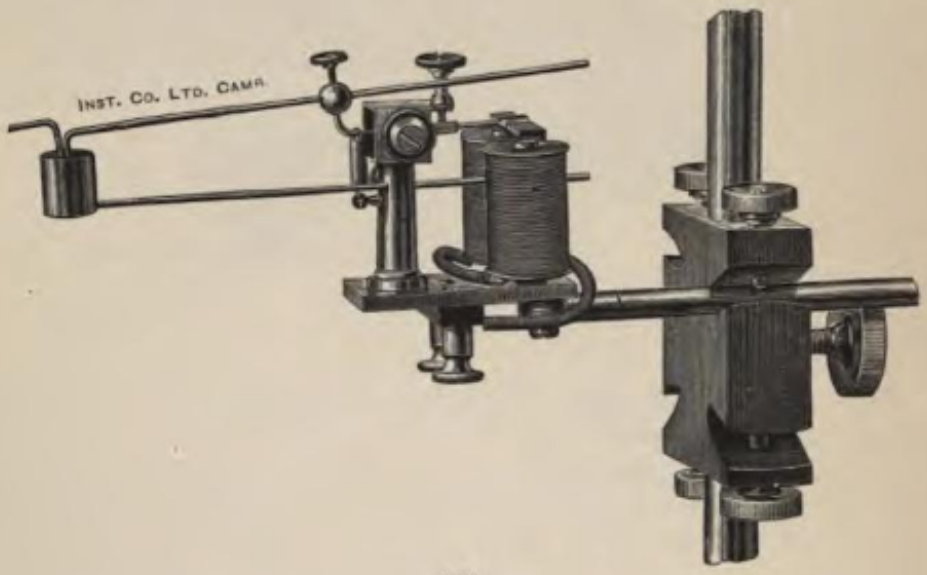
70. **Clock** for making an electric contact at each second. It consists of an American clock movement, modified so as to beat seconds and mounted on a board, and covered with a bell-shaped glass. A mercury cup is provided, into which a platinum wire dips at every vibration of the balance. Binding screws are fixed to the board for attaching the connecting wire to the battery and to any piece of apparatus such as time-markers. This simple and inexpensive clock gives the most satisfactory results ... ... **£1. 12s. 6d.** *Advowe.*

71. **Metronome.** Simple pattern ... ... **10s. 6d.** *Affair.*

72. Do. do. to sound at every beat **15s. 0d.** *Affective.*

73. **Metronome** fitted with Prof. Kronecker's arrangement for making and breaking contact. These contacts are made by means of platinum points fitted to the ordinary metronome arm dipping into two little mercury cups. (See *Outlines of Practical Physiology*, Stirling, 3rd Edition, page 222.) ... **£2. 0s. 0d.** *Affiancer*

74. **Time Marker to write with Ink on Continuous Paper.** The armature of a small electro-magnet moves a lever carrying a writing point which is pressed against the moving surface of paper on a recording instrument. If it is connected to a clock which makes contact at each second a zigzag line is drawn recording the velocity of the paper; this is useful for analysing any other curve drawn at the same time by another instrument. It can also be used to record the closing of an electric circuit by any other instrument.



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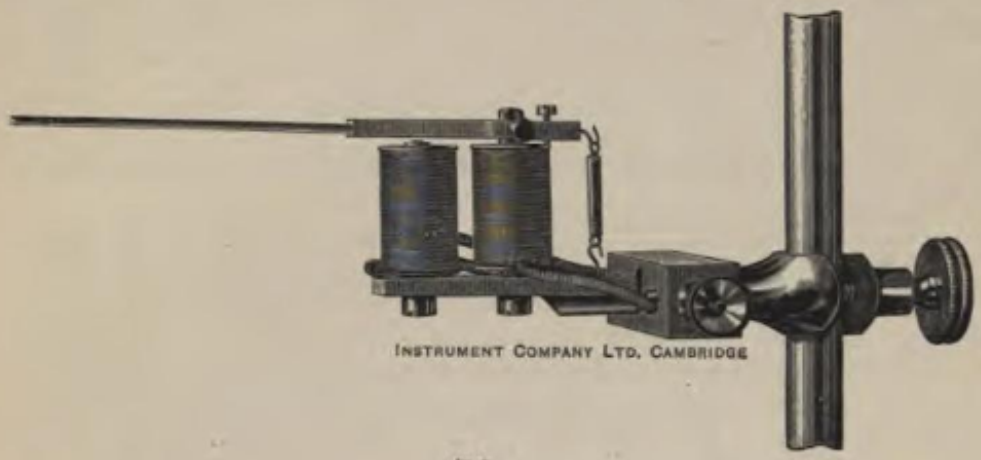
The pen is formed of a syphon made from a very fine glass tube, one arm of which always remains in a small vessel containing ink and the other arm rests against the paper and makes the mark. It is mounted by a stiff joint at the end of a horizontal rod which is clamped to a Simple Stand by a brass block or the four-way holder shown in the figure, see also p. 19 ... ... **£3. 0s. 0d.** *Affirmer.*

75. Do. do. fitted with an Adjustable Lever Support by means of which the pen can be applied to the surface of the paper with great accuracy **£4. 0s. 0d.** *Afflecter.*

76. Time Marker for Smoked Paper. This form can be used with the currents from an Electrically Maintained Tuning-Fork of slow vibration ... ... **£2. 10s. 0d.** *Affluxion.*



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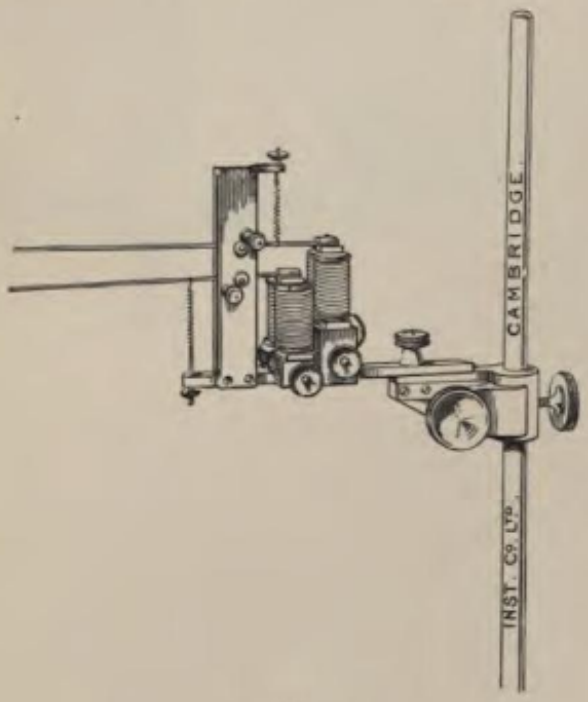
77. Do. do. fitted with Adjustable Lever Support ... **£3. 10s. 0d.** *Afford.*

78. Do. do. Cheap pattern for Students' use ... ... **£1. 10s. 0d.** *Afforest.*



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79. **Double Time Marker for Smoked Paper.** This is a combination of two Time Markers on one frame, with the styles very near together, one directly over the other. This is convenient, as both marking points can be brought against the surface of the cylinder at the same moment, the relative positions of the marks made is constant, and very little space is taken up on the smoked surface ... ... **£4. 10s. 0d.** *Affrap.*

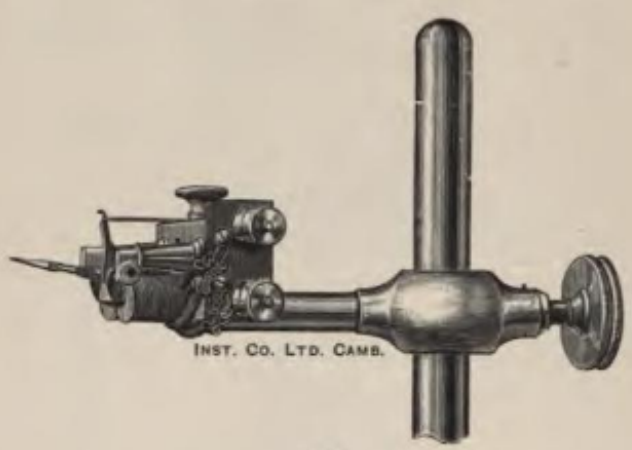
80. Do. do. fitted with Adjustable Lever Support ... **£5. 10s. 0d.** *Affret.*

81. **Triple Time Marker for Smoked Paper** ... **£5. 10s. 0d.** *Affix.*

82. Do. do. fitted with Adjustable Lever Support ... **£6. 10s. 0d.** *Afloat.*

83. **Time Marker Deprez Signal.** In this form the electro-magnets are very small and the moving parts extremely light. It is useful for recording small intervals of time on smoked paper. A good tracing can be obtained when connected with a Tuning-Fork interrupting the current 200 or more times a second ... ... **£3. 0s. 0d.** *Afoot.*

84. Do. do. fitted with Adjustable Lever Support ... **£4. 0s. 0d.** *Aforehand.*



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85. Do. do. Cheap pattern for Students' use ... ... **£2. 0s. 0d.** *Aforesaid.*

86. Do. do. do. with Adjustable Lever Support ... ... **£3. 0s. 0d.** *Afront.*

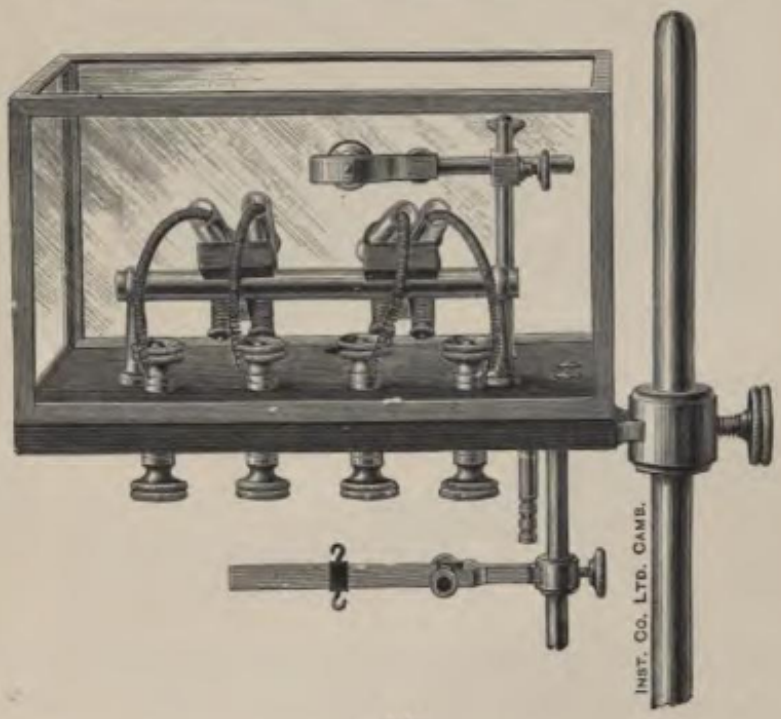
87. **Double Time Marker Deprez Signal.** In this instrument two small electro-magnets similar to those in No. 83 are mounted close together; their styles writing in two planes close to one another ... ... **£5. 0s. 0d.** *Agnition.*

88. Do. do. fitted with Adjustable Lever Support ... **£6. 0s. 0d.** *Agazed.*

NERVE AND MUSCLE.

Section 4.

89. **Moist Chamber,** to keep a muscle and nerve preparation damp during the experiment. The instrument is clamped to a Simple Stand and consists of an ebonite base, covered by a glass case. The current is led to the inside of the chamber by means of four double terminals. The two pair of non-polarisable electrodes can be placed in any desired position and can easily be removed. The platinum electrode shown in Fig. 92 can be used in their place. A vertical rod rises from the ebonite base and carries the clamp for the muscle; it

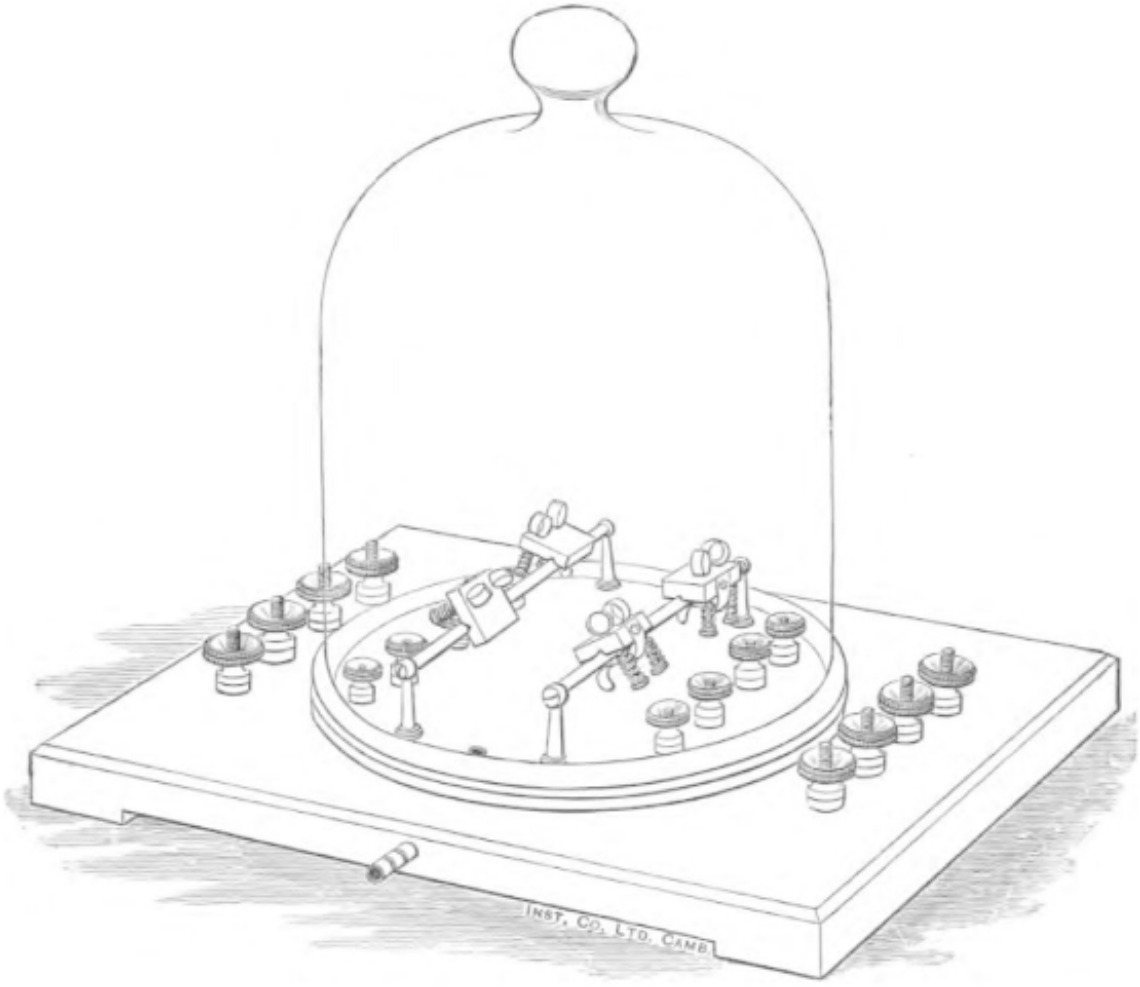


89

has a lateral and vertical adjustment. The writing lever is carried by a rod projecting downwards, and has a vertical adjustment. The tube passing through the base can be used for supplying moist air to the chamber. It is a useful instrument for demonstrations. Price complete, including Simple Stand ...
£6. 0s. 0d. *Agoing.*

90. **Moist Chamber.** *Students' pattern.* In this pattern the chief modifications are that a wooden base is substituted for the ebonite in No. 89, and the glass sides are supported by a wooden frame ... ... **£4. 0s. 0d.** *Agreeable.*

91. **Electrical Chamber.** This is a large Moist Chamber formed by a bell-glass resting on a wooden base. It has a contrivance similar to that above



91

described for supporting the Electrodes, but in this case four pairs can be used at the same time. Either Platinum Electrodes or Non-polarisable Electrodes can be



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used with the instrument. There is no muscle clamp or writing lever, as the Chamber is designed for studying the electrical properties of muscles and nerves. It is large enough to hold a frog lying between the supports for the Electrodes ...
£2. 15s. 0d. *Agriculture*

92. **Platinum Electrode** for use with the Moist Chamber ... **15s. 0d.** *Agrise.*

93. **Non-polarisable Electrodes** for use with the Moist Chamber. They consist of a piece of zinc wire connected to a short coil of insulated copper wire, and are ready to be inserted into the glass cannula containing the clay ...
per pair **1s. 6d.** *Aground.*

94. Cannulæ for above ... ... *per doz.* **7s. 6d.** *Ahead.*

Non-polarisable Electrodes.

95. Du Bois-Reymond's pattern ... ... *per pair* **£2. 10s. 0d.** *Aider.*

96. Burdon-Sanderson's do. ... ... do. **£1. 1s. 0d.** *Aigrette.*

97. Von Fleischl's do. ... ... do. **5s. 0d.** *Aimless.*

98. D'Arsonval's do. slightly modified do. **15s. 0d.** *Airbladder.*
See *Experimental Physiology*, Brodie, p. 83.

99. Zinc sulphate ... ... *per kilogramme* **1s. 6d.** *Airbuilt.*

Roy's Electrodes. These are made in two forms, one for use with cut and the other with uncut nerves, and are insulated by a vulcanite sheath. They can be applied to deep-seated nerves without risk of escape of current and without its being necessary to hold the surrounding tissues away from the nerve which is being stimulated.

100. For Cut Nerves ... ... **12s. 6d.** *Alack.*

101. For Uncut Nerves ... ... **£1. 8s. 0d.** *Alamire.*

102. **Electrodes for Deep-seated Nerves.** Ludwig's pattern ...
7s. 6d. *Amaurosis.*

103. **Platinum Electrodes.** Two stout copper wires with platinum points are enclosed in thick insulating sheaths; these are firmly bound together



and are connected to a pair of flexible connections by a simple and efficient arrangement which can be disconnected with ease ... ... **7s. 6d.** *Amazingly*

104. **Simple Muscle Lever,** with clamp for fixing to one of our Stands **10s. 6d.** *Ambsace.*

105. Do. do. for attachment to Adjustable Lever Support ... **14s. 6d.** *Amiable.*

106. Do. do. with Adjustable Lever Support complete **£1. 14s. 6d.** *Amition.*

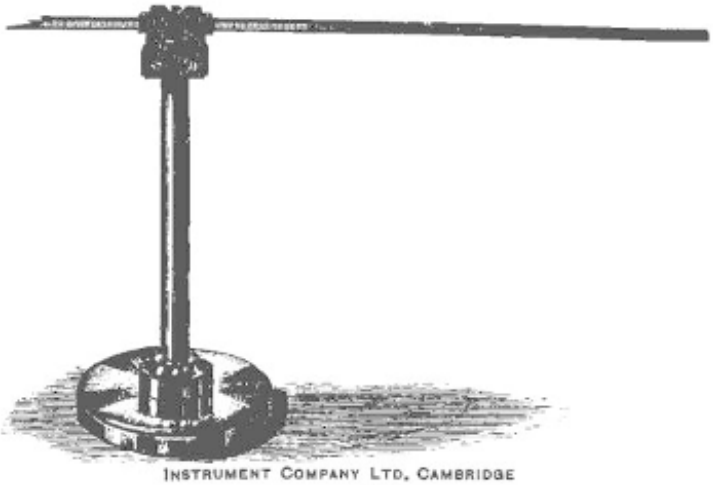
107. **Arrangement of Levers and Pulleys,** for recording the movements of the Mammalian heart. See *Experimental Physiology*, Brodie, p. 140 **£2. 5s. 0d.** *Amorosia.*

108. **Crank Myograph,** with screw for adjusting the horizontal arm of the bell-crank, wooden block supporting the cork table which is maintained at a constant temperature by means of water circulating in a small brass chamber. With clamp for attachment to one of our Simple Stands. See *Practical Physiology*, Stirling, 3rd Edition, p. 201 ... ... **£1. 10s. 0d.** *Applicor.*

109. Do. do. with Adjustable Lever Support **£2. 10s. 0d.** *Applique.*

110. **Frog Heart Lever.** A light lever made of wood rests on knife edges in steel supports. The lever can slide through the block supporting the knife edge, and thus the fulcrum can be placed at any point on the lever. The steel supports for the knife edges are fixed to the top of a brass rod fixed to a heavy foot ... ... **£1. 0s. 0d.** *Appositive*

111. Do. with arrangement so that the steel supports for the knife edges can be clamped to a Simple Stand instead of the stand shown ... **£1. 0s. 0d.** *Arboreous.*



INSTRUMENT COMPANY LTD, CAMBRIDGE

112. **Adjustable Lever Support,** to which may be attached writing levers, time markers, and many of the devices used in recording. It clamps on to one of our Simple Stands, and the adjustment permits the writing point to be applied to the recording surface with great accuracy and with the right amount of pressure by means of a slow motion screw. In Fig. 231 it is shewn supporting a Gaskell-Roy Tonometer; by removing a screw the Tonometer can be replaced by a Time Marker or other instrument ... ... **£1. 0s. 0d.** *Arboretum*

Muscle Forceps, for supporting a muscle and nerve preparation. A horizontal tubular arm clamps on the Simple Stand. A rod slides in this



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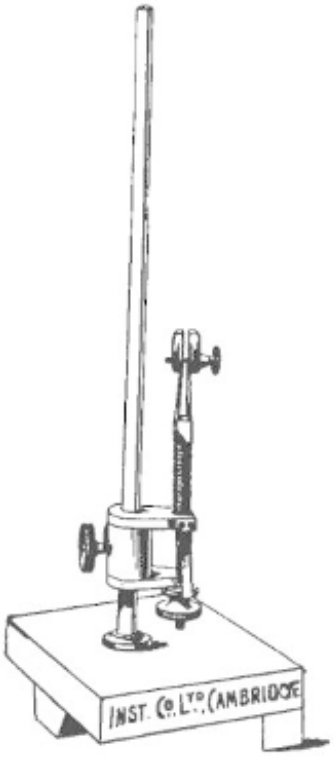
tubular arm and can be fixed in any desired position by a screw. If the rod be removed from the tube, it can be slipped into a hole running transversely to the horizontal arm and fastened in that position by the same screw. This gives great



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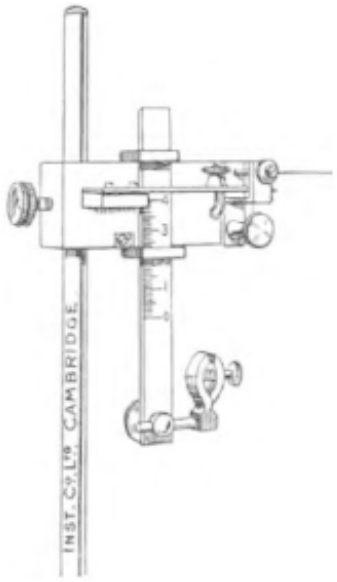

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power of adjustment. A small hole and set screw near the clamp can be used for holding a wire and making electrical connection.

113. With set screw for electrical connection ... ... **17s. 6d.** *Arborifon*

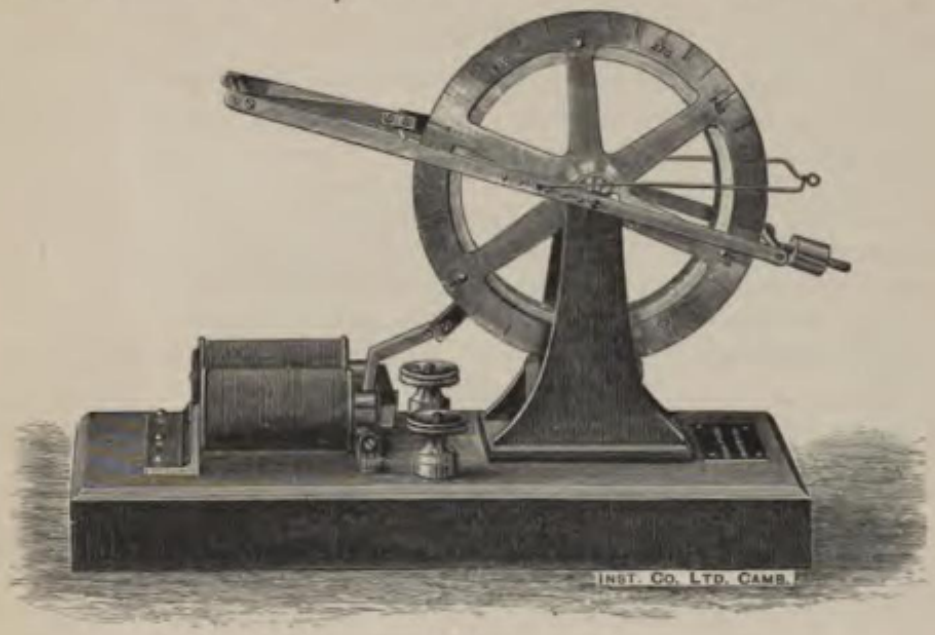
114. Without set screw ... ... **16s. 6d.** *Arcanum*

115. **Meyer's Tension Muscle Forceps** for use with large Frogs. These forceps can also be used with the Spring Myograph (Fig. 43). The jaws are larger and stronger than those shown in the illustration, and the tension on the muscle can be altered by means of a screw and divided scale ... **£1. 16s. 0d.** *Archaic.*

116. **Myotonometer.** This instrument was designed by Prof. Burdon-Sanderson, and is used for two distinct purposes, (1) As a Myograph, for obtaining so-called "isometric" myograms, (2) For obtaining a series of successive observations of the *tensions* of tetanized muscle and a second series of the *length* to which it is extended in each observation at the same moment. The two series taken together furnish the ordinates of its elasticity curve when in tetanus. One end of the muscle is held by a clamp, the other is attached to a spring. The distance between these can be varied at will and exactly measured. The spring is so stiff that when the muscle is tetanized, its length is scarcely altered. The small movement of the end of the spring is however visible when magnified by a lever and can be measured. By ascertaining the weight which when hung on the spring will produce a movement equal to that produced by the traction of the muscle, the force of traction (tension) of the muscle under the conditions of the experiment can be estimated ... ... **£3. 3s. 0d.** *Arduous*

117. **Fick's Arbeitssammler.** This instrument is arranged to measure the work done in raising a given weight by a muscle which is caused to contract by single induction shocks. A horizontal lever is moved by the contraction of the muscle which is firmly clamped at one end, a thread from its lower end connecting it with the lever at any desired distance from the fulcrum. On the same axis as the lever, but arranged to revolve independently of it, is a wheel loaded with a heavy lead rim, round the circumference of which is a scale, for measuring the amount the wheel has been turned. By removing some screws the heavy rim can be detached from the wheel and lowered into a cradle, in which position it does not touch the axle. When the muscle contracts the motion of the lever is transmitted to the wheel by a catch which is fixed to the lever itself. This movement of the wheel winds up a thread on a pulley fixed to its axis, and thus raises a weight attached to the thread. When the muscle relaxes the weight tends to make the wheel turn back to its original position ; this is prevented by a catch attached to the stand. The catch on the lever allows the lever to return to its original position ; both catches are made to slip freely over the wheel when it turns one way, but to grip it when it turns the other way. The armature of an electro-magnet is attached to the fixed catch ; it can thus be instantly thrown out of gear by closing an electrical circuit. The oscillating muscle lever is made of aluminium and is very light ; an

adjustable counterweight, shewn at the right in the engraving, allows it to be carefully balanced. The thread from the pulley on the axle supporting the weight



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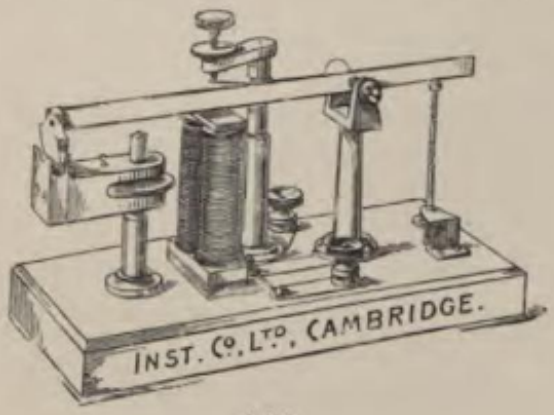
passes through a hole in the base; the table on which the instrument stands must have a corresponding hole to allow the thread to pass ... ... **£8. 0s. 0d.** *Arietta.*

See Fick, *Untersuchungen aus dem physiol. Labor. d. Zuricher Hochschule*, p. 5, Wien, 1869, also Hermann, *Handbuch der Physiologie*, p. 165, Vol. I.

118. **Heidenhain's Tetanometer,** for mechanically stimulating a nerve by a succession of rapid blows. An ebonite hammer rapidly beats the nerve which rests in a groove on a small ebonite anvil. It is driven by an electro-magnet in a similar manner to an ordinary electric bell. The force of the blows can be regulated



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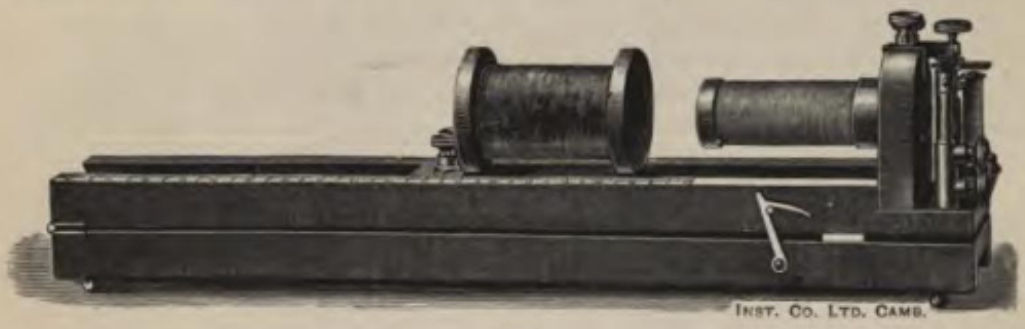
by moving the ivory anvil up or down, and their rapidity can also be altered. The instrument is fixed on a wooden base, which also carries the necessary terminals ...
£3. 0s. 0d. *Arming.*

119. **Mosso's Ergograph** *with Lombard's modifications.* By means of this apparatus the observer can study the process of fatigue on himself, the conditions that predispose to it, &c. The forearm is fixed by means of clamps upon an iron framework while the hand also is firmly fixed, the index and ring fingers being placed in hollow brass cylinders, while the middle finger is free. To the middle finger is attached a cord, passing to the writing-style, and to the latter is attached a weight, which can be varied. The experimenter bends the middle finger, lifts the weight, and then straightens the finger, repeating the process over and over again. See *Journal of Physiology*, Vol. XIII. pp. 3—5. Complete ... ... **£10. 0s. 0d.** *Armless.*

ELECTRIC.

Section 5.

Induction Coil. Du Bois-Reymond's pattern. The primary coil is fixed at the end of a wooden base board, and consists of a coil of thick copper wire wound round a bundle of soft iron wires. The secondary coil is wound on a wooden



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reel and slides in a channel formed in the base board, and can pass over the primary coil; its position can be read from a scale of millimetres fixed to the base. The base is made long and with a hinge in the middle; in the engraving it is shewn folded back on to itself; it is thus rendered more portable, and it can be conveniently used in this position when the whole length of the scale is not required. The hammer for automatically giving a series of induced currents is arranged so that it can be either used to absolutely break the current in the primary coil, or to short circuit it as in Helmholtz's method.

120. With 7000 convolutions of wire in secondary coil ... **£4. 10s. 0d.** *Armyworm.*

121. „ 10000 „ „ „ „ „ ... **£6. 10s. 0d.** *Aromatical.*

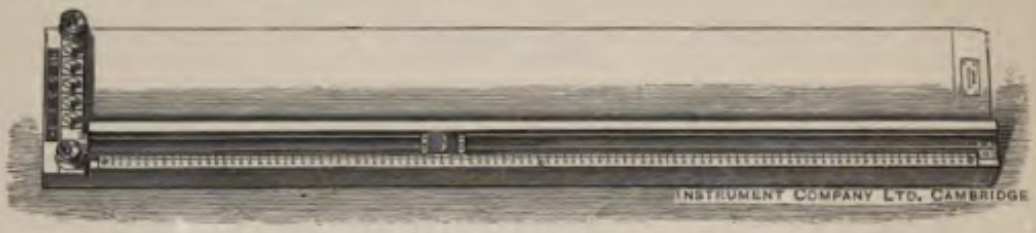
Induction Coil. Du Bois-Reymond's pattern as modified by Ludwig. In this form the secondary coil is fixed to a cord passing over a pulley and carrying a counterpoise. It slides vertically up and down a graduated bar, and moves very easily. See *Practical Physiology*, Stirling, 3rd Edition, pp. 167, 169.

122. With 7000 convolutions on secondary coil ... ... **£5. 0s. 0d.** *Arquifoux.*

123. „ 10000 „ „ „ „ ... ... **£7. 0s. 0d.** *Arras.*

124. **Du Bois-Reymond's Rheocord.** Two platinum wires are stretched by the side of a scale one metre long fixed to a board. These wires are electrically

connected together by an ebonite trough containing mercury which can slide along their length and the position read on the scale. The terminals are connected to



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one end of each of the platinum wires by means of brass plates. In one of these plates there are five pegs which can be removed like those of a resistance box, and various resistances thrown into circuit. The resistance of the Rheocord can be gradually increased from zero to a resistance equal to 42 metres of the platinum wire ... ... **£8. 10s. 0d.** *Arras*

125. **Round Compensator**; the Runder Compensator of Du Bois-Reymond. This is a convenient instrument for graduating to any extent the strength of a compensating or measuring current. It enables the resistance of a



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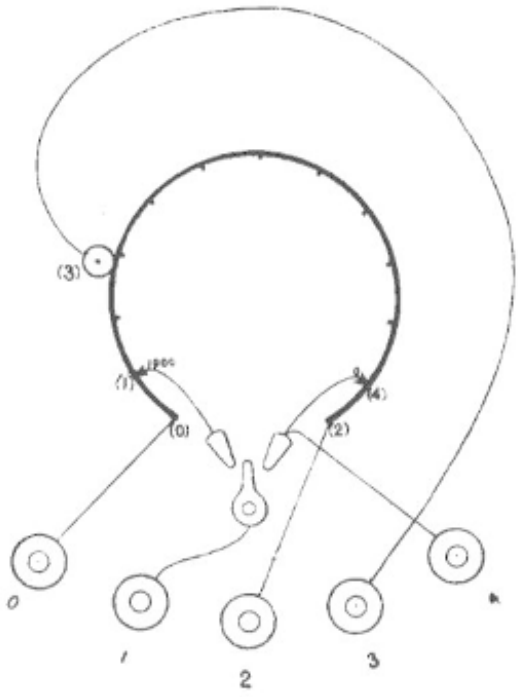
short circuit between the poles of a battery to be increased or diminished gradually, without the sudden changes that are occasioned when a box of coils is used ; thus the current passing through the main circuit is made to vary. A platinum wire rests in a groove in the edge of a disc of ebonite. A little platinum wheel makes

contact with this wire against which it is pressed by a spring. The disc can turn on a vertical axis and the angle turned through can be read from a divided circle on the top of the instrument; a microscope is fixed for reading the divisions. There are five terminals on the base, marked 0, 1, 2, 3, 4, and their connections to the different parts of the instrument are shown in the diagram ... **£15. 10s. 0d.** *Arraign.*



126. **Wheatstone's Rheostat.** An ebonite cylinder is fixed on a spindle which can be turned in its bearings by means of a handle. A groove forming the thread of a screw is cut on the outside of the cylinder. A German silver wire is wound round the cylinder in the groove, and as it projects above the surface of the cylinder it forms a screw with a projecting thread. A small wheel can rotate and slide on a rod parallel to the axis of the cylinder. It has a groove in its edge and it is pressed by a spring so that the wire is forced into this groove. When the cylinder is turned the wheel rotates and slides along the rod keeping in contact with the wire. One terminal is connected to the wheel and the other to one end of the German silver wire. The number of complete revolutions of the cylinder is read from graduations on the rod on which the wheel rotates and slides; and the parts of a revolution from a divided circle fixed to the cylinder ...

£4. 0s. 0d. *Arrivan*

127. **Rheostat for Students' use.** A fixed ebonite cylinder, mounted on a mahogany base, has a groove forming the thread of a screw cut on its outside surface. A Platinoid wire is wound round the cylinder in this groove; the ends of the wire being fixed to two terminals. A small contact-maker sliding along a brass

bar above the surface of the cylinder makes contact on the wire in whatever position it may be placed. This contact-maker is electrically connected with a terminal. The resistance can be varied from 0 to 25 ohms ... ... **£1. 0s. 0d.** *Arrogate.*



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128. **Fleischl's Rheonom,** for showing that it is the rapidity of the variations in the intensity of a galvanic current which excite a motor nerve. See *Practical Physiology*, Stirling, 3rd Edition, pp. 187, 188. ... **£1. 2s. 0d.** *Arrowroot.*

129. **Bernstein's Differential Rheotome,** for exciting a muscle or nerve at regular intervals and measuring the difference of potential at any two points in it at known short intervals of time after the excitement. At regular intervals an instantaneous current is sent through the primary coil of an Induction Coil, and at the required interval of time after this a separate circuit is closed for a short time. A vertical axis is driven by a pulley and cord from a suitable motor (p. 13); at every revolution the primary coil is closed by a steel pin passing over and just touching a piece of copper wire stretched radially to the axis between two insulated supports. One terminal on the instrument is connected to the copper wire; the other is connected to an annular trough round the axis, containing mercury; the steel pin is connected to the mercury by a wire moving round in the annular trough. The block carrying the copper wire can turn round a point concentric with the axis of rotation, so that contact can be made in various positions; the position can be read by a graduated circle on the base of the instrument. The terminals used for measuring the difference of potential are connected to two short troughs; these are filled so full with mercury that it projects up above their edges. Two other steel pins are carried by the rotating axle; they are insulated from the axis but connected together. They pass over and touch the surface of the mercury and thus electrically connect these troughs together. The relative position of these troughs can be altered so as to vary the length of time that they are put into electrical connection at each revolution ...
£10. 0s. 0d. *Arsenate.*

130. **Morse Key.** The key is of the usual design, and is mounted on an ebonite base. It has three terminals, one connected to the fulcrum of the lever, and the others to the platinum contacts under the ends of the lever. By moving a spring so as to make it press on the top of the lever it can be kept permanently down ... ... **£2. 7s. 6d.** *Arsenious.*

131. **Mercury Key.** The base is a wooden disc, at the centre of which is a small ebonite cup for the mercury. The lever consists of a thick copper wire which can be moved so as to dip into the mercury ... ... **15s. 0d.** *Artesian.*

132. Do. Cheap form. See *Experimental Physiology*, Brodie, p. 10. **7s. 6d.** *Artisan.*



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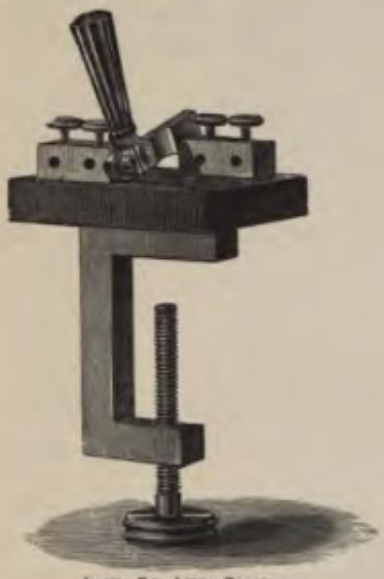

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Du Bois-Reymond's Friction Key. The base is of ebonite and is fixed to the table by means of a screw clamp. Two brass blocks are fixed to the base, with two terminals to each. A lever turns on a pivot in one of these; to close the key it is partially rotated and its end rubs over the face of the other brass block, completing the circuit.

133. Without table clamp ... ... **£1. 1s. 0d.** *Artistic.*

134. With table clamp (*see fig.*) ... ... **£1. 6s. 0d.** *Artlessly.*

135. Do. Cheap form. See *Experimental Physiology*, Brodie, p. 11. **10s. 0d.** *Artspun.*

Spring Key. A block of ebonite carries two terminals; one of these is connected to a horizontal brass spring. This spring is depressed by an ebonite knob, and closes the circuit by pressing against a platinum stud connected with the other terminal.

136. On ebonite ... ... **£1. 0s. 0d.** *Aruspex.*

137. Cheap form ... ... **6s. 0d.** *Asbestos.*

Galvanometer and Bridge Key, for measuring resistances. It is arranged to complete both the galvanometer circuit and the bridge and battery circuit in one operation. This is done in the right order to prevent the sudden throw in the galvanometer due to self-induction. Three flexible horizontal brass springs are fixed by one end to an ebonite base. The fixed ends carry terminals, and the free ends converge to a point over a platinum stud fixed to the base and connected to the fourth terminal. The springs are at different levels, and do not touch each other unless depressed. On depressing the top spring by means of an ebonite knob, its platinum contact point completes the battery and bridge circuit by pressing against the second spring just below it. The second spring carries a piece to insulate it from the third spring below it. When the depression is continued, the galvanometer circuit is completed by the third spring pressing against the platinum stud on the base.

138. Ebonite ... ... **£1. 5s. 0d.** *Ascaris.*

139. Cheap form ... ... **7s. 6d.** *Ascenden*

Plug Key. Two brass blocks are fixed to an ebonite base; they nearly touch each other, and a slightly conical hole is drilled so as to be partly in each block. When the plug is forced into this hole the two brass blocks are in electrical connection. Terminals are connected to each block.

140. One way ... ... **10s. 0d.** *Ashery.*

141. Two way with two plugs ... ... **17s. 0d.** *Ashtar.*

Porcelain Plug Key. In this key a fusible metal cup in a porcelain holder takes the place of the two brass blocks in the ordinary plug key. It is impossible for the key to work loose as so often happens in the ordinary key, and at the same time a better connection is made.

We are now fitting this type of plug to all our resistance boxes.

142. One way ... ... **16s. 6d.** *Ashy.*

143. Two way with two plugs ... ... **£1. 12s. 0d.** *Aspersio*

Brodie's Rotating Key, for eliminating the "make" and "break" shocks. See *Practical Physiology*, Stirling, 3rd Ed. 1895, p. 175.

144. With metallic contacts ... ... **£1. 7s. 0d.** *Asphodel*

145. „ mercury „ ... ... **£1. 5s. 0d.** *Asphyxy.*

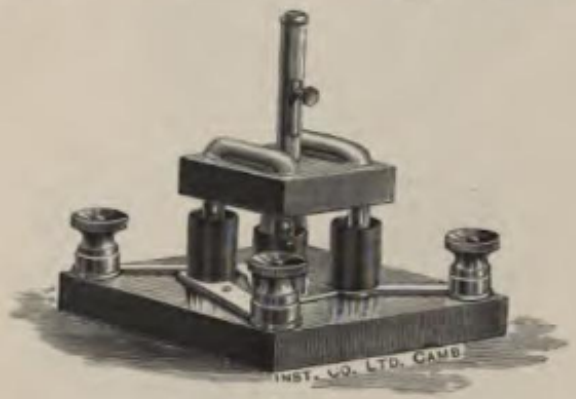
146. **Knock-Over Key.** A simple form of Key can be adapted to fix to the base of any of our Recording Cylinders. A projection fixed to the cylinder itself knocks the key open and thus breaks an electric circuit at a definite point in its revolution. This is useful for many experiments when the Recording Cylinder is used as a Chronograph ... ... **£1. 15s. 0d.** *Aspiring.*

147. **Marking Key,** designed by Professor De Burgh Birch. The key clamps on to our Simple Stand and is moved by hand and breaks an electric circuit; the same action moves a lever which marks the time on the smoked paper of a Recording Cylinder. The current remains broken after the hand has been removed ... ... **£1. 17s. 6d.** *Asquint.*

148. **Rocking Mercury Commutator,** simple form: the Wippe Commutator of Pohl. A circular wooden base has six metal mercury cups near its edge and at equal distances apart. A skeleton frame is formed of copper wire and has six feet, four of which can dip into four of the mercury cups at the same time, and connect them in pairs; the current then passes in one direction. By simply swinging the frame over, different connections are made and the current passes in the opposite direction ... ... **17s. 6d.** *Assail.*

149. Do. do. Very much improved, with large base, steel mercury cups, spring to hold the frame in a neutral position, &c. ... ... **£2. 2s. 0d.** *Assault.*

150. **Mercury Commutator.** The form shown in the engraving has an extremely small resistance, and may be used for large currents. It consists of an ebonite base with four terminals connected to four mercury cups. A block of ebonite carries two thick copper wires bent into the form of staples, which dip into the mercury cups, and connect them in pairs. By sliding the ebonite block up a



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brass rod fixed to the base, and by turning it through a right angle and lowering it again into the cups the current is reversed. If the copper wires are not lowered again into the mercury the current is permanently broken ... **£3. 5s. 0d.** *Assembling.*

151. **Astatic High Resistance Galvanometer.** This instrument is a Thomson reflecting galvanometer with a resistance of about 7,000 ohms and 30,000 convolutions. It is supported by three levelling screws. The suspension is extremely light; it consists of a small concave mirror with a focal length of about 3 feet; five small magnets are fixed to the back of the mirror. This mirror hangs in



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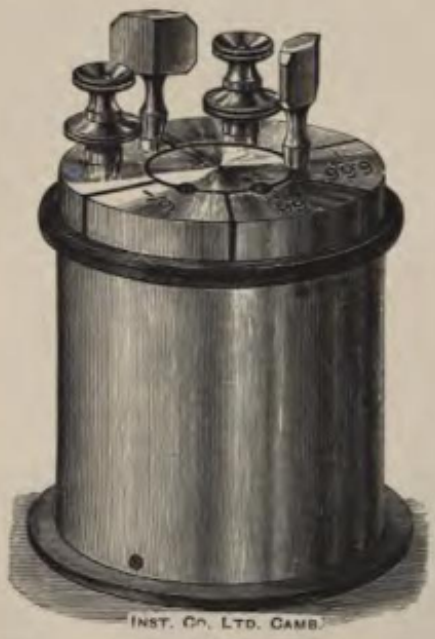
the centre of the upper pair of coils, and is connected by a strip of aluminium foil to a similar set of five magnets hanging in the centre of the lower coil. The upper

end of the fibre which supports the suspension is cemented to a pin capable of vertical adjustment and also of rotation; the pin with the fibre and suspension attached can be easily removed. The coils are fixed to two plates which turn on hinges at the bottom of the central plate. By simply removing two screws with milled heads the plates supporting the coils can be turned back and the suspension inspected or removed. This is useful as a means of demonstrating the internal arrangement. There are four terminals on the base, two for the upper pair, and two for the lower pair of coils. In order to give great sensibility the coils are wound with three sizes of wire, the finest wires being nearest the magnets. A record is kept of the resistance and of the number of convolutions in each coil.

There are decided advantages in using quartz fibres, instead of cocoon fibres, for the suspension; these can be supplied if required; see *Quartz Fibres*, p. 48.

£15. 0s. 0d. *Assentive.*

152. **Astatic Low Resistance Galvanometer,** similar to the High Resistance Galvanometer, except that the coils are wound with thick wire and can be made of any required resistance. Unless otherwise ordered coils with a resistance of 10 ohms are supplied. A record of the resistance and of the number of convolutions in each coil is kept ... ... **£14. 0s. 0d.** *Assessor.*



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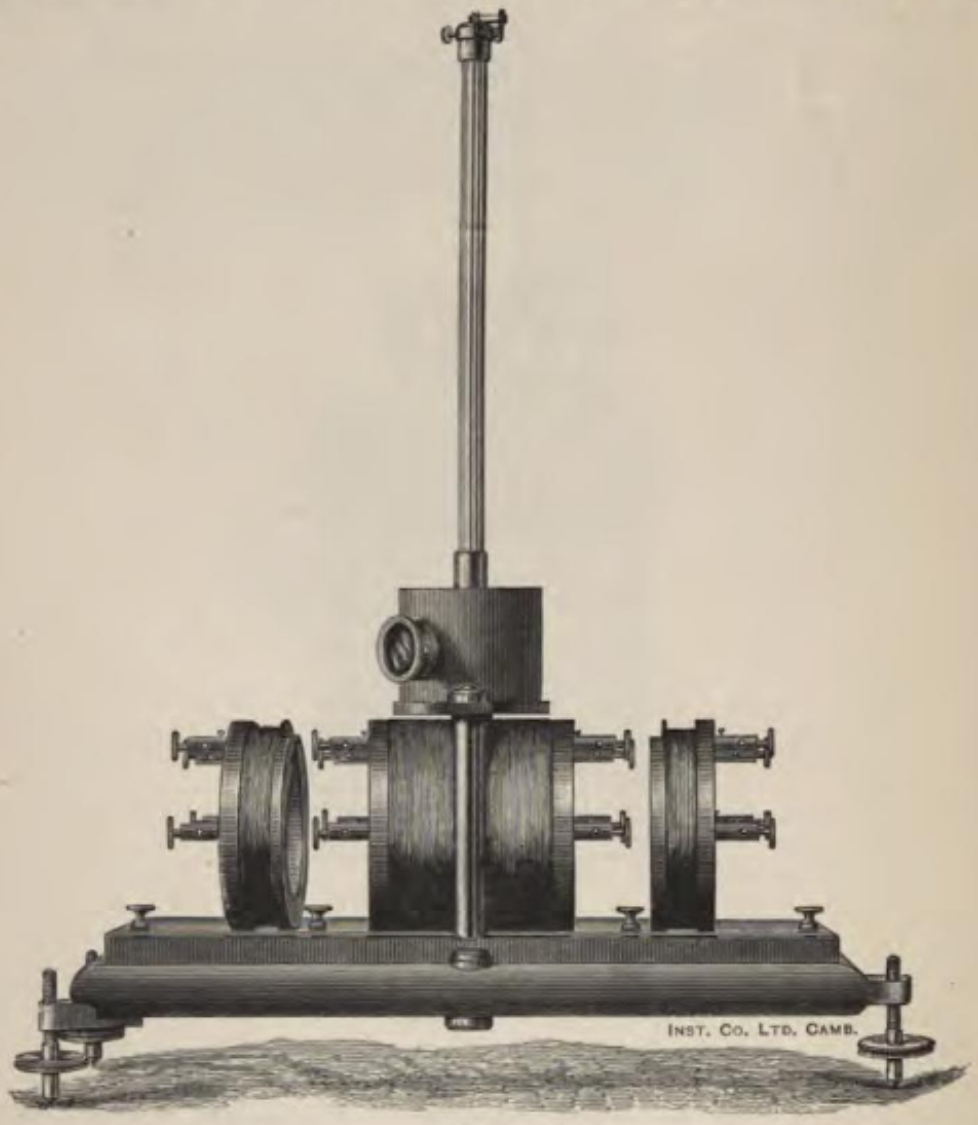
153. **Combined High and Low Resistance Galvanometer;** Astatic. This is a combination of the preceding instruments. The brass plates supporting the coils instead of turning on hinges fixed to the central plate, are capable of being easily removed. Two pairs of plates are supplied, one carrying the high and the other the low resistance coils. A record is kept of the resistance and of the number of convolutions ... ... **£20. 0s. 0d.** *Assiduous.*

154. High Resistance, not Astatic Galvanometer. It is in other respects similar to No. 151.

A record is kept of the resistance and of the number of convolutions ... ... **£12. 0s. 0d.** *Associo*

155. Low Resistance, not Astatic Galvanometer. It is in other respects similar to No. 152 ... ... **£10. 0s. 0d.** *Astridi*

156. Galvanometer. *Students' Pattern.* This instrument has been especially designed to supply the want of a cheap but reliable galvanometer. It is fitted with two coils of a total resistance of about 10 ohms, levelling screws, magnet control, &c. ... ... **£4. 4s. 0d.** *Astring*



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157. **Galvanometer Shunt.** This can be supplied with any of our Galvanometers, and contains three resistance coils of resistances equal to $\frac{1}{9}$, $\frac{1}{99}$, $\frac{1}{999}$ of the resistance of the galvanometer coils ... ... **£4. 0s. 0d.** *Astrologer.*

158. **Wiedemann's Galvanometer.** The magnet is in the form of a ring, which hangs in a chamber in the centre of a copper cylinder. This cylinder is fixed to a wooden base board which is supported by three levelling screws. There are four bobbins of wire supplied with the instrument, two of high resistance and two of low resistance; all four of these are shown in their place in the engraving, but only two are used at a time. When in their place, the bobbins enclose the copper cylinder, and they can be easily removed by moving them along a slide cut in the base board. The magnetised ring is connected by a strip of aluminium to a circular plane mirror, hanging in a brass box with a window in front. To render the needle astatic a separate piece of apparatus is supplied. It consists of a magnet which can slide along a bar which is clamped to the table in front of the galvanometer. A slow motion is also applied by means of which the magnet can be rotated through a small angle in a horizontal plane; by means of cords and pulleys this slow motion can be worked from a distance if desired. Price without cord and pulleys ... ... **£30. 0s. 0d.** *Astutely.*

159. **Sine Galvanometer.** The agate cup at the centre of a short magnet rests on the point of a needle at the centre of a divided circle, 175 mm. in diameter. A long pointer is fixed to the magnet by means of which the graduations are read. The coil is wound on a brass ring 230 mm. in diameter. This ring is cut into two parts and joined together again with blocks of ebonite in order to insulate the one half from the other. It is fixed to the divided circle so that the magnet is at its centre, the whole can turn in a ring standing on three levelling screws, and the angle of rotation about a vertical axis can be read from graduations on the ring ... **£15. 0s. 0d.** *Athwart.*

160. **Thomson Galvanometer-Lamp and Scale.** Polished mahogany, brass fitted lamp, adjustable slit. Sliding horizontal and vertical motions to scale ... ... **£2. 0s. 0d.** *Atlanta.*

161. Do. black hard wood ... ... **£1. 10s. 0d.** *Atlas.*

162. Extra for condensing lens in suitable mounting ... ... **3s. 6d.** *Atomist.*

163. Extra for rack and pinion zero adjustment ... ... **7s. 6d.** *Atrium.*

164. Extra for fitted case for above ... ... **8s. 6d.** *Atropia.*

165. **Galvanometer-Lamp and Scale.** A paraffin lamp with a large flat oil reservoir stands on a wooden base supported by three wooden screw-feet. The flame of the lamp is behind an adjustable slit. The scale is capable of movement along its length, and has a screen over it to cut off the extraneous light. A vertical adjustment is obtained by turning the three screw-feet ... **£2. 5s. 0d.** *Attainment.*

166. Do., do. *Students' pattern* ... ... **15s. 0d.** *Attaintu*

Our galvanometer scales are divided to millimetres; but special scales will be divided to order.

167. **Reading Telescope.** The Telescope has an object glass 32 mm. in diameter and 230 mm. focal length, and is fitted with a Ramsden eye-piece and cross wires. The method of focussing is the same as that used in our Cathetometers. The telescope is made to clamp on a vertical steel rod fixed to a cast iron foot **£5. 0s. 0d.** *Attest.*

Quartz Fibres, made by the method described by Mr C. V. Boys. They are used for supporting the suspensions in any instrument such as a galvanometer, in which the forces tending to rotate a light suspended body are to be measured. These fibres have the great advantage of being apparently perfectly elastic. They are supplied on frames each containing 6 or more fibres.

168. Frame containing fibres about 16 cm. long ... ... **5s. 0d.** *Attic.*

169. „ „ „ „ 30 „ „ ... ... **7s. 6d.** *Auction.*

170. „ „ „ „ 40 „ „ ... ... **10s. 0d.** *Auditing*

Stout quartz fibres for supporting weights up to 50 grammes are supplied at double the above prices.

BLOOD CIRCULATION.

Section 6.

171. **Frog Heart Clamp,** Dr Gaskell's pattern for clamping the heart in the auriculo-ventricular groove. It fits the Simple Stand. By turning a screw a sliding piece is gradually forced forward and the slit closed. A spring draws the sliding piece back when the screw is slackened. The edges of the slit are bevelled; and the whole instrument is gilt ... ... **£1. 15s. 0d.** *Augural.*



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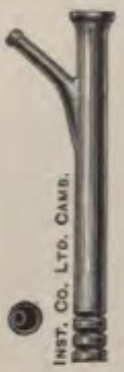
172. **Frog Heart Forceps,** Dr Gaskell's pattern, for the same purposes as the Frog Heart Clamp. The pieces forming the edges of the slit spring apart in the same manner as the points of an ordinary dissecting forceps. A screw is used to press the edges together ... ... **12s. 6d.** *Auletic.*

173. **Kronecker's Perfusion Cannula,** for supplying fluids to the interior of the frog's heart. It consists of a double tube, one outside the other; the end view is shewn in the engraving. The inner tube branches out to the left; thus when the ventricle is tied to the outer tube of the Cannula, a current of liquid can be made to pass into the heart by one tube and out through the other ... **5s. 0d.** *Aural.*



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174. **Ludwig's Arterial Cannula,** for making a connection with an artery. A slit is cut in the artery and a small plate which is fixed at the end of the cannula is passed through it into the inside of the vessel; a second plate is then forced down so that the wall of the artery is gripped between the plates and the slit closed. The pressure is given by a milled head turning on a screw cut on the tube itself. The plates are made of the same size and shape, and they are curved; when pressed together they form part of a tube the same size as the artery. The Cannula is thus in connection with the inside of the artery and the flow of the blood is not perceptibly obstructed. A lead tube can be used to connect the Cannula to any instrument. See *Methodik der Physiologische*, by E. Cyon, p. 48 ... **12s. 6d.** *Auricile.*

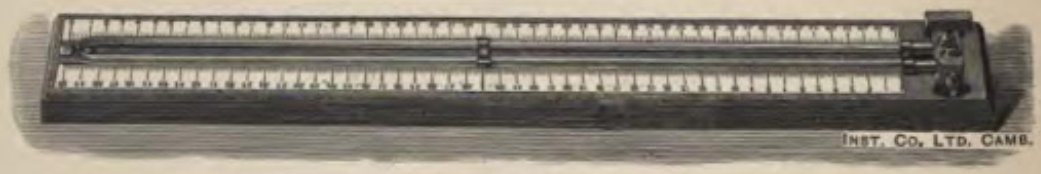
175. **Trachea Cannula,** three sizes, ... *each* **8s. 6d.** *Aurora.*

176. **Cannula for Gastric Fistula,** as described by Dr Lauder Brunton in his article on 'Digestion' see *Handbook for the Physiol. Laby.* Ed. by Prof. Burdon-Sanderson ... ... **15s. 0d.** *Auspicia*

177. **Glass Cannulae.** A set of 15 varying from ½ a millimetre in diameter to 8 millimetres ... ... *per set* **3s. 6d.** *Auspicio*

178. **Glass Osmometer Tubes,** Dr Lazarus Barlow's pattern. See *Journal of Physiology*, Vol. XIX. p. 421 ... ... *each* **2s. 6d.** *Austere.*

179. **Hæmodromometer of Volkmann.** The two ends of a glass tube bent into the form of the letter U enter a brass block; the inlet and outlet tube for making the connection with the artery also lead into the block. Two taps in the block are geared together so that one movement turns both of them; in one position there is a straight passage from the inlet to the outlet tube, and the openings to the glass tube are closed; if the taps are turned the straight passage is closed; and at the same time openings to the glass tube are made, so that there is a passage from the inlet to the outlet through the whole length of the glass tube. **£3. 10s. 0d.** *Australi*



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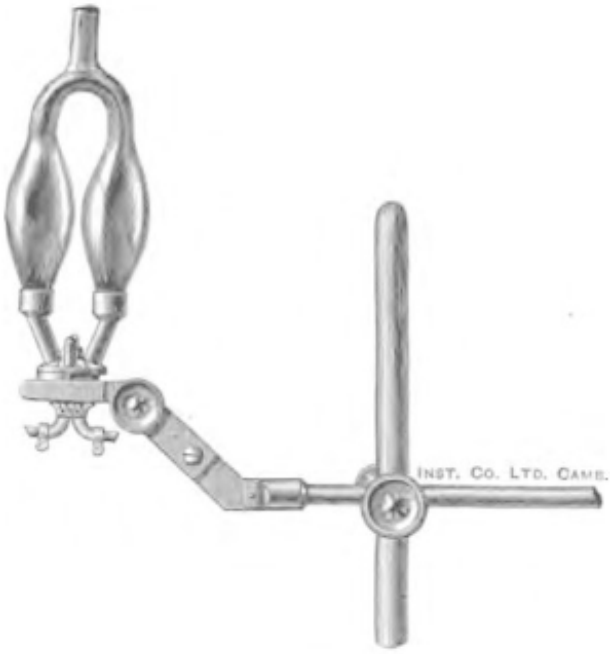
180. **Ludwig's Rheometer or Stromuhr,** for measuring the rate of blood-flow through an artery: with three sets of Cannulae for use with different

sized animals, handle for rotating the bulbs, &c. Complete. See *Text-Book of Physiology*, M. Foster, 6th Ed. p. 223 ... ... **£4. 17s. 6d.** *Authorism.*



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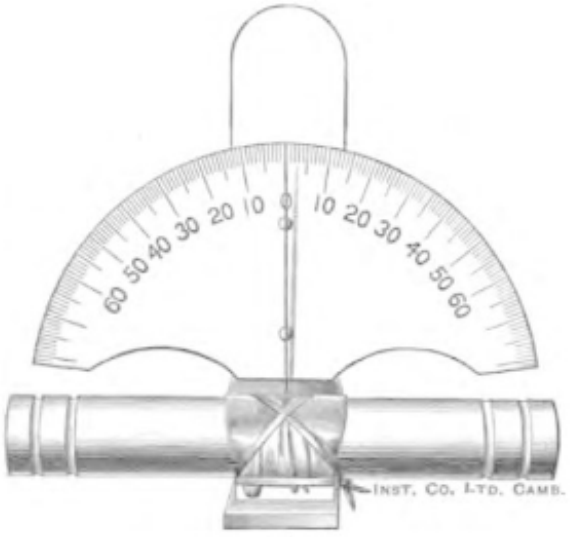
181. **Hæmotachometer of Chauveau and Lortet,** for measuring the blood current in an artery. A tube, the wall of which is at one point composed of an indiarubber membrane, is tied between the cut ends of an artery. A light lever pierces the membrane. The short expanded arm of this lever project-



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ing within the tube is moved on its fulcrum in the indiarubber membrane by the current of blood passing through the tube. The angular movement of the lever is read from the projecting arm of the lever on a graduated circle ... **£1. 5s. 0d.** *Authori*

182. **Ludwig's Mercury Manometer.** It consists of a glass tube bent into the form of the letter U. This is partially filled with mercury; the pressure is transmitted to one arm of it from the artery by means of a lead tube containing a liquid. The mercury in the other arm supports a float in the form of a piston nearly fitting the tube. A fine wire is fixed to the float and is guided by passing through a hole in a brass cap fitting over the mouth of the tube. The style or writing pen is fixed to the upper end of this wire. The float is now made in the improved method devised by Professor Anderson Stuart. The instrument is arranged to screw on to the Continuous Paper Kymograph (p. 3); or it can be screwed directly on to the table, and used to record on any Revolving Cylinder. See *Text-Book of Physiology*, M. Foster, 6th Ed. p. 207 ... ... **£3. 5s. 0d.** *Autocrat*



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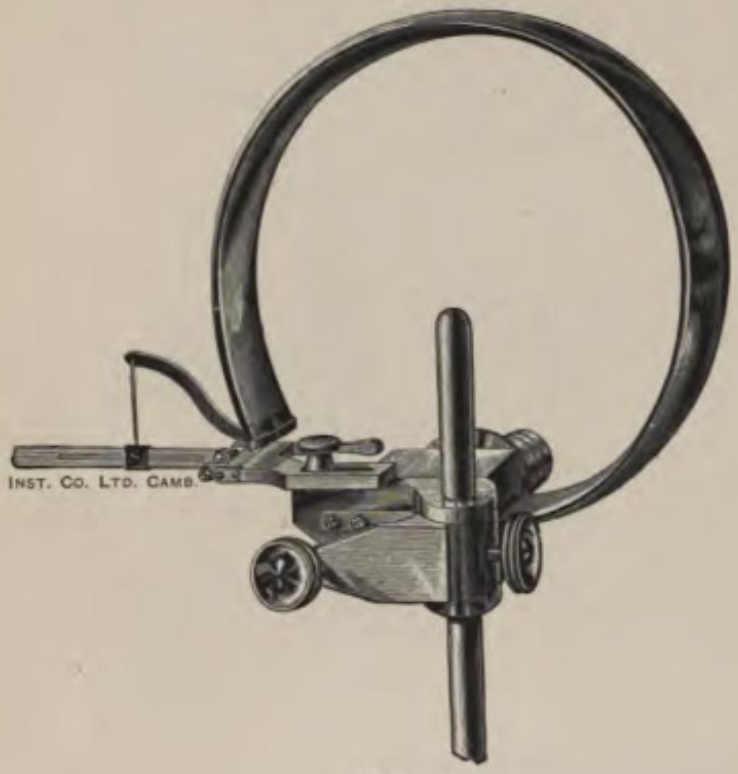
183. **Roy's Mercury Manometer.** It differs from Ludwig's form in two points; the wire from the float is guided at a point above the writing style; and the bore of the glass tube is smaller. By this means the inertia of the moving parts is reduced ... ... **£3. 15s. 0d.** *Autonom*

184. **Fick's Spring Manometer.** The pressure is transmitted from the artery by a tube containing a liquid to a flattened tube bent into the shape of



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the letter C. One end of the tube is fixed, and the effect of the pressure is to raise the other end and move the lever by means of a connecting link. Both the fulcrum of the lever and the point of attachment of the connecting link can be moved, thus allowing the ratio of the arms of the lever, and the movement of the writing point to be increased at pleasure. To clamp on one of our Simple Stands **£5. 0s. 0d.** *Availing.*

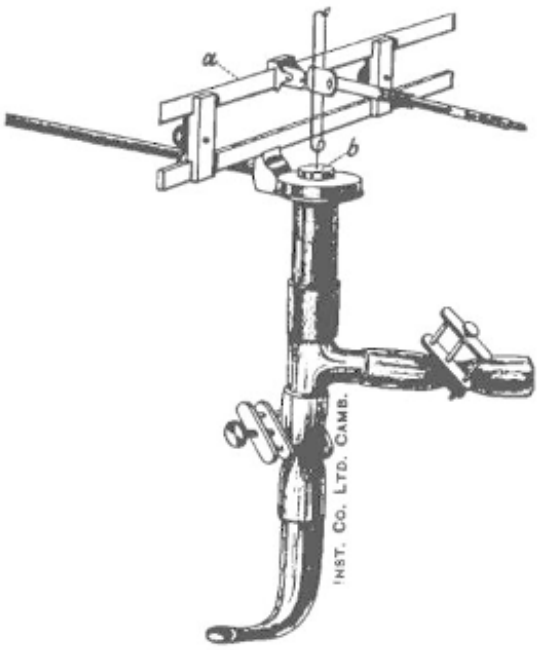
185. Do. If fitted with Adjustable Lever Support ... **£6. 0s. 0d.** *Avaunt.*

186. Do. Improved form, in which the movements of the manometer are communicated to a small air tambour. The latter can be connected in the usual manner with a writing tambour thus allowing the manometer to be some little distance from the recording drum ... ... **£6. 5s. 0d.** *Aversely.*

See *Text-Book of Physiology*, M. Foster, 6th Ed. p. 269.

187. **Torsion Manometer.** This instrument was invented by Professor Roy for recording such rapid and great changes of pressure as take place with the ventricles of the mammalian heart.

The movements of an ebonite piston (*b*) in a brass cylinder twist a strip of steel (*a*), and at the same time are magnified by a recording lever. The piston fits the brass



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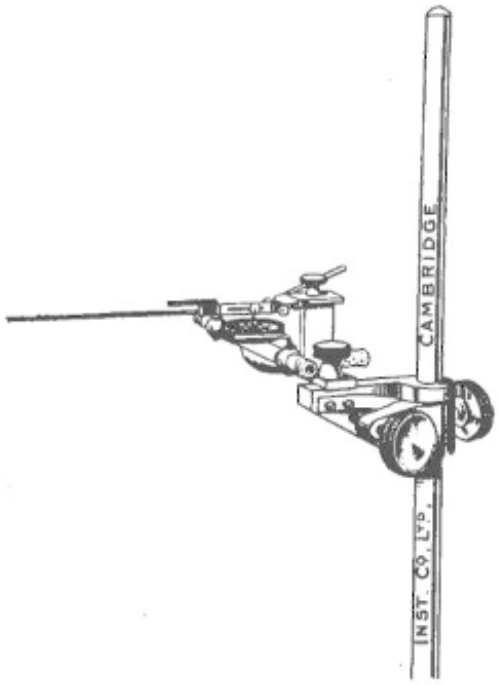
tube sufficiently closely to prevent escape of blood by the side of it, but not so closely as to cause appreciable friction.

The resistance to torsion by the strip of steel can be varied at will by changing the length of the strip. The glass tube at the lower part of the figure is introduced into the heart. An arrangement, not shown in the figure, is supplied to enable the instrument to be clamped to one of our Simple Stands. To find the values of the tracings given by this instrument it must be gauged after each experiment by means of a Mercurial Manometer, see Manometer with Compressor, p. 57. Also *Journal of Physiology*, Vol. VIII. p. 236 ... ... **£2. 10s. 0d.** *Aversion*

188. **Hürthle's Membrane-Manometer.** This consists of a very small tambour 15 mm. in diameter, somewhat like that of Marey, but hemispherical. A thin metal disc is fixed to the centre of a delicate elastic membrane and is connected to the lever in the usual manner. By partially closing the taps sudden oscillations can be reduced. A second motionless writing-style is attached for drawing the base line. To fit on to one of our Simple Stands ... **£3. 5s. 0d.** *Avoidles*

189. Do. with Adjustable Lever Support ... ... **£4. 5s. 0d.** *Avowal.*

See *Text-Book of Physiology*, M. Foster, 6th Ed. p. 244.



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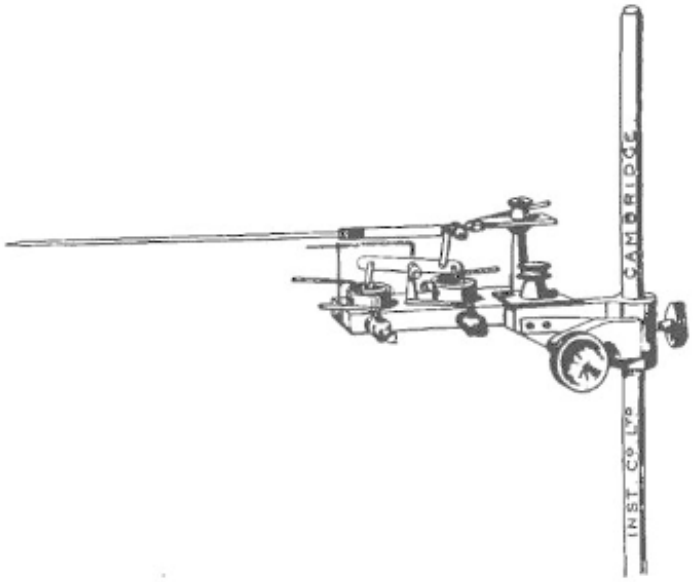

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190. **Hürthle's Differential Manometer** for indicating the differences of pressure between the ventricle and aorta. It consists of two membrane-manometers balanced one against the other. When the pressure in the two is equal

the lever arm is horizontal; any difference of pressure between the two leads to an upward or downward movement of the lever.

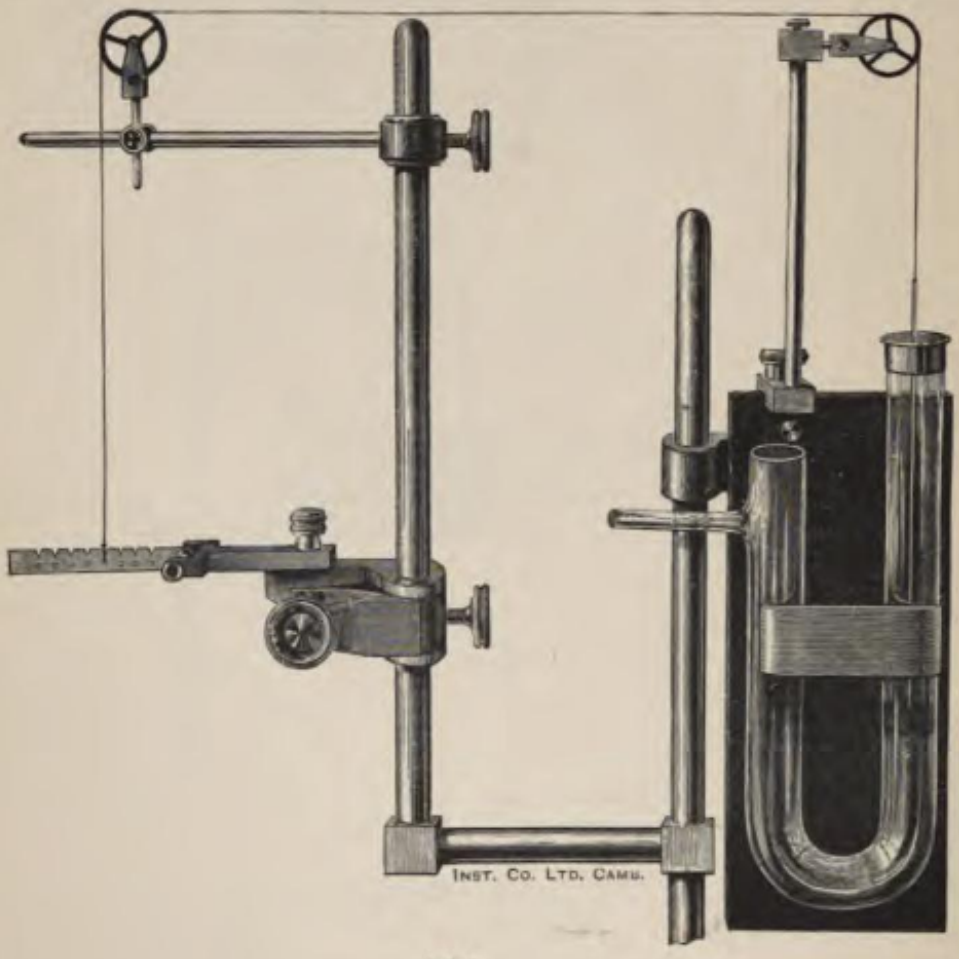
To fit on to one of our Simple Stands ... ... **£7. 5s. 0d.** *Avulsion.*

191. Do. with Adjustable Lever Support ... ... **£8. 5s. 0d.** *Awake.*

See *Text-Book of Physiology*, M. Foster, 6th Ed. p. 254.

192. **Mercury Manometer** for endocardial pressure in the heart of a Frog ... ... **£4. 10s. 0d.** *Awaking.*

193. **Water Manometer.** This instrument is the invention of Dr Milne Murray, and consists of a U-shaped glass tube which is fixed on a firm vertical support. The tube is partially filled with water. A cork floats in the tube and carries a fine wire which is guided by passing through a small hole in a brass cap over the mouth of the tube. The movement of the piston is transmitted



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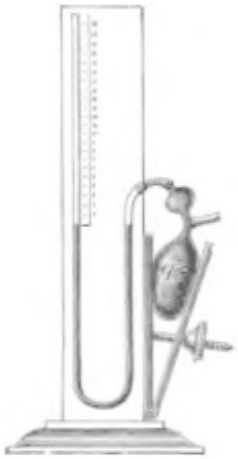
to the writing lever by a thread passing over two pulleys. The lever can be fixed to one of our Adjustable Lever Supports ... ... **£4. 10s. 0d.** *Awarding.*

194. If fitted with Adjustable Lever Support ... ... **£5. 10s. 0d.** *Awesome.*

195. **Manometer with Compressor.** This instrument is useful for giving a known pressure to the liquid contained in any instrument. It is used in connection with the Tonosphygmograph (p. 64), or for such a purpose as measuring the movement of the writing lever in Roy's Torsion Manometer (p. 53), or Fick's Spring Manometer (p. 53), which is produced by a definite pressure. The pressure is given by compressing an indiarubber ball between two flat surfaces by means of a screw. The tube from this ball branches into two tubes; one is used for making any desired connection and the other leads to the manometer, which consists of a U-shaped glass tube fixed to a board in an upright position and containing mercury. The pressure is given by the difference of level on the mercury in the two limbs of the glass tube ... ... **£2. 0s. 0d.** *Awhile.*



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Marey's Metallic Manometer. This instrument, which is exceedingly sensitive, indicates any changes of pressure by means of a mercury manometer and at the same time records these changes of pressure by means of a writing tambour. The divided scale is moveable to allow of adjustment to the zero of the manometer. See *La Circulation du Sang*, Marey, pp. 180—181.

196. Complete with our new pattern tambour No. 208 ... **£4. 10s. 0d.** *Awkwardly.*

197. Without writing tambour ... ... **£2. 12s. 0d.** *Awlshaped.*

198. **Ludwig's Sphygmograph** for Laboratory use with a Recording Cylinder. A frame of appropriate shape is bound to the wrist with ribbon. There is a long opening in the frame which enables the pulse to be felt with the finger when the frame is in its place. When the frame is approximately fixed in the right

position the piece carrying the recording part of the apparatus is clamped to it by means of milled headed screws. The clamping arrangement allows a certain amount of lateral movement, so that the button can be made to press on the artery at the required point without shifting the binding which holds the frame to the wrist. The button is fixed at the end of a spring, which can be adjusted to give the desired pressure on the artery. The movement of the spring is carried to the writing lever by a rack and pinion; the rack is a screw and the pinion a small worm wheel. The movement is greatly multiplied by this arrangement; there is no back lash, and there is a rapid rough adjustment as well as a fine adjustment for bringing the writing style to the required position. The writing lever is at right angles to the wrist, allowing the ordinary recording cylinder to be conveniently used. The writing style at the end of the lever is fixed to a very small and light piece which turns on an axis parallel to the axis of the lever ... **£3. 5s. 0d.** *Axestone.*

199. **Arm Rest for Ludwig's Sphygmograph.** When a record is being taken from the Sphygmograph the arm must be held in the right position, and kept perfectly still. The arm rests in a horizontal support fixed at the upper end of a rod; it is fixed to the table by a screw clamp and can be adjusted vertically. A handle carried by the rod can be adjusted in every direction and clamped in a convenient position to be gripped by the hand of the patient. **15s. 0d.** *Axiform.*

200. **Dudgeon's Sphygmograph.** In this instrument a small metal plate is kept pressed on the artery by means of a spring. The pressure, in ounces, on this spring is regulated by a graduated screw and cam. By means of a system of levers the vertical movements of the metal plate are converted into horizontal movements of a small style over a surface of blackened paper, the pulse movement being magnified fifty times. A small clock causes the paper to travel at a uniform rate. See *Text-Book of Physiology*, M. Foster, 6th Ed. p. 271 ... **£2. 12s. 6d.** *Axillar.*

Strips of glazed paper for the above ... ... *per* 100 **2s. 6d.** *Azote.*

„ unglazed „ „ ... ... „ „ **1s. 0d.** *Azurine.*

201. **Richardson's Modification of Dudgeon's Sphygmograph.** This instrument is similar to the Dudgeon Sphygmograph with the addition of an arrangement of rollers by means of which broken horizontal lines are marked across the smoked paper. The clock-work is so arranged that each break follows the preceding at a distance of 2 mm. See *Experimental Physiology*, Brodie, pp. 166, 167 ... ... **£2. 17s. 6d.** *Baboon.*

Strips of glazed paper for the above ... ... *per* 100 **2s. 6d.** *Baccate.*

„ unglazed „ „ ... ... *per* 100 **1s. 0d.** *Bacchano*

202. **Marey's Sphygmograph,** directly recording on a strip of smoked paper ... ... **£5. 5s. 0d.** *Bacillum*

Strips of prepared paper for the above, glazed ... ... *per* 100 **2s. 6d.** *Backban*

„ „ „ „ „ unglazed „ „ **1s. 0d.** *Backbitin*

203. **Marey's Sphygmograph,** adapted for transmitting the pulse movements to a distance ... ... **£2. 5s. 0d.** *Backboard*

204. Do. as modified by Chapman. In this instrument it is very easy to replace the rubber membrane ... ... **£3. 15s. 0d.** *Backdoor.*

205. **Teske's Pocket Sphygmograph.** This is a very simple and sensitive instrument which can easily be carried in the waistcoat pocket **£3. 7s. 6d.** *Backed.*

206. **Sphygmomanometer,** as designed by Prof. von Basch **18s. 0d.** *Bacon.*

207. **Gas Sphygmoscope.** See *Outlines of Practical Physiology,* Stirling, 3rd Ed. p. 295 ... ... **£1. 2s. 0d.** *Baddish.*

208. **Marey's Tambour, Improved Pattern,** in which the rubber membrane can be easily changed ... ... **£2. 0s. 0d.** *Badgering*

209. Do. with Adjustable Lever Support ... ... **£3. 0s. 0d.** *Badgers.*

210. **Marey's Tambour, Cambridge Pattern.** It possesses the following advantages: the quantity of air contained is very small; the indiarubber can easily be replaced, and it is very simple. The body is made of a thin piece of ebonite and slips on to our Simple Stands, and is clamped by a simple arrangement not shewn in the figure. The indiarubber membrane is held between a metal plate and the ebonite; by removing four screws the plate comes off, and the membrane can be replaced ... ... **10. 6d.** *Badness.*



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211. **Marey's Tambour, Original Pattern.** The indiarubbber membrane is tied over the mouth of a shallow brass vessel. An aluminium plate is fixed to the centre of the membrane and carries the connecting rod to the writing

lever. The vessel and the point of attachment of the connecting rod to the lever can be adjusted sideways, this allows the multiplication of the writing lever to be



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altered. The fulcrum of the lever can also be moved up and down; by this means

the lever is placed exactly horizontal. The Tambour clamps on to the Simple Stand ... ... **£1. 16s. 0d.** *Baggage.*

212. With Adjustable Lever Support ... ... **£2. 16s. 0d.** *Baggy.*

213. **Set of Marey's Tambours,** consisting of a receiver and transmitter of the original pattern, with 2 metres of indiarubber tube. Complete **£3. 12s. 6d.** *Bailage.*

214. Do. of the Improved Pattern ... ... **£4. 0s. 0d.** *Baked.*

215. Do. of the Cambridge Pattern ... ... **£1. 2s. 6d.** *Balanite.*

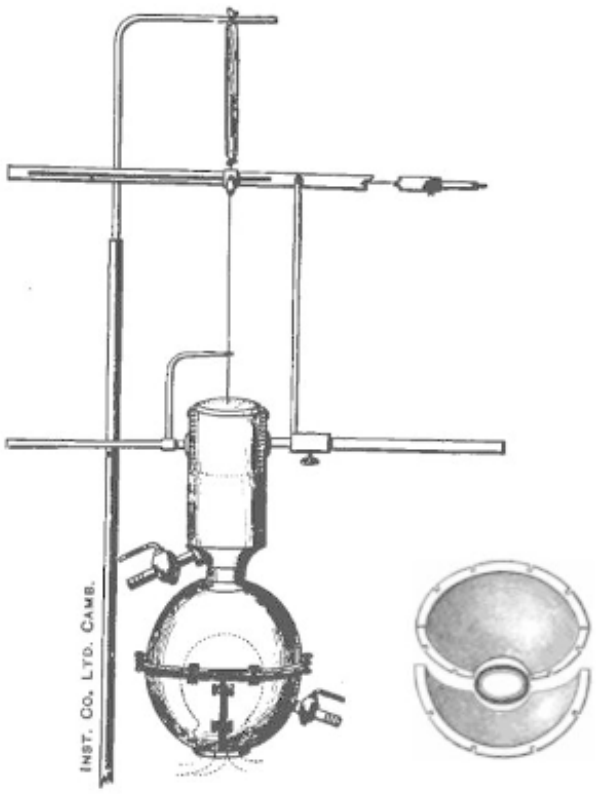
216. **Cardiograph,** Professor Burdon-Sanderson's pattern. A Marey's Tambour (p. 59) is required for recording the movements of this instrument. It is connected by a tube to a drum covered with a flexible membrane forming part of the Cardiograph. This drum is fixed mouth downwards to a small tripod stand with adjustable screw legs. This rests on the wall of the chest and is held in that position by a band passed round the body. The legs are enlarged at their lower ends where they rest on the surface of the chest. The tripod is lowered by the screw legs till an ivory knob attached to a spring presses on the skin over the heart. A pin attached to the ivory knob transmits its motion to a metal plate fixed to the membrane over the drum, and thus the air is expelled at each movement ... ... **£2. 10s. 0d.** *Balconies.*

217. **Marey's Cardiograph,** latest pattern ... **£1. 5s. 0d.** *Baldpate.*

218. **Cardiograph,** for recording the heart movements of very small animals. By means of two tambours the movements are considerably magnified. See *Practical Physiology*, Stirling, 3rd Ed. p. 308 ... ... **£1. 5s. 0d.** *Balefully.*

219. **Cardiometer,** for the Mammalian Heart. This instrument was designed by Professor Roy and Professor J. G. Adami to record graphically the changes in volume of the mammalian heart which result from the contractions and expansions of its walls. In principle it is an Onkograph. The heart is introduced into a rigid walled box containing warm olive oil. The pericardium is clamped to the edge of the aperture in order to prevent the escape of the oil by the side of the large vessels at the root of the heart. The changes in volume of the heart are recorded by a piston and lever arrangement like that of the Onkograph (p. 69). The pressure of the oil in the box can be reduced below the atmospheric pressure so as to resemble the normal conditions of the heart. See *British Medical Journal*, Dec. 15, 1888 ... ... **£16. 0s. 0d.** *Ballast.*

220. Do. if fitted with automatic counter to electrically count the beats of the heart, see *Phil. Trans. Roy. Soc.*, 1892, Series B, pp. 199—298 ... ... **£20. 0s. 0d.** *Ballflower*



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221. **Myocardiograph,** for the Mammalian Heart. This instrument was designed by Professor Roy and Professor J. G. Adami to obtain tracings of the contractions of any part of the mammalian heart wall. It consists of an arrangement for recording the distance between any two points on the heart wall without the tracing being affected by the movements of the heart as a whole. See *The Practitioner* of Feb. 1890 ... ... **£4. 15s. 0d.** *Balloonist.*

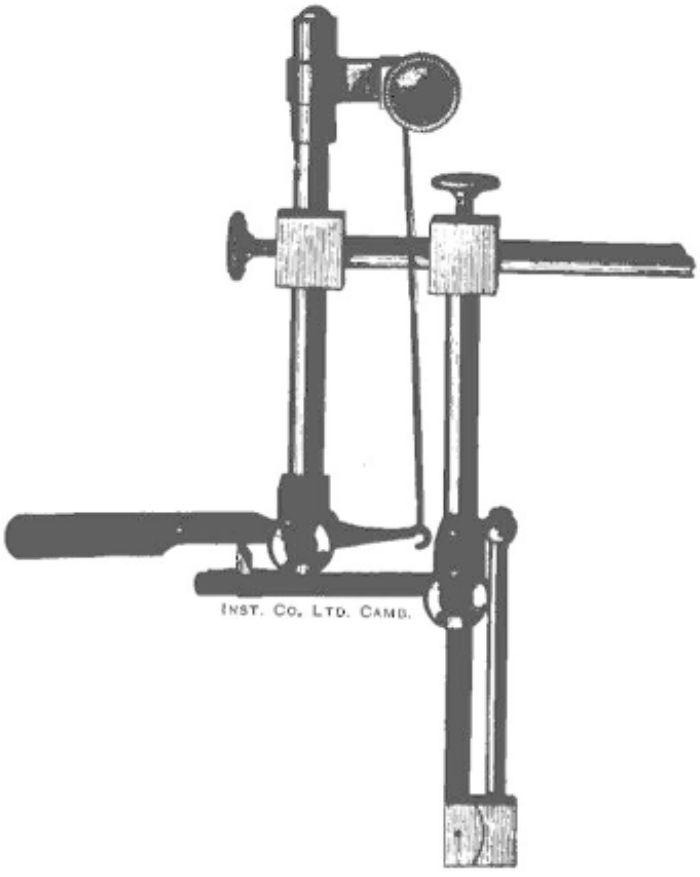
222. **Knoll's Polygraph, Cambridge pattern.** This apparatus is so arranged that two tracings can be taken simultaneously on the same drum. It can be used to record simultaneously cardiac impulse and a pulse tracing, or respiratory movements and a pulse tracing, or two pulse tracings.

It consists of a drum 10 cm. in diameter driven by clockwork making a revolution in one minute, a time marker beating seconds, two Marey registering tambours, a tambour to be fixed over an artery and an indiarubber bag which can be strapped

to the body for studying the respiratory movements, and a sphygmograph. Complete with case ... ... **£9. 0s. 0d.** *Ballater.*

Prepared paper per roll ... ... **9d.** *Balister.*

223. **Arteriograph,** Dr Milne Murray's Design. This instrument records the pulse in an artery which has been neither tied nor opened. The artery passes between two ivory blocks which are pressed together by a spring, and are shewn at the bottom of the engraving. One of these is concave towards the artery and is fixed to a rigid vertical rod; the other is convex and is fixed to the vertical arm of a bell-crank lever. As the pressure in the artery varies, the bell-crank turns about the fulcrum, and a knife edge near the end of its horizontal arm moves up and down. This vertical motion is multiplied by a horizontal writing lever recording on a revolving cylinder. The apparatus is supported by a horizontal rod, shewn to the right in the figure ... ... **£3. 3s. 0d.** *Balkers.*



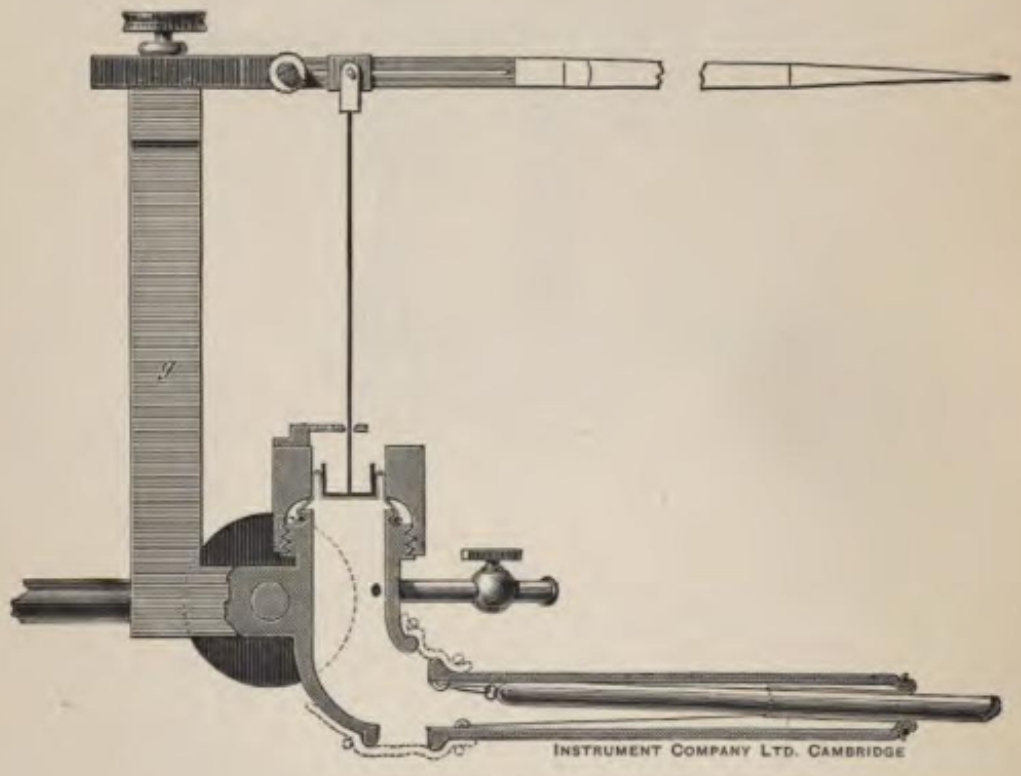
223

224. **Testing Machine for Animal Tissues.** This instrument was designed by Professor Roy to investigate the properties of the arterial wall.

A curve is obtained in which the abscissæ are proportional to the weight applied to stretch the strip of tissue, and the ordinates are proportional to the elongations produced by the weights. The surface on which the curves are recorded is moved by hand or by clockwork and pulls with it a weight which slides along the recording lever, the height of whose point corresponds with the length of the strip of tissue experimented on. It is a convenient arrangement for demonstrating to a class that the elasticity curve of animal tissues is a hyperbola. See *Journal of Physiology*, Vol. III. p. 125 ... ... **To order.** *Bamboozl*

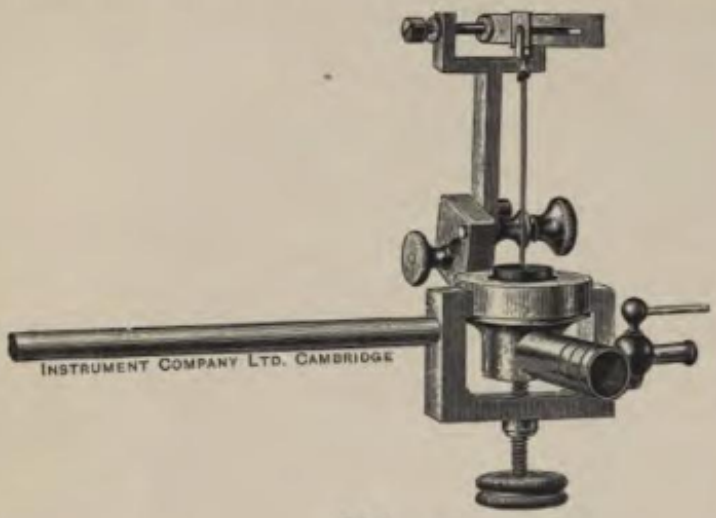
225. **Tonosphygmograph.** This instrument was designed by Professor Roy. It is used to obtain tracings either of the changes in volume of a short piece of the unopened artery or the changes in pressure of the blood within an artery. A very light piston attached to a recording lever rests on a column of fluid which is in communication with either the interior of a small tube-shaped box enclosing the artery, or directly with the interior of the artery. The tube containing the artery is made in a separate piece; it can be made of various sizes if desired, one size only is usually supplied with the instrument. The Manometer with Compressor (p. 57) is used with this instrument. See *Journal of Physiology*, Vol. II. p. 70

£3. 10s. 0d. *Bananas.*



225

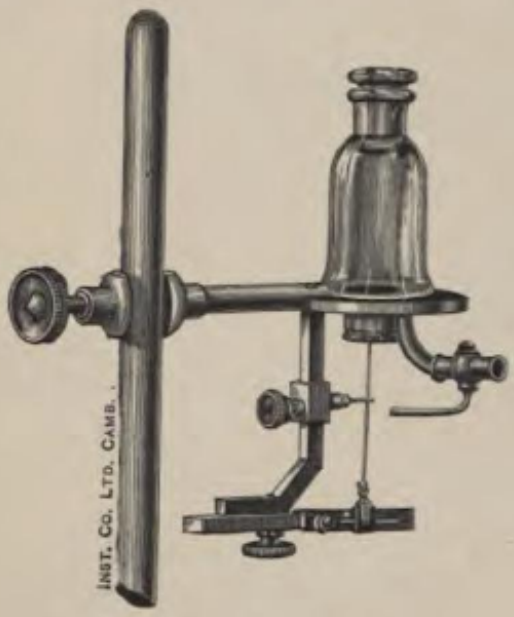
226. **Pulse Tonograph,** Professor Roy's design. This instrument resembles the Tonosphygmograph, and is used for similar purposes. The flexible



226

membrane is however not tied in its place, but the method described in the Onkograph is adopted (p. 69) ... ... **£3. 10s. 0d.** *Bandanna.*

227. If fitted with Adjustable Lever Support ... ... **£4. 10s. 0d.** *Bandeaux.*



228

228. **Tonometer or Frog Cardiograph.** This instrument was designed by Professor Roy. It gives graphic records of the changes in volume of the ventricle or auricles of the frog or other cold-blooded animal of about the same size, the pressure of the blood contained in the heart being regulated at will. It consists of a small glass vessel which contains olive oil, and is closed below by a piston attached to a lever which consequently moves as fluid enters or leaves the vessel. The top of the vessel receives a glass stopper, and a Kronecker's Perfusion Cannula (p. 49) is cemented into a hole passing through the stopper. The heart is fastened to the Cannula and introduced into the glass vessel. With each contraction of the heart the lever is moved proportionally to the volume of blood expelled through the Cannula. See *Journal of Physiology*, Vol. I. p. 452. Price without Cannula **£2. 12s. 6d.** *Bandele*

229. If fitted with Adjustable Lever Support ... ... **£3. 12s. 6d.** *Bandeli*



231

230. **Gaskell's Modification of Roy's Frog Cardiograph or Tonometer.** This instrument was designed by Dr W. H. Gaskell. It differs from the Cardiograph above described in being arranged to allow of the frog's heart being immersed in normal saline solution instead of oil. See *Journal of Physiology*, Vol. III. p. 50 ... ... **£5. 0s. 0d.** *Bandico*

231. If fitted with Adjustable Lever Support ... ... **£6. 0s. 0d.** *Banditti*

232. **Schäfer's Heart Plethysmograph.** An apparatus for recording and measuring the changes of volume of the contracting frog's heart.

The instrument consists of a horizontal glass tube connected through a stopcock to a small glass vessel in which the heart is suspended. The vessel and part of the

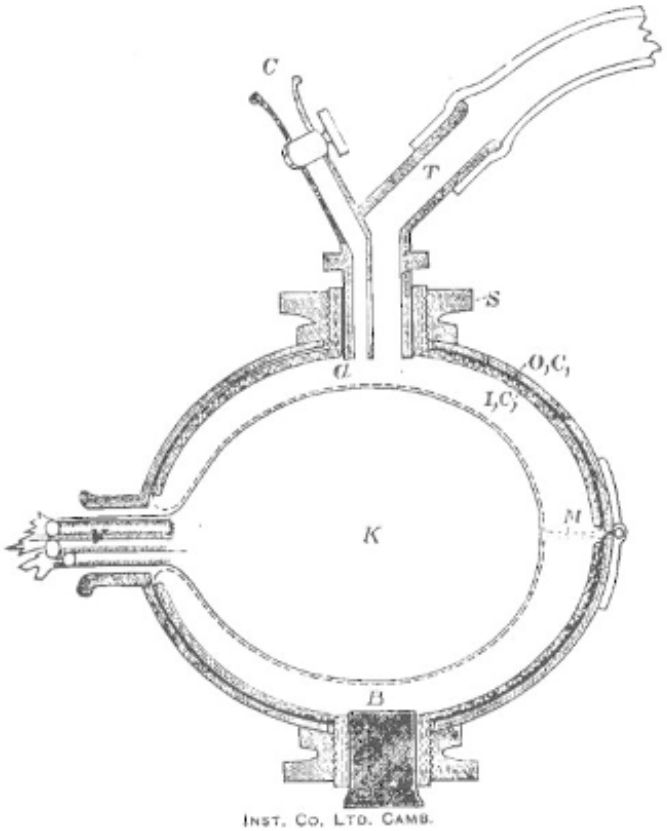
tube are filled with oil, and a light piston fits the tube. The movements of the piston record the change of volume of the heart by means of a style fixed directly on the piston rod which writes on the smoked paper on a cylinder. A perfusion cannula (see p. 49) is fixed in the hollow stopper of the vessel and supplies the heart with blood. See *Journal of Physiology*, Vol. v. p. 130. Price without Cannula ...
£1. 15s. 0d. *Bandog.*

233. **Williams' Frog Heart Apparatus.** See *Archiv f. experimentelle Pathologie u. Pharmakologie.* Vogel, Leipzig. Vol. XIII. Oct. 1880 ...
£3. 3s. 0d. *Bandyleg.*

Onkometers. Professor Roy's design.

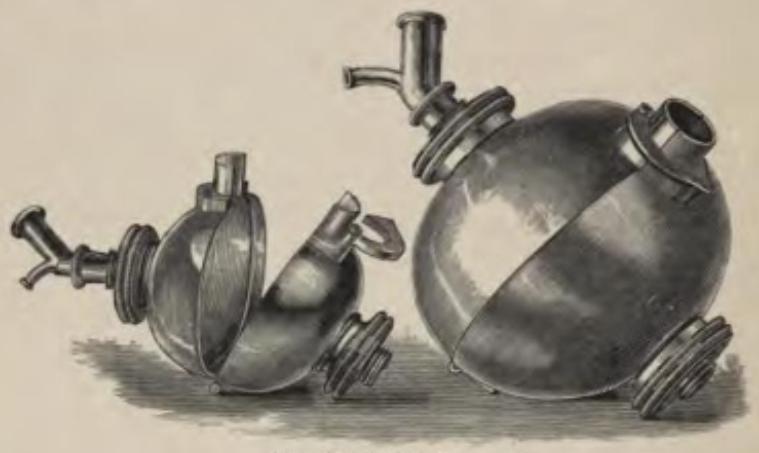
These instruments are used to measure the variation in volume in a living organ. A metal box made in various shapes and sizes to suit the kidney or spleen can open by a hinge along one side; it closes round the organ, but leaves a passage for the connecting vessels and nerves to enter the box. The space in the box not occupied by the organ contains oil; when the organ increases in size some of the oil is forced out of the Onkometer, and is carried by a tube to the Onkograph, which measures and records the amount of the change in volume. See *Journal of Physiology*, Vol. III. Nos. 3 and 4.

The method by which the oil is prevented from leaking out of the box is



explained by the engraving and description taken from *Text-Book of Physiology*, 1891, by Professor M. Foster, 5th Ed. p. 658.

Renal Onkometer. Seen in section (semi-diagrammatic). *K*, Kidney, *V*, Vessels and nerves imbedded in fat, &c., entering hilus of organ, *O,C*, and *I,C*, outer and inner metal capsules screwed together by the screw *S*, and holding between them the edge of the membrane *M*, which applies itself to the surface of the kidney, and forms with the metal capsule two chambers, *a* and *B*, one of which (*B*) is closed by a plug filling the opening *B*, while the other (*a*) communicates by a tube *T* with the recording instrument. The other opening *C* (which is closed by a small tap) is for the purpose of filling the chamber *a* with warm oil, after the kidney has been



235 234



236 (Open)

placed in the box, the other chamber *B* having been previously partly filled, the quantity introduced into it depending upon the size of the kidney.



236 (Closed)

234. **Onkometer for the Kidney,** Large Size suitable for a Dog **£3. 5s. 0d.** *Banisters.*

235. Do. do. Small Size, suitable for a Rabbit ... .. **£2. 15s. 0d.** *Bankable.*

236. **Onkometer for the Spleen,** Large Size, suitable for a Dog **£5. 0s. 0d.** *Banneret.*

237. Do. do. Small Size, suitable for a Rabbit ... ... **£2. 10s. 0d.** *Bannition.*

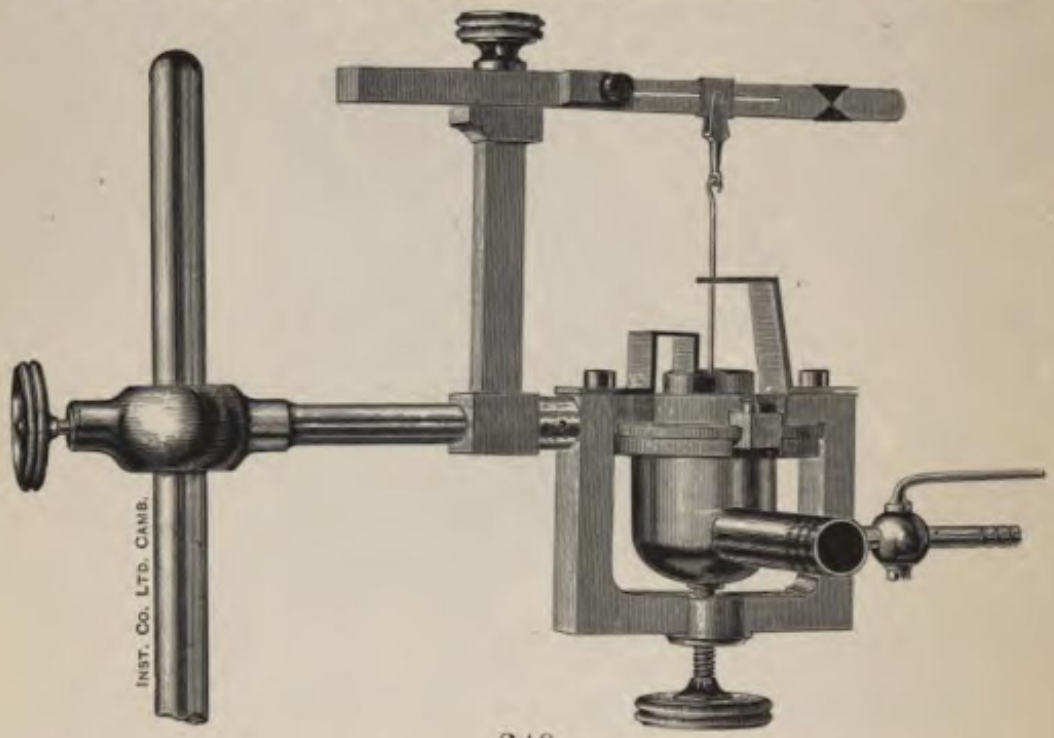
Air Onkometer, for use with a Marey's tambour. This consists of a brass bowl with plate-glass window, as used by Schäfer and Moore in their experiments upon the Spleen. See *Journal of Physiology*, Vol. xx. p. 5.

238. For the Kidney ... ... **£2. 2s. 0d.** *Banns.*

239. For the Spleen ... ... **£2. 2s. 0d.** *Banshee.*

240. **Onkograph.** This instrument was designed by Professor Roy. It is used in connection with the Onkometer and for other purposes. When the organ in the Onkometer changes in size, oil flows to or from the Onkograph, and moves a piston. The amount of the movement of the piston is thus a measure of the change of the volume of the organ. The difficulty of obtaining a frictionless piston without any leak has been overcome by the use of a delicate animal membrane. The cylinder is

made in two parts; the lower part can be removed by slackening the milled headed screw shewn at the bottom of the engraving. A piece of membrane is then placed



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between the two parts and they are clamped together again. A light piston passes down the cylinder without touching its sides. The membrane is loose and very thin and flexible; it thus forms a fold between the sides of the piston and cylinder, and prevents leakage without producing perceptible friction. See *Journal of Physiology*, Vol. III. p. 205 ... ... **£4. 0s. 0d.** *Banterer*

241. If fitted with Adjustable Lever Support ... ... **£5. 0s. 0d.** *Banyan.*



242

242. **Plethysmograph for Dog's Leg.** Professor Roy's pattern. It consists of a brass tube of elliptical section, into which the leg of the dog is placed. The opening of the tube is connected with the dog's leg by a piece of dried intestine which is glued to the leg and tied on the end of the tube. Two tubes leave the instrument at the other end; one of these is closed by a tap, and is used for filling the space round the leg with oil, and the other is used to make the connection with the Onkograph ... ... **£1. 5s. 0d.** *Baptism*

243. **Plethysmograph,** as designed by Prof. Mosso to shew the changes of blood-pressure in the hand and arm.

The apparatus consists of a glass cylinder closed at one end into which the arm is inserted; the cylinder being suspended in order that the involuntary movements of the body may not cause any displacement of the arm. The opening round the arm is closed with sheet indiarubber and vaseline and the cylinder filled with warm water. The closed end of the cylinder communicates with a special manometer which records the changes of volume in the arm. See *La Circulation du Sang*, Marey, 1881, pp. 366, 7.

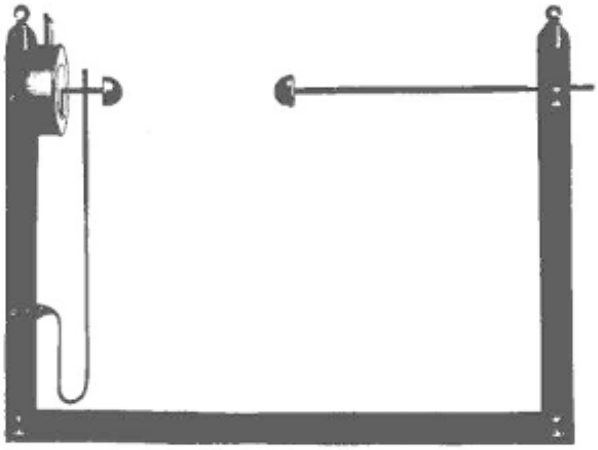
Complete with manometer ... ... **£7. 5s. 0d.** *Baptistic*

244. Cylinder with necessary indiarubber, suspension &c. **£2. 15s. 0d.** *Baptizab*

245. **Gad's Pneumatograph,** for continuously recording the volume of air in the thorax of a rabbit during respiration. The record is made on a Revolving Cylinder by a lever turning on a horizontal axis. A square shallow box is fixed to the axis of the lever and turns with it. Its mouth is downwards and dips into water which thus closes it; the air expelled from the lungs is led into this enclosed space and lifts the box out of the water and turns the lever; when the air is withdrawn the lever falls again. The walls of the box are made of mica and are extremely thin and light. A counterweight is arranged to balance the weight of the box. The pressure of the air required to move the box is imperceptible; and the movement of the writing style is proportional to the volume of air passing into the box. See *Archiv für Anatomie und Physiologie*, Du Bois-Reymond, p. 181, 1879 ... ... **£5. 15s. 0d.** *Baptizare*

246. **Recording Stethometer,** Professor Burdon-Sanderson's Pattern. A Marey Tambour is connected by a tube to a drum covered with a flexible membrane forming part of the Stethometer. A metal plate fixed to the centre of the membrane is moved by any change in the length of the selected diameter of the chest. Two ebonite knobs are adjusted so as to press against the body at the ends of the diameter; one of these knobs is at the end of a rod fixed in a rigid frame; this rod is capable of longitudinal adjustment to suit the size of the chest. The other knob is opposite and is fixed at the end of a screw passing through the end of a spring. The drum is fixed to a frame and the point of the screw presses on the metal plate of the membrane. By turning the screw the pressure on the metal plate can be adjusted. Any increase in the distance between the knobs forces air from the Marey Tambour. The instrument is supported on the neck of the patient

by a band hooked to the ends of the frame. See *Handbook for the Physiological Laboratory*, Burdon-Sanderson, p. 291, 1873. Price without Tambour **£2. 10s. 0d.** *Baptizing*



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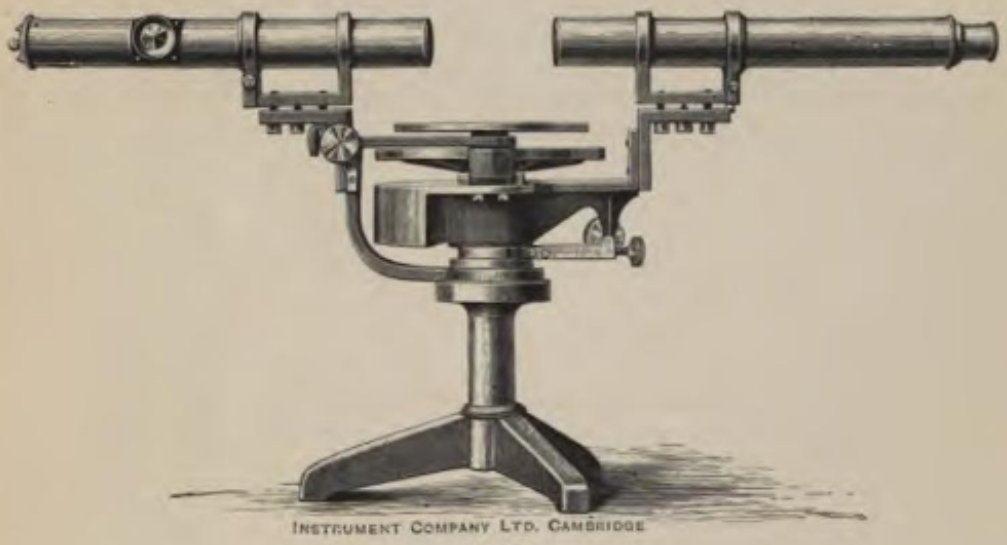
247. **Marey's Pneumograph.** A Marey Tambour is connected by a tube to a drum covered with a flexible membrane forming part of the Pneumograph. This drum is fixed to a flexible steel plate; when the plate bends, a system of levers compresses the membrane on the drum, and air is sent along the tube to the tambour. The instrument is supported from the neck of the patient, and is then bound to the body so that the steel plate is pressed against the wall of the chest. The tambour thus records changes of curvature of the wall of the chest at the selected point. See *La Circulation du Sang*, Marey, 1881, p. 709. Price without recording tambour ... ... **£2. 10s. 0d.** *Barbacan.*

See also Kymoscope for demonstrating many of the phenomena of the circulation designed by Prof. Anderson Stuart, p. 118.

SPECTROSCOPES AND BLOOD ANALYSIS.

Section 7.

248. **Spectrometer,** arranged for working with a prism or a grating. The circle is graduated into divisions of 20′, and is 152 mm. in diameter; it is arranged so that the divisions are in the same plane as those of the verniers attached to the moving parts, thus securing accuracy in reading. The circle has two series of divisions, one on the outer and one on the inner edge. The angular movement of the telescope is read by two verniers from the divisions on the outer edge, the angular movement of the table supporting the prism by two verniers from the inner edge of the divided circle. The verniers read to 1′; the telescope has an aperture of



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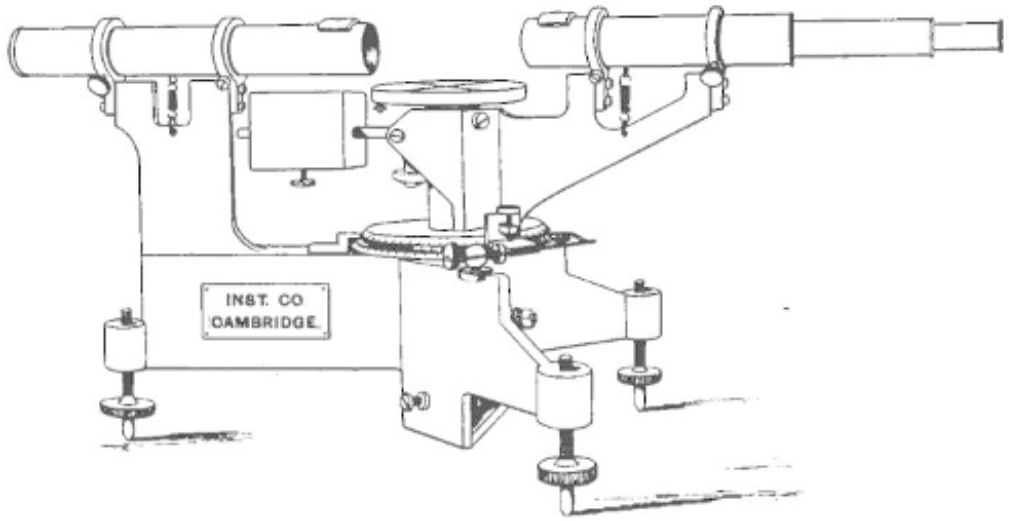
32 mm. and a focal length of about 280 mm. The line of collimation of the telescope can be placed parallel to the circle by means of adjusting screws. The collimator has the same aperture and focal length as the telescope, and can also be placed parallel to the circle. The telescope and collimator have each a rack and pinion motion for focussing. The width of the slit can be accurately adjusted by a fine threaded screw with a milled head ... ... **£30. 0s. 0d.** *Barbaric.*

249. **Spectrometer.** Our own Design. It is of great rigidity, the bearings being geometrically arranged so that the movements are perfectly free, unconstrained and without shake. The collimator is fixed to a firm cast-

iron tripod stand forming the base of the instrument and having screw feet. A vertical steel tube carries the prism table and turns in geometrical bearings in



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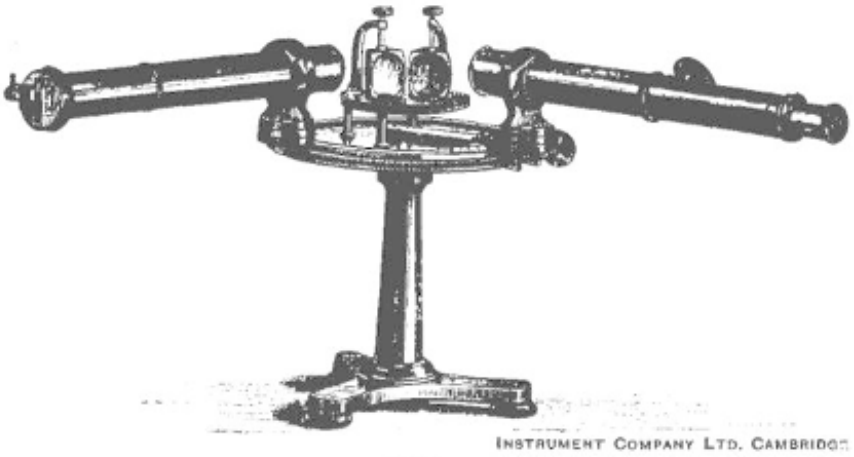
the base. The divided circle is fixed to this steel tube ; the telescope is held in a cast-iron frame having geometrical bearings turning on the steel tube. As the divided circle is concentric with the outer surface of the steel tube, the telescope and prism rotate truly and independently about an axis passing through the centre of the divided circle. The telescope and collimator are focussed by sliding the object-glass in the manner used in our Cathetometer ; the object-glasses are 35 mm. in diameter and 280 mm. focal length. The telescope and collimator are capable of adjustment in order to set them parallel to the prism table. The circle is 152 mm. in diameter and the verniers read to 1′, and are arranged so that their surfaces are at the same level as the divisions on the circle. The circle has two series of divisions, and there are two pairs of verniers for reading the two motions. The telescope and prism table can each be clamped and there are two slow motion screws for giving the final adjustment. The prism table can either take a prism or grating, and is capable of adjustment by means of three screws ... ... **£27. 10s. 0d.** *Barbar*

250. A small table standing on three screw feet for supporting the prism or grating is a useful addition to the instrument, and can be made of any size that may be required ... ... *from* **£1. 1s. 0d.** *Barbar*

251. **Spectroscope,** for comparing the spectra from two sources of light. The slit can be adjusted to the required width by a fine threaded screw. One source of light is placed directly in front of the slit, and the other at one side, and the light reflected in the required direction by a small internally reflecting prism. The prism can be turned so as to send the light in the required direction, and the comparison spectrum formed by it can be varied in width. The collimator has a lens 32 mm. in diameter and is focussed by a sliding tube. Two prisms are supported on a small table which can rotate about an axis concentric with a

divided circle 200 mm. in diameter. The telescope has an object-glass of 32 mm. in diameter, and is focussed by a rack and pinion. Vernier reading to 1′ of arc. The



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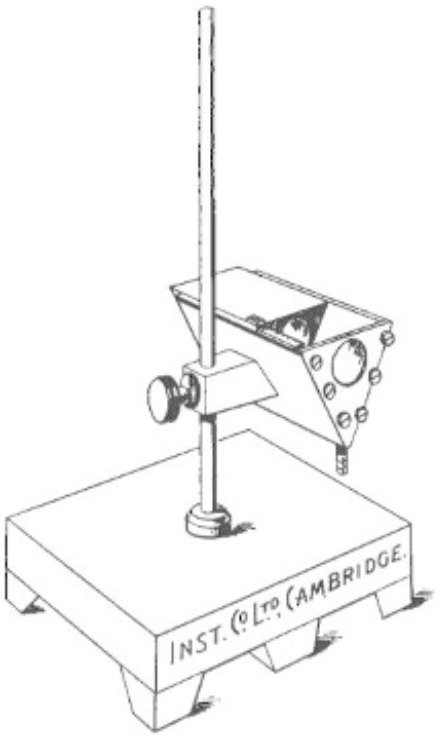
tangent screw for giving the final adjustment to this motion is in a convenient form, it is instantly ready for use without moving a clamping screw, and does not interfere with the quick movement. The prisms are made by Steinheil of Munich. The instrument can be used with either one or two prisms as required ... ...

£18. 0s. 0d. *Barbel.*



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252. **Spectroscope Cell or Absorptiometer.** Our own Design. The Spectroscope Cell described in our former catalogue was not satisfactory; it was difficult to fix the glasses parallel to each other and troublesome to clean them. In the new design there is no packing whatever. It consists of a brass trough with one end closed by a piece of glass, in this trough slides a brass block in the form of a triangular prism making a water-tight joint with the sides of the trough. A circular hole is drilled through the whole length of the brass block and one end is closed by a glass plate. The liquid is placed in the trough and enclosed between the two glass plates, one at the end of the trough and the other at the end of the hole through the sliding triangular prism. The prism slides along the trough and the thickness of the liquid under examination is varied; the thickness of the liquid is read by means of a scale fixed to the trough. If the rubbing surfaces are covered with a little vaseline before using, the joint is perfectly water-tight. A cover-plate slides over the liquid to prevent dust falling in, or, if blood is under examination, to prevent coagulation. It is quite easy to remove the brass block and clean the glasses. The instrument fits on to one of our ordinary vertical support stands which is supplied with it ... ... **£3. 18s. 6d.** *Barbellat*

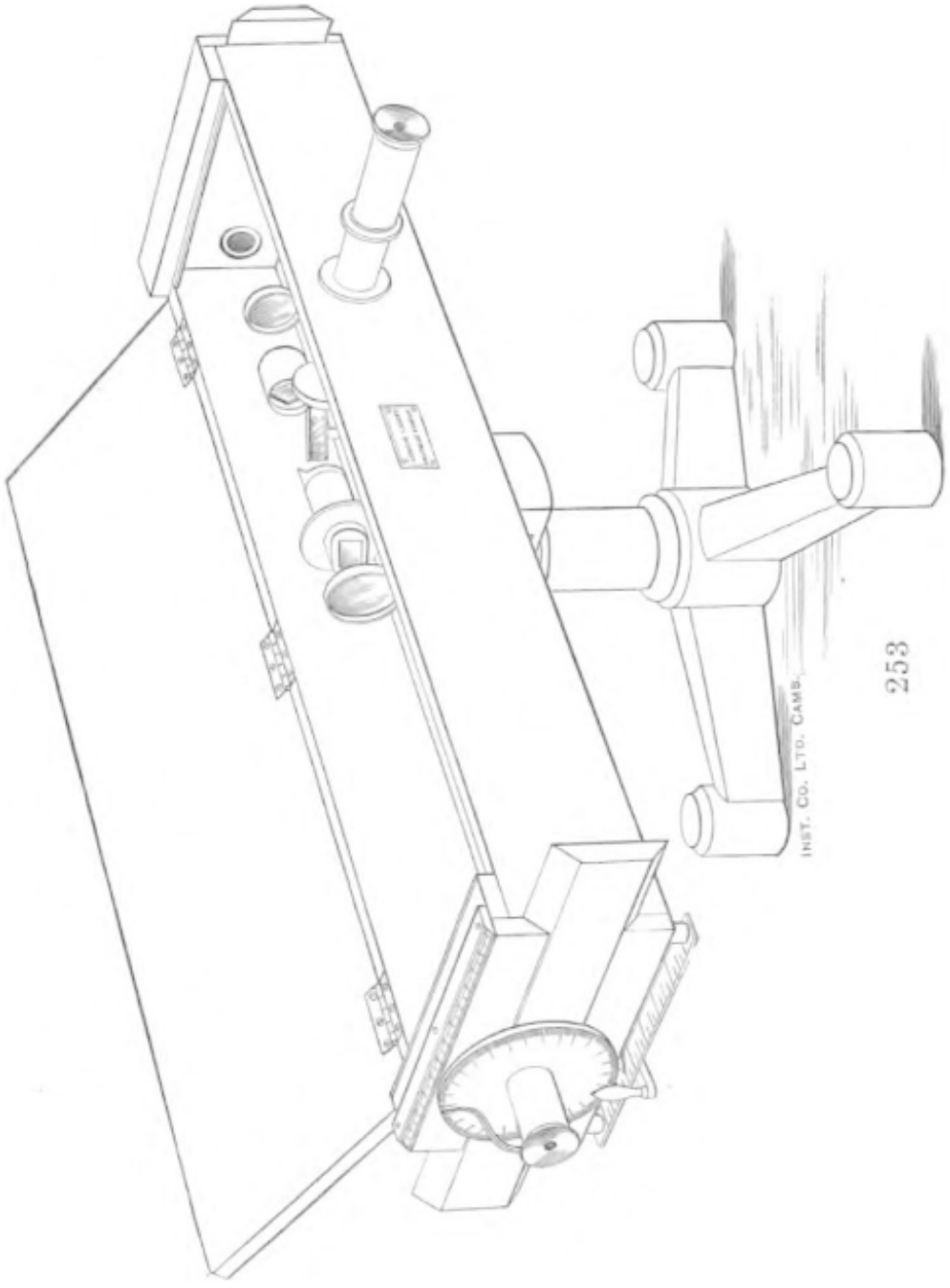
253. **Spectrophotometer.** This instrument is a modification of the colour-box of Clerk Maxwell and may be used for three purposes of physical and physiological interest.

1. *As a Spectrophotometer.* By means of an appropriate arrangement of prisms, lenses and slits, two adjacent superposed polarised spectra are produced, of which a portion of any desired colour may be observed through an appropriate eye-piece. By rotating the Nicol prisms which produce the polarisation, the brightness of these portions of the spectra may be varied within any desired limits and thus the intensity of the light which has passed through any given absorbing media may be directly compared.

2. *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 which is capable of being rotated about a vertical axis. By rotating this mirror any one portion of one spectrum can be placed vertically below, and in juxtaposition with any portion of the other spectrum, and hence the colour-perception of an observer can be at once tested by desiring him to match the hues of the strips of the two spectra.

3. *As a means of matching mixed spectral colours with any one colour of a pure spectrum.* For this purpose a doubly refracting prism is introduced into the path of the light which yields one spectrum. By a proper adjustment of this prism any two colours of this spectrum can be seen as mixed, and by rotating the revolving mirror, any portion of the other spectrum can be compared with the mixed colours until an exact match is obtained.

For further information 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. **£15. 0s. 0d.** *Barberry.*



254. **Condensing Lens.** A double convex lens, 76 mm. in diameter and 76 mm. in focal length, is supported by a flexible arm, giving great freedom of movement. The lens can be fixed in any required position by clamping the joints in the arm. The base consists of a heavy cast-iron tripod ... ... **£1. 15s. 0d.** *Barbette.*



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255. **Optical Lantern,** for throwing the image of a transparent slide, or of the spectrum, on the screen. Two condensing lenses are used, set at an angle so that the lantern will project either image on the screen without any re-adjustment. The body of the lantern is strongly made of brass, and will take either an electric lamp or an oxyhydrogen burner. It is fitted with a dark glass for use when adjusting the carbon points; a small ordinary gas-burner is also fixed in the lantern, giving sufficient light to enable the necessary adjustments to be made before the lantern is in action. A slide 76 mm. square can be used; it is illuminated by a condensing lens 102 mm. in diameter, and the image is thrown on the screen by an achromatic combined objective lens, with a rack and pinion for focussing. The slit used for the spectrum is adjustable by means of a screw, and is placed in front of a similar condensing lens. A bisulphide of carbon prism can be used; it can stand on a shelf fixed to the body of the lantern in a convenient position ... ... **£12. 10s. 0d.** *Barbiton*

256. **Colour Mixer.** This is supplied either for rotating a single disc at ordinary velocities, or can be furnished with a special arrangement by means of which two concentric discs may be rotated at very high and unequal velocities.

Coloured discs of cardboard are supplied with the instrument, and the light from the different colours can be mixed in varying proportions ... ... **£6. 10s. 0d.** *Barbule.*

257. If fitted with the arrangement for driving two discs **£10. 0s. 0d.** *Bard.*

258. Do. do. *simple form* with heavy iron base ... ... **£3. 10s. 0d.** *Bardic.*

259. **Vibrating Stand for Optical Illusions.** Modified by Dr. J. Ward from the instrument described by Prof. Bowditch and adapted to give the motions there described, as well as those of a Colour-mixer. The diagram for the experiment is fixed by drawing-pins to a small vertical board. It can be arranged to have either a horizontal reciprocating motion in its own plane, or the motion described as "rinsing" in the above paper. When giving the rinsing motion the board does not revolve round its centre like the disc of a Colour-mixer but is made to describe a circle in the plane of its own surface so that each point in the board describes a circle of the same size. Both these motions are given by cranks capable of adjustment so that the amplitude of the motion can be altered.

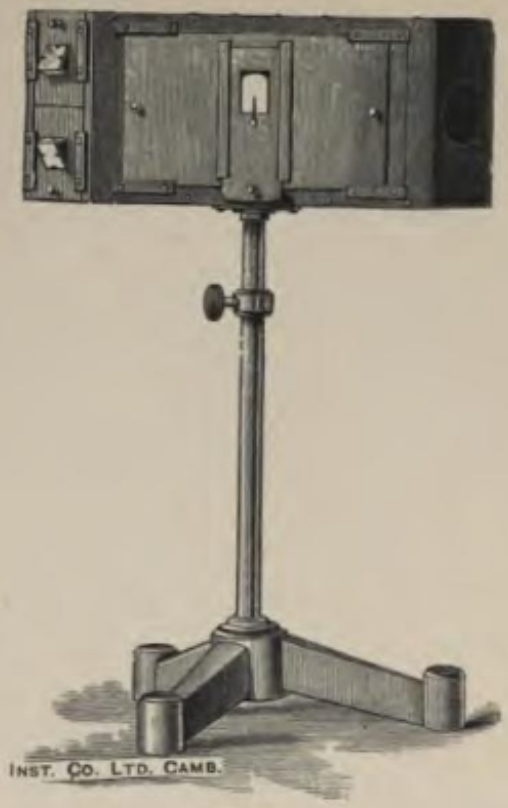
The instrument is driven by a cord passing from a large pulley turned by hand, to small pulleys on the crank axles. See *Journal of Physiology*, Vol. III. p. 297

£14. 0s. 0d. *Bardis.*

260. **Wheatstone's Pseudoscope.** Two tubes each carrying a right-angled prism are held together by a suitable clamp, so that an observer can look through them, one with each eye. The ray of light before reaching the eye is refracted at the first surface of the prism, is internally reflected at the next surface, and is again refracted on passing out of the prism; the prisms are arranged so that the original direction of the ray is not altered. Thus the right eye sees the view usually obtained by the left eye and conversely.

A hemispherical cup forms part of the instrument and can be placed so that either the convex or concave side is towards the observer. The convex side will appear concave, and the concave side, convex ... ... **£4. 4s. 0d.** *Barebone.*

261. **Phakoscope,** devised by Helmholtz for studying the changes of curvature of the lens during accommodation. The instrument consists of a metal box fixed to a stand capable of vertical adjustment. The person whose eye is to be examined looks through a hole in the side of the box, and either accommodates his eye to a near or distant object as may be desired. The near object is a needle fixed in an aperture in the box opposite to his eye. The light from a candle enters the box through two prisms at one side and falls on the eye. These two prisms are arranged to deflect the rays in opposite directions. The observer looks through another hole in the side of the box at the eye of the person under examination, and sees two images of the candle in each of the reflecting surfaces of the cornea and lens. The prisms are capable of vertical adjustment, and thus the images can be made to approach or recede from each other ... ... **£5. 10s. 0d.** *Barefaced.*



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We are in a position to supply the following instruments for Blood Analysis :—

		£	s.	d.	
262.	Gower's Hæmacytometer	3	3	0	*Barefooted.*
263.	Gower's Hæmoglobinometer	1	1	0	*Barege.*
264.	Both Apparatus in one case	4	4	0	*Baregnawn.*
265.	Charts for use with above, per book of 25		5	6	*Barelegged.*
266.	Oliver's Hæmoglobinometer with candlelight standards	4	4	0	*Bargeboard.*
267.	Extra for daylight standards and 9 riders	3	3	0	*Bargown.*
268.	Oliver's Hæmocytometer, complete	1	1	0	*Bargeman.*
269.	Lloyd Jones' Hæmometer, complete with supply of Solutions, Pipettes, &c.	4	4	0	*Barilla.*
270.	Fleischl's Hæmometer	3	0	0	*Barium.*
271.	Bizozerro's Chromo-Cytometer	1	11	0	*Barleycorn.*
272.	Hermann's Hæmatoscope	2	2	0	*Barmecide.*
273.	Hoppe Seyler's Hæmatinometers, per pair	1	15	0	*Barnabee.*
274.	Thoma-Zeiss Hæmacytometer, complete	2	4	0	*Barnyard.*
275.	Miescher's Hæmacytometer, in case	2	14	0	*Barolite.*
276.	Zeiss' Micro Spectroscope, in case	10	0	0	*Barology*

For Capillary Centrifugal Machine, see p. 97.

MICROTOMES AND MICROSCOPE ACCESSORIES.

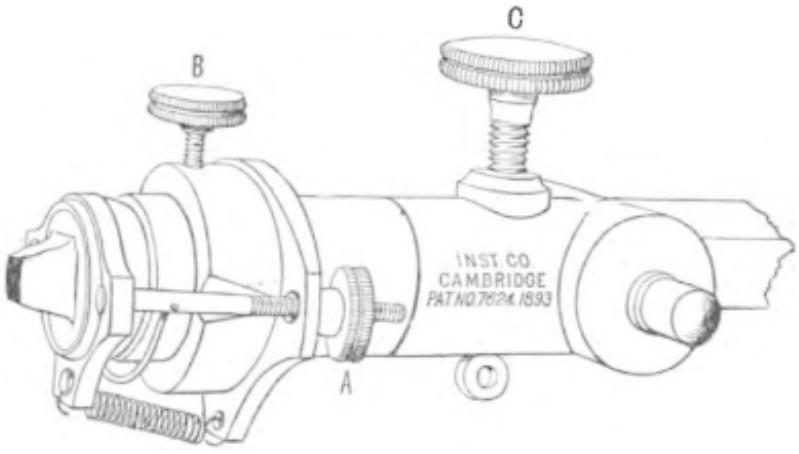
Section 8.

In consequence of the increased demand, we have been enabled to considerably reduce the price of our Microtomes. The design has also been improved in several particulars, especially by the addition of:—

(1) An Improved Clamp. Patent No. 7624, 1893. Either the simple tubular holder or the Orientating Apparatus is firmly clamped to the rocking arm by a very small turn of the screw shewn at C in the figure. The advantages of this arrangement are, that when the screw is loosened the holder slides with perfect ease, giving an easy rough adjustment of the object towards the razor, and the connection to the rocking arm is very rigid ;

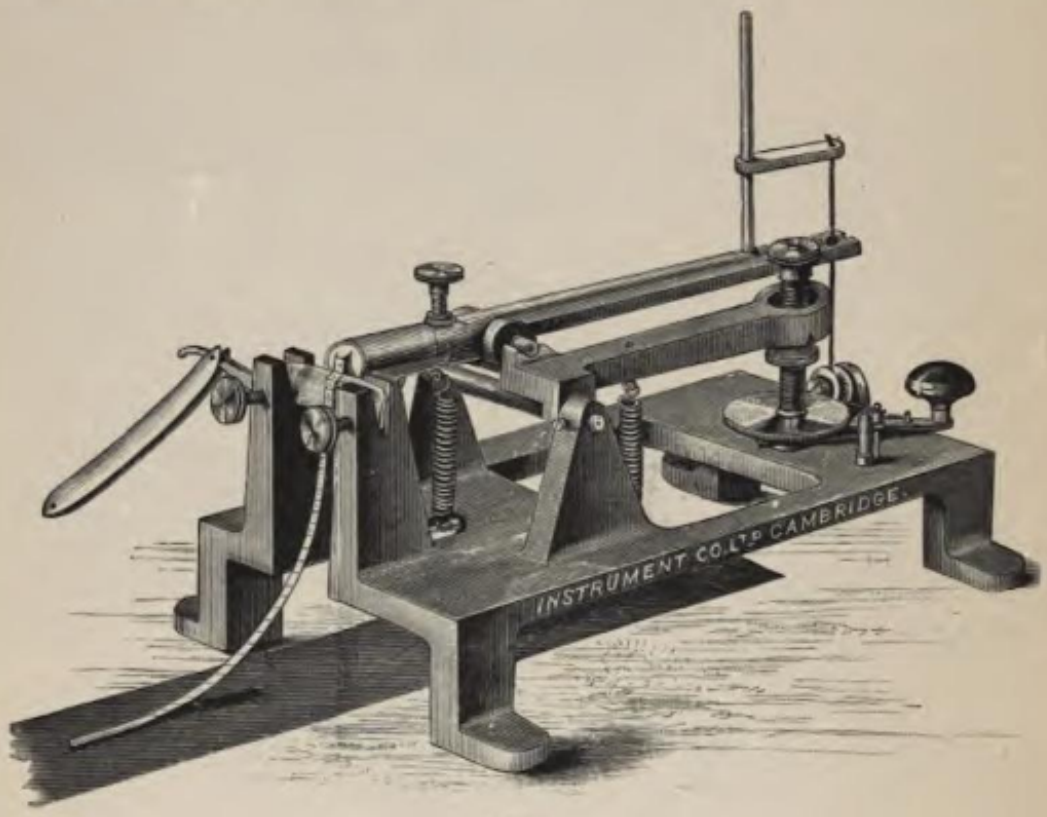
(2) By the addition of an Adjustable Object-Holder or Orientating Apparatus.

By means of this holder the object can be placed in the exact position for cutting sections in the desired plane. The body of the holder consists of a tube of the same size as the ordinary tubular object-holder, and it is fixed to the rocking arm in the same manner. The object is placed in a hemispherical cup which is firmly pressed against the open end of the tube by means of two screws, one of which is



shewn in the figure at A. When these screws are both tightened the cup is rigidly clamped; when one is loosened and the other tightened the cup is turned about a vertical axis. If the head of the screw shewn at B is turned the cup rotates about a horizontal axis. The object can be thus rotated independently about a vertical or horizontal axis. This object-holder can be adapted to any existing Rocking Microtome having our improved clamp, but for Microtomes of earlier make (previous to 1894) it is necessary to have a new arm, which can be supplied at an additional cost of ... ... **£1. 5s. 0d.** *Baroness*

277. **Rocking Microtome,** for producing ribbons of sections in the method devised by Mr Caldwell.



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Two uprights are cast on the base plate of the instrument and are provided with slots at the top, into which the razor is placed and clamped by two screws with milled heads. The inner face of the slot gives the razor the proper inclination. As it is clamped between a flat surface and a screw acting against the middle of the blade, the edge is not injured. The embedded object is cemented with paraffin into a brass tube which fits on to the end of the upper or long lever rocking about its horizontal axis. This tube is clamped by means of our improved patent arrangement to the above lever and by this means is readily brought into position against the razor for cutting. To the other end of this lever is attached the cord which communicates the rocking movement, and by a simple device, consisting of a steel rod and brass arm, any length of stroke can be arranged, it also serves as a ready means of keeping the lever in a convenient position for examining the embedded object prior to cutting. The bearings of the pivot are V-shaped grooves, which themselves form part of another lever. Immediately under the first pair of V's is another pair of inverted V's, which rest on a rod fixed to two uprights cast on the base plate. The end of the horizontal arm, or lower lever, is supported by a nut running on a vertical screw; as the nut cannot turn in a horizontal plane the

effect of turning the screw is to raise or lower the end of the horizontal arm; this moves the rocking lever containing the object to be cut towards the razor. The top of the screw is provided with a milled head, which is used to turn the screw by hand.

A wheel with a milled edge is fixed to the bottom of the screw. An arm to which a pawl is attached rotates about the pin which supports the screw. This arm is moved backwards and forwards by hand or by a cord attached to any convenient motor and moves the object past the razor; on the return stroke the pawl engages in the milled wheel and moves the object forward the required amount for the next section. By moving the position of an adjustable sector, the thickness of the section can be varied from nothing to about ·025 mm. The values of the teeth on the milled wheel are approximately as follows:

1 tooth of the milled wheel $= \frac{1}{40000}$ of an inch = ·000625 mm. of thickness of section cut

2 teeth " " " $= \frac{1}{20000}$ " " = ·001250 mm. " " "

4 " " " " $= \frac{1}{10000}$ " " = ·0025 mm. " " "

16 " " " " $= \frac{1}{2500}$ " " = ·01 mm. " " "

£3. 15s. 0d. *Baronetcy.*

278. Do. do. with Razor as illustrated ... ... **£3. 17s. 6d.** *Barony.*

279. Do. do. with Orientating Apparatus and without Razor ... ... **£4. 10s. 0d.** *Baroscopic*

280. Do. " " " and Razor complete ... ... **£4. 12s. 6d.** *Barouche.*

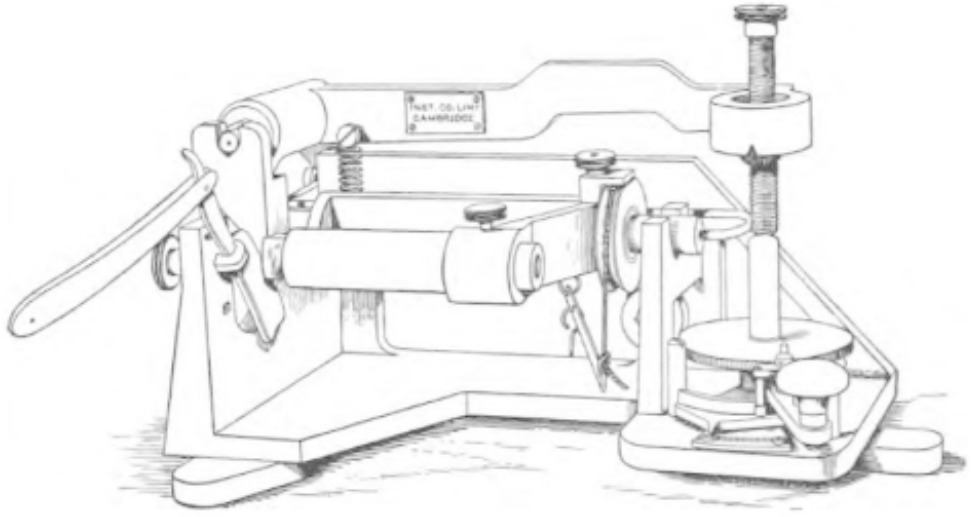
281. Orientating Apparatus ... ... **15s. 0d.** *Barpost.*

282. **A Larger Rocking Microtome,** on the same principle as the original type just described, is also made, suitable for large pathological specimens. It will cut an object 45 mm. in diameter ... ... **£7. 10s. 0d.** *Barracoon.*

283. **Rocking Microtome, new pattern to cut Flat Sections.** In order to meet the wishes of some of our customers we have designed a new pattern Rocking Microtome to cut truly flat sections, the sections cut by the original form of rocking Microtome being slightly Cylindrical. With small objects we think the error produced quite inappreciable, but with large sections it may be of some importance.

It differs from the original Rocking Microtome in other respects; larger sections can be cut, the tube holding the paraffin block is 30 mm. in internal diameter instead of 20 mm. The forward movement of the object towards the razor is also greater, thus an object 12 mm. long can be cut up throughout its whole length, without readjusting the object-holder. A graduated arc gives the thickness of the sections in thousandths of a millimetre. The object can be raised and

fixed in a position clear of the razor, and our improved clamp is used for fixing the object-holder; a larger Orientating Apparatus is also made suitable for this



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Microtome. The razor can be clamped either at right angles to the movement of the object as in the original Rocking Microtome, or in a diagonal position for giving a slicing cut.

The success of the Rocking Microtome is largely due to its great stiffness, to the geometrical arrangement of its bearings giving absolutely no shake, and to the simplicity and efficiency of the mechanism for advancing the sections between each stroke; the new instrument has all these advantages in addition to those above described.

From the engraving it will be seen that many of the essential features of the old Rocking Microtome have been retained but are arranged in different positions on account of the modification in the design.

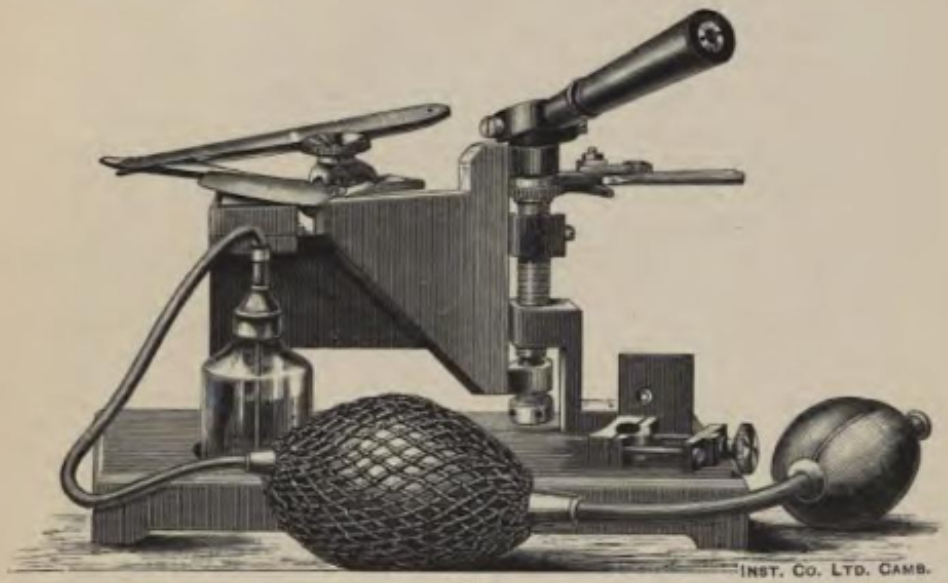
With Orientating Object-Holder and Razor complete ... ... **£8. 10s. 0d.** *Barracu*

284. Orientating Object-Holder ... ... **£1. 0s. 0d.** *Barratr*

Directions for the use of Rocking Microtomes.

The object to be cut should be embedded in hard paraffin. The block containing the object should then be fixed to the paraffin contained in the object-holder of the Microtome, by gently melting the surfaces. The sides of the block must now be cut so that the opposite sides are parallel, it is then dipped into melted soft paraffin, that is paraffin with a low melting point, so that it is coated all over. The coating of soft paraffin is then removed from two opposite sides, and, if necessary, the thickness is reduced on the two other sides. Unless the sides are flat and the coating of soft paraffin is very thin the sections will not form a good ribbon. The object-holder with the block attached is now ready to be replaced on the Microtome,

care being taken that the coated sides of the block are above and below, so that the one coated side shall first come into contact with the edge of the razor. The Microtome will now cut sections adhering together and forming a ribbon. The largest section which can be cut is 20 mm. in diameter. Slides 152 mm. in length and 25 or 50 mm. wide with cover glasses of a slightly smaller size, are found convenient for mounting the ribbon of sections on. A suitable apparatus for preparing specimens for the Microtome and finishing them for the Microscope is described on p. 87.



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285. **Roy's Improved Freezing Microtome.** This Microtome can be used also for cutting unfrozen objects. The Clamp for holding such objects is shewn resting on the base of the instrument; the metal plate can be easily removed with a screwdriver and the clamp fixed in its place.

The freezing is performed with ether, blown in spray against the under side of the metal plate supporting the object. A drop of gum water is preferable to water for surrounding the object to be frozen, as it is not so hurtful to the edge of the razor. If the object has been previously immersed in spirit, it should be washed with water, as the spirit retards the freezing. The bottle should be about half filled with ether, and placed in the socket in the wooden base, and if the ether be good the freezing in the first instance should occupy not more than from 30 to 60 seconds for a piece of tissue of moderate thickness. After once freezing the object may be kept at a suitable hardness for cutting by an occasional stroke or two of the bellows. At the lower end of the tube which dips into the ether is a small metal plug which acts as a regulator for the supply of ether to the spray. By a little adjustment of this plug the spray may be used with a minimum waste of ether.

The razor should be clamped quite near to its end, as shewn in the engraving;

this gives a slicing motion to the cut. The wedge-shaped piece of brass is used to raise the back of the razor, and to prevent anything but the edge of the razor from touching the object.

Before the tissue is frozen, the razor should be raised to its highest position above the plate. The brass handle should be moved backwards and forwards, care being taken that the steel ratchet click on its under side engages with the teeth of the ratchet wheel on the farther side of the instrument. After a few movements of the brass handle, the razor-holder and razor will be as high as they will go. The steel ratchet click should now be turned so as to engage with the teeth on the near side of the ratchet wheel. Moving the brass handle backwards and forwards, now will lower the razor-holder and razor, and moving the wooden handle backwards and forwards will make the razor pass over the surface of the object to be cut. The thickness of the sections will depend upon the distance that the brass handle is moved at each stroke. When several sections have been cut, they may be removed from the razor with a camel-hair brush and placed in water. With a little practice sections may be cut with very great rapidity.

Should any looseness occur in the screw, it may be taken up, by tightening the small screw of the nut through which its central portion passes.

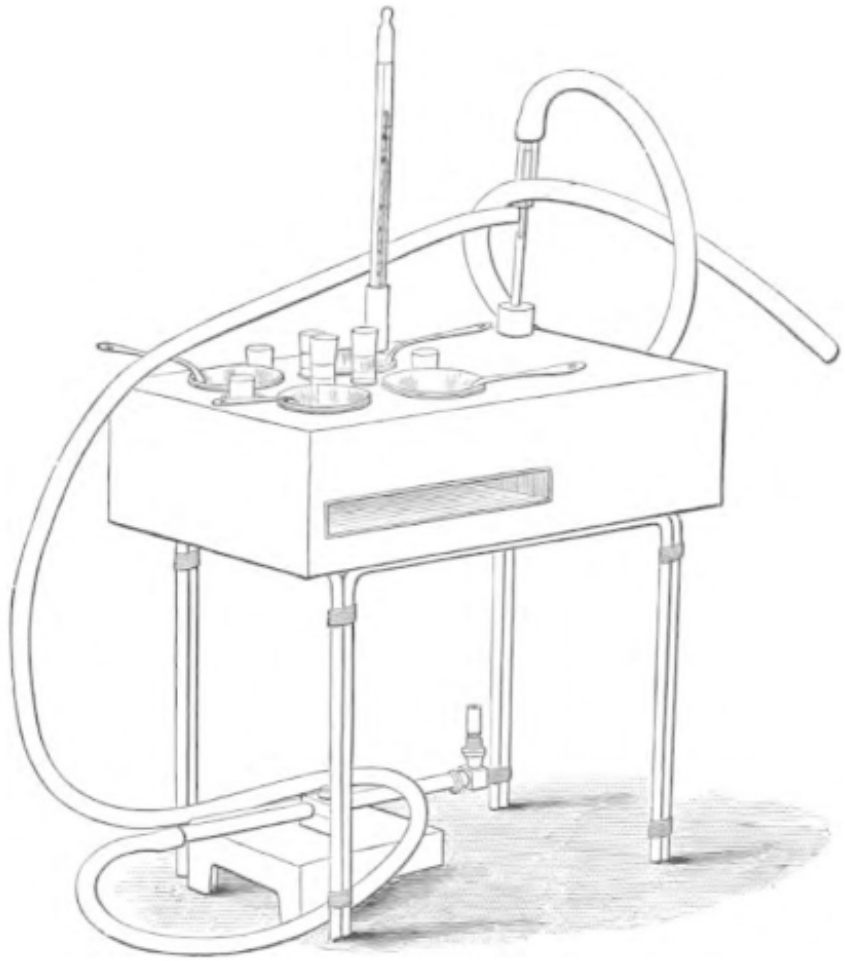
Microtome complete, with an additional clamp for holding unfrozen objects **£6. 6s. 0d.** *Barrelle*

286. **Rocking Microtome Driving Gear.** A pulley is driven by a cord from a Water Motor; a crank with adjustable throw is fixed to the side of this pulley; a hook at one end of a piece of cord is slipped over the handle of the Microtome, and the other end is pulled backwards and forwards by the crank; thus the sections are automatically cut whilst both hands are left free ... **£2. 10s. 0d.**

For Motors see p. 13.

287. **Object-Holder,** as used by Professor Flemming. The object is embedded in a small block of paraffin and then attached to a small block of wood. The holder consists of a vice-like arrangement into which the small wooden block is clamped; it is attached to a tube and fixed on the Microtome arm in the usual manner ... ... **15s. 0d.** *Barrellin*

288. **Embedding Bath,** for melting and keeping at a constant temperature the various preparations used in the ribbon method of cutting sections. The size of the bath is about 350 by 177 by 76 mm. Four copper pans (two large and two small) are supplied for holding the embedding material. Four appropriate tubes are provided for the small bottles and glass tubes in which the objects to be saturated are placed, together with a warm internal chamber for evaporating the chloroform, &c. The bath is fitted with a simple but efficient gas regulator and burner, and is supplied complete with stand, silver-plated copper pans, glass bottles, tubes, thermometer, and a small supply of Hard and Soft Paraffin **£2. 5s. 0d.** *Barren.*



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289. **Large Embedding Bath.** This is similar to the last described bath and is about 558 by 330 by 153 mm. It contains fourteen copper pans (six large and eight small) and twenty-two holes for holding bottles and tubes. It is supported on an iron stand and is provided with a Gas Regulator and Burners. Metal tube fittings are supplied and the necessary connections to the gas main are easily made ... ... **£5. 0s. 0d.** *Barrenly.*

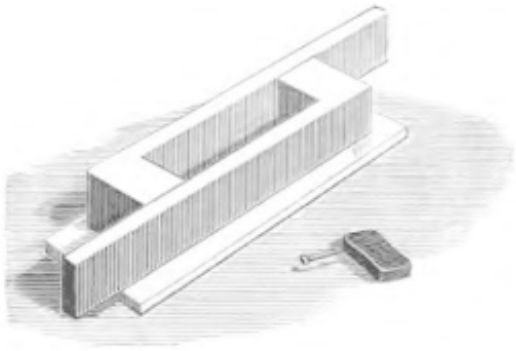
290. **Large Embedding Bath.** This bath which is the same size as No. 289 has been specially designed for the heating of several students' preparations at the same time. It is fitted with 36 pans and gas regulator, but without internal chamber and thermometer,—although a hole is provided for the latter, with stand complete ... ... **£4. 0s. 0d.** *Barrenwort*

291. Do. with 36 pans, 36 specimen tubes, gas regulator, burner, thermometer and stand complete ... ... **£5. 15s. 0d.** *Barretcap.*

292. **Hard Paraffin Wax,** suitable for embedding objects for the Rocking Microtome, melting about 55° C. ... ... *per kilo.* **2s. 0d.** *Barshot.*

293. **Soft Paraffin Wax,** suitable for coating the block of Hard Paraffin, melting about 48° C. ... ... *per kilo.* **2s. 0d.** *Barsowite*

294. **Embedding Trough,** or Mould. This is a convenient arrangement for embedding the tissue in the block of paraffin. Two brass blocks, each in the shape of the letter L, form the sides and the ends of the trough; they are placed on a piece of glass, which then forms the bottom. This arrangement allows



a block of paraffin of any desired length to be cast. The object is transfixed by a pin, as shewn in the engraving; the trough is then filled with melted paraffin, and just as it begins to set the object is placed in the middle of the trough and moved up to one end. When cool the block of paraffin can then be removed from the trough. The thinnest possible coating of glycerine facilitates the removal of the block ... ... **2s. 6d.** *Bartram.*

295. **Razors,** best quality for use with our Microtomes, *each* **2s. 6d.** *Barwood.*

296. **Hones,** of various sizes suitable for sharpening Razors, in box complete ... ... *from* **7s. 6d.** *Baryta.*

Large Glass Slides for use in mounting ribbons of sections from the Rocking Microtome. Several long pieces of the ribbon of sections can be mounted side by side; this gives great facility in examining the sections consecutively.

297. 6 in. × 1 in. (152 × 25 mm.) unground edges ... *per* 100 **5s 0d.** *Barytic.*

298. 6 in. × 2 in. (152 × 50 mm.) ... ... *per* 100 **7s. 6d.** *Basaltic.*

Large Cover-Slips suitable for the above

299. 5 in. × $\frac{7}{8}$ in. (127 × 22 mm.) ... ... *per* 100 **£1. 15s. 0d.** *Basanite.*

300. 5 in. × $1\frac{7}{8}$ in. (127 × 45 mm.) ... ... *per* 100 **£2. 5s. 0d.** *Bascinet.*

Glass Slides for mounting Microscope Specimens 3 in. × 1 in. (76 × 26 mm.)

301. white crown-glass with ground edges ... ... *per* 100 **3s. 6d.** *Baseball.*

302. „ „ „ unground „ ... ... *per* 100 **2s. 6d.** *Baseless.*

303. best white plate-glass with ground edges ... ... *per* 100 **7s. 6d.** *Baseviol.*

Special sizes to order.

304. **Cover-slips** for the above $2\frac{3}{4}$ in. × $\frac{3}{4}$ in. (70 × 19 mm.)
per 100 **17s. 6d.** *Bashaw.*

305. **Cover-Glasses, Circles.**

Diameter	16		19		22 mm.	
	3s. 0d.	*Bashfully.*	**4s. 6d.**	*Basify.*	**5s. 6d.** *per* 100.	*Basilar.*

306. **Cover-Glasses, Squares.**

Side	16		19		22 mm.	
	1s. 9d.	*Basilical.*		*Basilweed.*	**3s. 6d.** *per* 100.	*Basin.*

Special sizes to order.

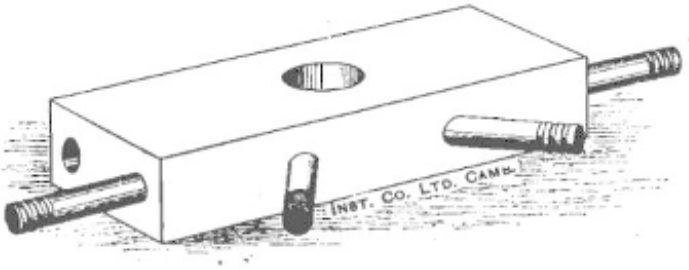
307. **Glass Slides** with concave centres, ground edges 3 in. × 1 in (76 × 26 mm.) ... ... *per doz.* **1s. 6d.** *Basketry.* *per* 100 **10s. 0d.** *Bassrelief.*

308. **Platinum Lifters** made of Platinum Iridium alloy, with brass handle, for removing sections from the staining reagents ... ... **7s. 6d.** *Basseting.*



309. **German-silver Lifters,** made entirely of German-silver ...
from **6d.** *Basshorn.*

310. **Stricker's Warm Stage,** for raising the temperature of objects placed upon the stage of the Microscope. It consists of a brass box with a transverse hole through its centre; a chamber is formed by covering this hole with cover slips both at the top and the bottom; the under surface of the box is recessed round the hole to prevent the cover slip from touching the stage of the microscope. The chamber has no opening to the interior of the box, but two tubes passing through the box can be used to introduce any gas into the chamber. The object is placed in this chamber and can be examined by transmitted light when on the stage of the microscope. Two other tubes enter the box itself and are used to



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introduce warm water, and thus the object is heated. A horizontal tube passing from end to end through the box is used for inserting a thermometer **£1. 10s. 0d.** *Bastinade*

311. **Schäfer's Warm Stage** with small boiler, automatic gas regulator, rubber tubing and thermometer. Complete ... ... **£3. 0s. 0d.** *Basto.*

312. **Simple Microscope Stands,** arranged to take either a Zeiss or Steinheil simple microscope lens. This form of microscope is largely used in the Morphological Laboratory in Cambridge. The object is placed in a dissecting trough, and the microscope on the table on one side; the lens is then moved to any convenient position over the object. A heavy cast-iron foot supports a flexible brass arm carrying the lens at its end. The arm has two ball-and-socket joints, which allow the lens to be placed in any position. The friction of these joints keeps the lens in that position; if through long use they become loose they can easily be made to move with the right amount of stiffness by screwing up the cap or slightly adding to the packing. If desired, we place the first ball and socket joint on the base plate similarly to that shown in the figure of the condensing lens, p. 78 ... ... **£1. 5s. 0d.** *Basyle.*

Steinheil's Aplanatic Lenses, giving a relatively long focal distance with a large flat field. The following are kept in stock:—

313. Equivalent focal distance 41 mm. and 5⅓ magnifying power *each* **11s.** *Basylous*

314. „ „ „ 27 mm. „ 8 „ „ *each* **13s.** *Bathbrick*

Zeiss Aplanatic Lenses (Steinheil's formula). The higher powers are adapted for use with dissecting Microscopes, the lower ones as hand lenses or with a lens holder, in wooden capsule.

315.	Magnifying power	6	...	...	...	...	...	**15s.**	**0d.**	*Bathmetal.*
316.	„	„ 12	...	...	...	...	...	**15s.**	**0d.**	*Bathroom.*
317.	„	„ 20	...	...	...	...	...	**12s.**	**0d.**	*Batman.*
318.	„	„ 30	...	...	...	...	...	**12s.**	**0d.**	*Batrachian.*

319. **Zeiss Lens-holder.** Heavy metal foot, lens holder with hinge-joints and pinion for focussing. The holder rotates on a vertical axis fitted with a clamping screw, by which means the lens can be passed over an extended area without interfering with the adjustment. An exceedingly useful form of lens holder **£2. 0s. 0d.** *Batrachoid.*



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320. **Incubator.** This is heated by our Gas Burner, and the temperature is maintained constant by our Gas Regulator. An iron tripod standing in a zinc tray supports a cylindrical copper vessel. This vessel has hollow sides, which are filled with water, and the gas regulator is placed in the water. The eggs are held in perforated zinc trays; the lower tray has a tube fixed to its centre which passes through holes in the centre of the other trays; they can thus be moved individually or all together. This tube passes through a hole in the cover and if not closed allows sufficient ventilation for the eggs. The cover is pierced for a thermometer.

In the engraving indiarubber tubes are shewn connecting the gas burner and regulator. These connections as well as the connection to the gas main should be made by means of metal tubing. Price complete with gas regulator, burner, &c.

£10. 0s. 0d. *Batswing.*

321. **Digestion Apparatus,** similar in every respect to the Incubator except that the egg-trays are not supplied ... ... **£9. 0s. 0d.** *Battalous.*

322. **Cultivator** as used by Dr Klein for bacteria, germs, etc. It consists of a large copper cupboard with hollow sides (608 × 584 × 496 mm.) which are filled with water, and it has a sliding plate-glass door in front. The Gas Regulator is placed in the water; it is raised on an iron stand and heated by our Gas Burner, placed underneath. It is divided into two compartments, and is provided with moveable shelves. Holes pass through the hollow sides for introducing a thermometer into the cupboard without opening the glass door **£20. 0s. 0d.** *Battleaxe.*

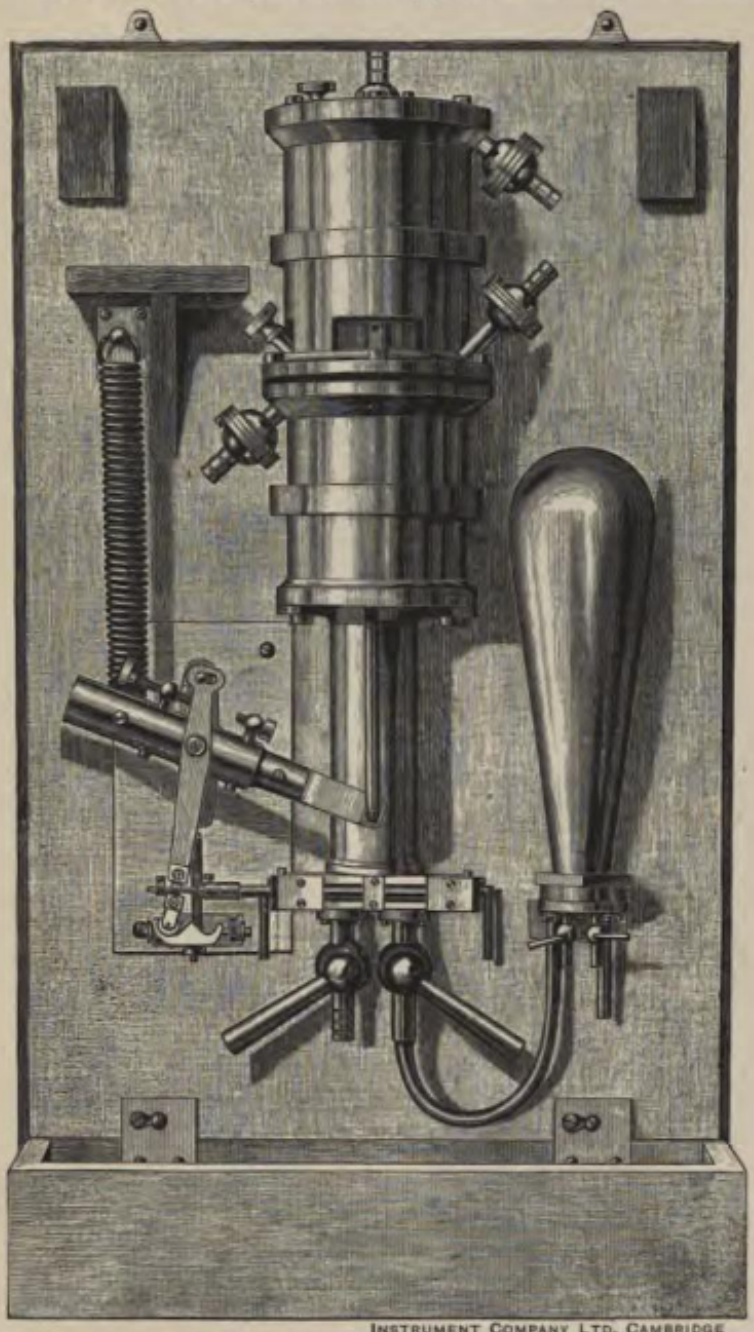
323. **Small Cultivator.** This is similar to the Cultivator above described ... ... **£9. 15s. 0d.** *Battue.*

We are prepared to supply various Cultivators, Ovens, Sterilisers, Filters, &c. for Bacteriological work of all the best Continental makers.

SURGICAL AND VARIOUS APPARATUS.

Section 9.

324. **Artificial Respiration Apparatus.** The machine consists



INSTRUMENT COMPANY LTD. CAMBRIDGE

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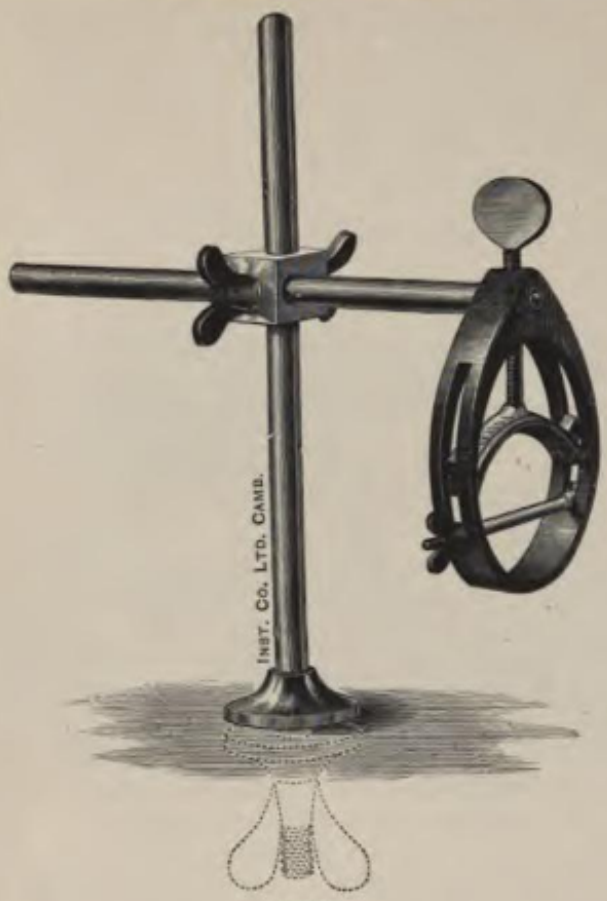
of the following parts:—Two large air cylinders with two valves to each, below these the water cylinder with its valve and taps, on the right the air vessel with its inlet tube and two taps for emptying, on the left the spring and striking gear for cutting off the water and regulating the stroke of the machine. The tube at the bottom of the air vessel should be connected to the water main by means of a strong indiarubber hose. The water after partly filling the air vessel will force the piston in the water cylinder upwards, the pistons of both air cylinders will, at the same time, move upwards, forcing the air from both of them. When the upward stroke is completed the water valve is automatically moved and the spiral spring pulls the pistons downwards, and air is drawn into both air cylinders. The lower cylinder pumps the air into the lungs and the upper one withdraws it. Part of the air as it enters the lower cylinder may be made to pass through chloroform contained in a Wolff's bottle, connected to the inlet by indiarubber tubing. The apparatus may be fixed at any point in the room and the air taken by a pipe from the lower cylinder to the required position. A second pipe should be used from the inlet of the upper cylinder to the same point, to withdraw the air from the lungs. These pipes may be of any length to suit the room. By turning the two taps under the water cylinder the velocity of the piston during the up and down stroke can be independently varied. The quantity of air delivered at each stroke can also be altered to suit all requirements; this is done by turning the milled headed screw near the spring. When desired the volume of air delivered at each stroke can be greatly increased by connecting the upper outlets of both air cylinders with the delivery tube. In this case, the exhausting action of the down stroke is not used. Some Physiologists prefer to use the apparatus habitually in this way. A handle can be slipped into the socket in the oscillating piece; this is useful in case the water is turned off at the main when the apparatus can be worked by hand. The amount of water used in working the apparatus is very small. These machines have been working in various English, American, and Continental Laboratories for some years, and have been found to keep well in order, and to thoroughly answer the purpose for which they were constructed ... ... **£50. 0s. 0d.** *Baubee.*

325. **Artificial Respiration Apparatus.** Cheap form. This consists of a pair of bellows worked by a system of levers and fly-wheel. It can be driven by hand or motor ... ... **£3. 15s. 0d.** *Baudekin.*

326. **Dog Holder.** Improved from Bernard's Model and suited for both large and small animals ... ... **£3. 10s. 0d.** *Bavaroy.*

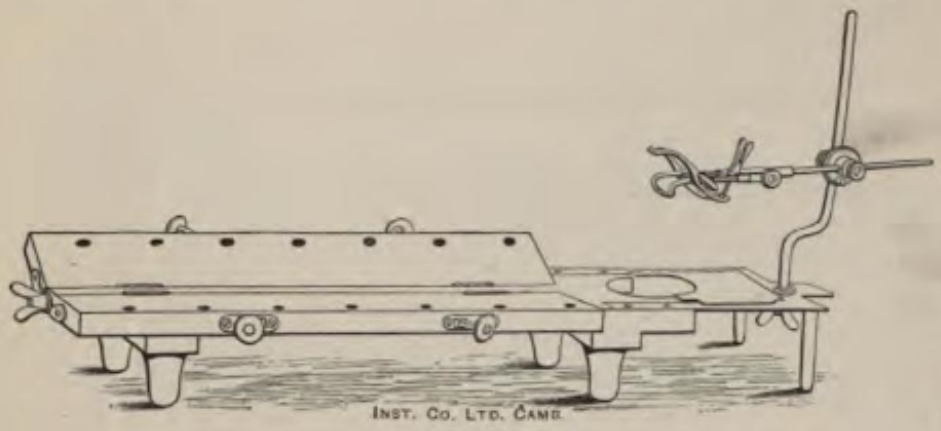
327. **Roy's Dog Holder.** It securely holds the dog's head in any position and can be used with dogs of all sizes ... ... **£7. 7s. 0d.** *Barrulet.*

328. **Rat Holder.** This is for the same use as the Dog Holder; but it is differently constructed and suitable for a rat; it has also a tube for applying the anæsthetic ... ... **£1. 0s. 0d.** *Bawcock*



326

329. **Rabbit Holder.** Modified from Czermak's form, with adjustable table for supporting the animal in any position, and with improved bit **£4. 10s. 0d.** *Bastion.*



329

330. **Abbott's Holder** for Guinea-pigs, Rats, and small animals ... **£2. 15s. 0d.** *Baya*

331. **Hürthle's Dog Holder** ... ... **£5. 0s. 0d.** *Bayo*

332. **Fine Forceps,** specially made with highly finished points for delicate dissections ... ... *each* **1s. 6d.** *Bayo*



332, 333

333. **Large Forceps,** specially made with slightly hooked points which lock into each other. They are useful in large dissections for holding any tissue with great firmness ... ... *each* **8s. 6d.** *Beadl*

334. **Aneurism Needles.** A curved needle is fixed into a gilt brass handle by its pointed end. They are used for such a purpose as tying an artery; the thread is passed through the eye of the needle, and the needle passed under the artery; the thread is then removed from the eye, and the needle withdrawn, leaving the thread, the ends of which can then be tied together. These needles are made in three sizes. The larger size is suitable for use in tying ligatures round the ribs or large arteries, the smaller for passing a thread round fine nerves. The intermediate size is useful for general purposes ... ... *each* **2s. 0d.** *Beadl*

335. **Seekers for Dissecting.** They are made in two sizes, large and small, and are useful for separating tissues, or for any purpose requiring a blunt pointed instrument ... ... *each* **1s. 6d.** *Beadx*



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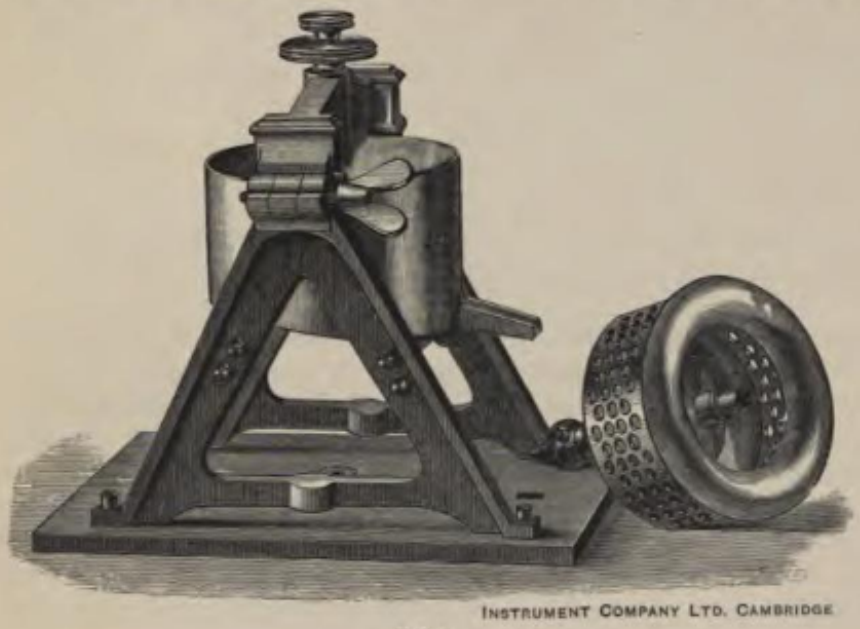
336. **Small Centrifugal Machine,** for drying crystals, or rapidly separating extracts. The rotating cage is a brass cylinder perforated with large holes, and is lined with a piece of wire gauze. It is fixed to a spindle which is driven by a small pulley at its base. The spindle and cage can be easily removed

from the bearings to allow for thorough cleaning; in the engraving it is shown separated from the frame of the instrument. The cage revolves in a brass vessel for collecting the liquid. It can be driven by a motor or by a large pulley turned by hand. For Motors, see p. 13 ... ... **£15. 0s. 0d.** *Beakiron.*



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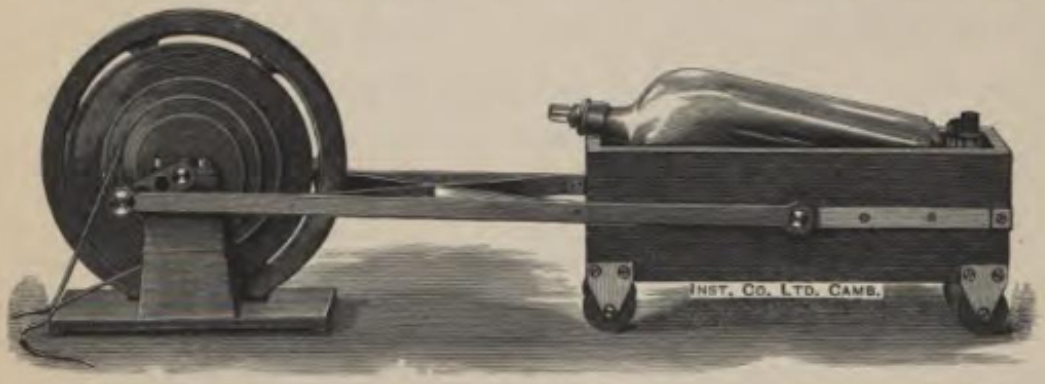
337. **Capillary Centrifugal Machine** for blood, as used by Dr Lloyd Jones.

One end of an ordinary vaccine tube 120 mm. long is placed in a drop of blood and allowed to become nearly full. The ends are sealed in the flame, and the tube is fixed to a disc of which it forms a diameter. When the disc is rotated the blood flies to both ends of the tube and the corpuscles are separated; their ratio to the whole quantity of the blood can be found by measuring the lengths of tube filled by them and by the serum ... ... **£12. 12s. 0d.** *Beamlet.*



338.

338. **Shaking Machine** for shaking bottles and rapidly saturating solutions with salts. This is adapted for use with any motor. A pulley with several grooves in it for driving at different speeds is fixed to a horizontal axle turning in bearings and carrying a fly wheel. Cranks are fixed at each end of this axle and give by means of a connecting rod a horizontal reciprocating motion to a box containing the bottle to be shaken. This box has wheels resting on the table, and in order to prevent noise these wheels have india-rubber tires. The extent of the motion can be reduced by unscrewing the crank pins and fixing them in other holes in the crank nearer the axle ... ... **£6. 0s. 0d.** *Beanc*

339. **Air Pump.** This pump is arranged in the well-known manner usually described in text-books. It has two barrels, and the piston rods are in the form of racks gearing into a toothed-wheel, one on each side *from* **£10. 0s. 0d.** *Bearis*

340. **Single Barrel Air Pump** for exhausting or compressing gases. It has a brass or iron barrel fixed to a board. A handle is attached to the piston rod, and as the cylinder is not large the force required to move it is not great. There are no valves, but in their place a three-way tap which can be moved between each stroke, and connects the cylinder alternately with the inlet and outlet tubes. The connections are made to the pump by thick walled india-rubber tubing slipping over the inlet and outlet tubes. As there are no valves and as the flat face of the piston can be pushed right against the flat bottom of the cylinder, the amount of gas left in the cylinder at each stroke is very small **£5. 10s. 0d.** *Bearsk*

Filtering Pumps or Aspirators.

341. Bunsen's pattern, in glass ... ... **2s. 0d.** *Beatifi*

342. „ „ brass ... ... **5s. 0d.** *Beauf*

343. Geissler's pattern in glass ... ... **1s. 9d.** *Beauti*

344. „ „ brass ... ... **4s. 6d.** *Beaver*

345. **Sprengel's Mercury Air Pump,** improved form on black wooden stand ... ... **£2. 15s. 0d.** *Becaln*

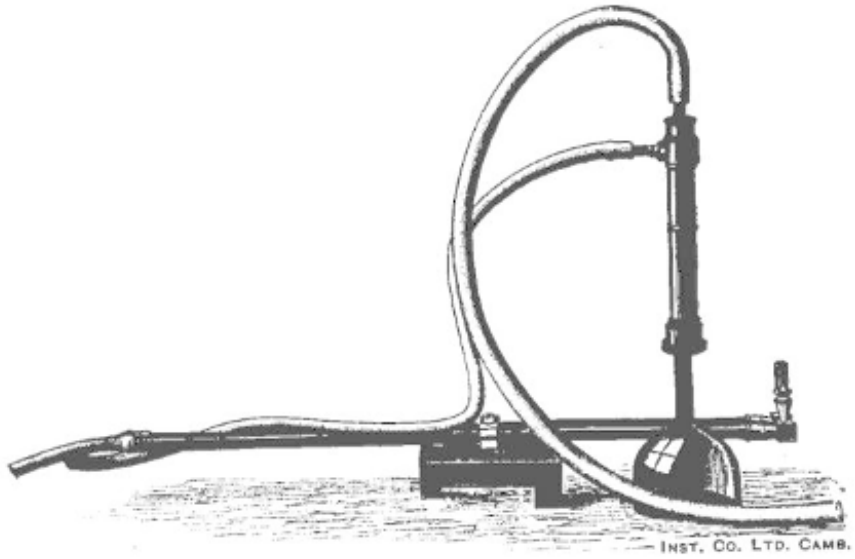
346. Do. on polished mahogany ... ... **£3. 10s. 0d.** *Bechan*

347. Do. Alvergniat's Model, with reservoir of a capacity of 250 c.c. A most useful pump for Physiological Work ... ... **£7. 10s. 0d.** *Bechan*

348. **Automatic Mercury Pump** worked by water pressure, very suitable for high vacua work ... ... **£15. 0s. 0d.** *Becket.*

349. **Gas Regulator.** This can be used for maintaining any pieces of apparatus at a constant temperature. It consists of a glass vessel with a narrow

tubular neck; this is filled with mercury, and forms a very large thermometer. The gas flows through a fine metal tube passing down the narrow cylindrical neck and as the temperature rises the gas supply is cut off by the mercury closing the open end



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of the metal tube. The gas supply can be regulated for any required temperature. Very constant results are obtained with this regulator, and with very little attention. The necessary mercury is not sent unless specially ordered ... ... **£1. 5s. 0d.** *Beckoning.*

350. With Burner and Tubing complete ... ... **£1. 17s. 6d.** *Becnian.*

351. **Mercury** ... ... *per kilogramme* **7s. 0d.** *Bedabble.*

Gas Regulators made of glass.

352. Page's pattern ... ... *each* **2s. 6d.** *Bedagat.*

353. Reichert's pattern ... ... *each* **4s. 6d.** *Bedaggle.*

354. **Gas Burner** for the above. This consists of two burners almost touching one another, one of which is connected with and controlled by the regulator, and the other, a very small flame, is connected with the gas main, and is always burning, so as to re-light the larger burner in case the gas has been cut off by the rise of the mercury. It stands on a cast-iron foot ... ... **12s. 6d.** *Bedashed.*

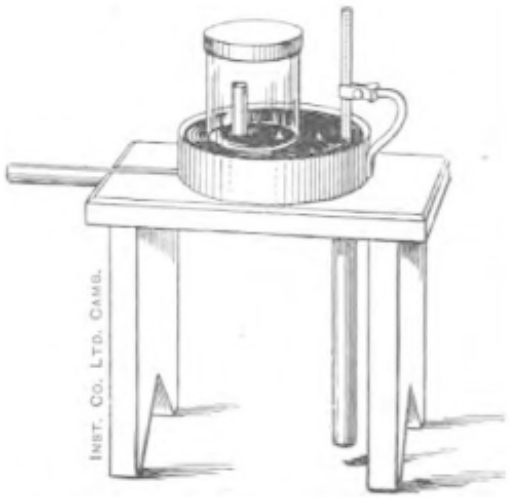
355. **Pressure Regulator** for maintaining a constant pressure of the ordinary gas supply, as designed for Mr E. H. Griffiths.

It is extremely simple and works in a most satisfactory manner. Gas from the main is taken into an inverted cylindrical vessel 458 mm. diameter, placed with its

mouth in water like a gas holder. The pressure of the gas raises this vessel, turning it about a horizontal axis and at the same time raising a scale-pan with weights in it. This upward movement closes a valve and cuts off the supply of gas from the main; thus the pressure of the gas in the vessel remains constant within very small limits, notwithstanding change of pressure in the main and variation in the quantity of gas used. The valve consists of a cup containing mercury which is raised by the lifting of the cylindrical vessel and the surface of the mercury closes the open end of the inlet gas tube. By varying the weight in the scale-pan the pressure of the gas can be altered ... ... **£4. 4s. 0d.** *Bedaz*

356. **Aerating Apparatus** for constantly supplying a small experimental aquarium with air. It consists of an india-rubber gas-bag between pressure boards, which can be loaded with weights. The tap of the bag is used for regulating the quantity of air allowed to pass through an india-rubber tube to a glass nozzle placed on the bottom of the vessel containing the animals or ova to be kept alive ...
£2. 15s. 0d. *Bedch*

357. **Micrometer Pressure Gauge** for measuring minute differences of Air Pressure. The instrument was designed for Mr W. N. Shaw for use in his investigations on air currents. A small bell-glass stands with its mouth in a shallow vessel containing oil. A needle is fixed in the vessel under the bell-glass; it is vertical and has its point upwards; the oil is adjusted till it is just level with the point. This adjustment is made by lowering or raising a graduated rod into the oil and thus slightly altering the levels of the surfaces inside and outside the bell-jar; the contact between the needle point and the oil surface is observed by watching the reflection of a bright object in the surface of the oil. The rod is held in the desired position by a clip. In order to allow a long rod to be lowered into the oil, one part of the shallow vessel is made deep by a tube projecting below its base. If the pressure in the bell-glass alters, the



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level of the oil will change; the change of level is measured by the movement of the graduated rod necessary to again bring the oil surface level with the needle point. A tube passing through the oil in the shallow vessel into the interior of the bell-glass is used for bringing the internal air into communication with any space in which the pressure is to be determined. Extremely small differences of pressure can be measured with this instrument which is now made in a slightly modified form to that shown in the illustration. See the article on "Ventilation" in Stevenson and Murphy's *Treatise on Hygiene* ... ... **17s. 6d.** *Bedded.*

358. **Millimetre Paper Scales.** These are printed on stout paper from a carefully divided copper plate, and are 500 mm. long ... *per doz.* **4s. 0d.** *Bedimming.*

359. **Sectional Paper,** divided into squares of millimetres or of inches and tenths. The size of the sheets is 18 ins. by 23 ins. (525 × 630 mm.) ... ... *per doz.* **2s. 9d.** *Bedismal.*

360. **Parchment Paper Tubing for Dialysers** ... ... *per* 10 *metres* **2s. 0d.** *Bedmaker.*

BOTANY.

Section 10.

361. **Klinostat.** The plant is fixed in a small wooden box; the box is then clamped by a screw to a disc at the overhanging end of a horizontal spindle driven at a uniform speed by clock movement. The box projects beyond the frame of the instrument, and can thus be enclosed in a separate chamber, the air of which may be kept damp. The box is a cube, and can be clamped with either its bottom or side against the disc at the end of the spindle. In one case the stem of the plant will be parallel to the axis of rotation, and in the other it will be at right angles to it. In order that the power of the clock may be sufficient to drive the spindle, the centre of gravity of the rotating parts must lie on the axis of rotation. To make this adjustment, the screw cut on the end of the spindle which connects it with the disc should be slackened; when this is done, the disc and box will be found to have a certain amount of lateral movement. The clock should be then disconnected by slipping off the band, and the spindle allowed to come to rest. The box should



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be raised with the left hand to lift the spindle off the friction roller; now if the spindle be tapped downwards it will be found to move relatively to the disc. To perfect the balance this process must be repeated two or three times. See *Linnean Society's Journal*, Vol. XVIII. p. 449, also *The Physiology of Plants*, by S. H. Vines ... ... **£5. 5s. 0d.** *Bedrench.*

362. **Klinostat on Adjustable Stand.** The Klinostat itself is similar to the instrument described above, but is supported on a special stand which will allow it to be clamped with the spindle making any angle with the horizon. This angle is read by means of a pendulum and a divided circle, shewn on the right-hand side of the figure ... ... **£10. 10s. 0d.** *Bedroom.*

363. **Klinostat for Intermittent Motion.** In this instrument the spindle remains at rest for a given interval of time and then suddenly turns through half a revolution, remains at rest again and so on. In other respects it is the same as the Simple Klinostat. The interval of rest can be either half-an-hour or one hour as desired. The clock in this case releases a detent at regular intervals of time; this allows a small weight to turn the spindle through half a revolution when the motion is again stopped by the detent. In order to prevent the shock at the end of each half turn, the motion must not be too rapid. A simple form of air governor standing on a separate stand is driven by a thread from the pulley on the spindle of the Klinostat and thus regulates the motion ... **£7. 15s. 0d.** *Bedroppe*

364. Do. do. on Adjustable Stand ... ... **£13. 0s. 0d.**

365. The simple Klinostat can easily be adapted for use as one giving intermittent motion at a cost of ... ... **£2. 12s. 6d.** *Bedstaff.*

366. **Vertical Klinostat.** An instrument for eliminating the effect of one-sided illumination on growing plants. The plant is placed on a small table which rotates by means of clock work about a vertical axis ... **£4. 10s. 0d.** *Bedtime.*

367. **Plant-case,** with apparatus for keeping the temperature constant by means of a gas flame. It consists of a small glass house with the whole of one side forming a door, in which experiments on growing plants can be conducted. It is raised upon four feet and is heated by a double Gas-burner, one flame of which is automatically regulated by a Gas Regulator (p. 99) placed inside the glass house. In order to distribute the heat in the case the flame is applied to a water tank which forms part of the base ... ... *from* **£25. 0s. 0d.** *Beducked*

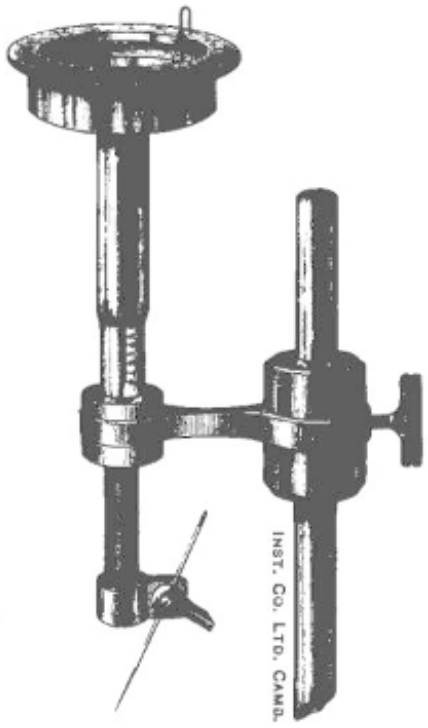
368. **Bell Glass Cultivator,** for Botanical purposes. It is similar to the Incubator (p. 91) except that the egg trays are not supplied and the cover is replaced by a bell glass standing in an annular channel which can be filled with water ... ... **£11. 0s. 0d.** *Beemaster*

369. **Growth, or Auxanometer Lever.** This is useful for experimenting on the growth of plants, and is shewn in the engraving on page 7 recording on the cylinder of the Auxanometer. A thread connects the top of the plant with the short arm of the lever, and the writing point is fixed at the end of the long arm. The lever is a light square wooden bar with a knife edge fulcrum. The thread from the plant is tied to a hook resting on a knife edge. Both knife edges are capable of being placed at any point on the lever, giving a convenient arrangement for altering the ratio of its arms ... ... **£3. 3s. 0d.** *Beerhouse*

(For Auxanometer Cylinder see p. 6.)

370. **Centrifugal Machine for Knight's Experiment.** This instrument is used for demonstrating the effect of gravity on growing plants. The seed or growing plant is attached to a disc of cork fixed to a horizontal axis turning in bearings. The axis which turns in ball bearings is driven at a considerable speed by any convenient Motor (p. 13). The cork disc is enclosed in a bell glass in order to prevent the seed from drying ... ... **£8. 0s. 0d.** *Beershop.*

371. **Potometer** for showing the rate of absorption of water by transpiring plants. *Practical Physiology of Plants*, Darwin and Acton, p. 72 **3s. 6d.** *Beeswax.*



372. **Baranetzky's Pulleys.** This apparatus consists of a vertical steel rod with two adjustable arms at right angles carrying two light and well balanced grooved pulleys, with a small additional grooved pulley on the lower arm. A thread to which a small weight is attached is fastened to the plant under observation and passes over the small pulley; an endless thread passing round the two larger grooved pulleys carries the style in a place most convenient for the recording drum of an Auxanometer ... ... **£2. 5s. 0d.** *Beetrave.*

373. **Cup Micrometer.** A simple piece of apparatus for accurately measuring small vertical movements. It was first designed for Mr F. Darwin for determining the growth of plants. See "On the change of shape exhibited by Turgescent Pith in water," by Miss Anna Bateson, *Annals of Botany*, Nov. 1889. It will measure to the one-hundredth of a mm., and is useful in many cases where a cathetometer is commonly used. The instrument clamps on one of our Simple Stands (see p. 19), and consists of a horizontal arm in the end of which a vertical micrometer screw turns. The vertical movement of the screw is read in the usual manner ... ... **£4. 4s. 0d.** *Befall.*

ANTHROPOMETRIC APPARATUS.

Section 11.

The Instruments described below are used for measuring and testing the chief physical characteristics of the human body, on the same general principles as those exhibited and employed by Mr Francis Galton at the Health Exhibition in London in 1884, but with considerable improvements made in concert with him.

The use of preserving even the minor personal data is considerable, such as those of the colour of the Eyes and Hair, which appear from the large collection of statistics published by the American War Office in 1875, under the direction of Dr Baxter, to be associated with a marked tendency to various forms of disease or to immunity from them. If then, even the colour of the eyes and hair is a proper subject for anthropometric record, much more may we feel assured that the more obviously important personal data deserve measurement and registration.

374. **Colour of Eyes.** The standards used are artificial glass eyes matching those used by Mr Galton. Three standards are used and a number is engraved above each thus: Blue, No. 1; Grey-brown, No. 2; Brown, No. 3. They are mounted in a convenient form for use ... ... **£1. 12s. 0d.** *Befits.*

375. **Colour of Hair.** Five samples of Human Hair are mounted behind a sheet of glass, and a cover is arranged by means of which the light can be excluded. The samples match those used by Mr Galton. Numbers are engraved over each thus: Red, No. 1; Flaxen, No. 2; Light Brown, No. 3; Brown, No. 4; Black, No. 5 ... ... **£1. 10s. 0d.** *Beflatter.*

376. **Head Measurement.** *Horizontal Head Spanner.* This is used for measuring the maximum horizontal length of the head from the forehead to the back, and also the maximum horizontal width across the head in a direction at right angles to this. Two pieces of wood are arranged to slide one against the other in a longitudinal direction, and a pair of slender steel rods are fixed to the ends of each piece of wood, projecting at right angles to them. Each pair of rods is in a plane at right angles to the direction of motion of the slide. In using the spanner, the slide is moved so that each pair of rods just touches the opposite surfaces of the head, and the spanner is moved about until the maximum dimension in the required direction is obtained. The result is read off from a scale either in millimetres, or in inches and tenths ... ... **£2. 5s. 0d.** *Befogged*

377. *Flowers' Craniometer.* This consists of a steel bar divided into inches and millimetres, at one end of which a calliper arm is fixed. The other end being attached to a bone handle. A second arm carrying a vernier slides along the bar. This instrument is generally employed in preference to No. 376, as by its means a considerable number of various anthropometric measurements can be taken. ...
£2. 5s. 0d. *Befool.*

378. *Vertical Head Spanner.* The third dimension required is the maximum height of the upper surface of the head above the plane passing through the holes in the ears and through the lowest part of the orbital cavity of the eyes. The person to be tested sits down and rests his head in a hollowed block fixed to the back of the seat. The attendant loosens the screw behind the head of the person; this allows the measuring apparatus to be moved into the correct position, where it can be fixed by tightening the screw again. During this operation the attendant must keep his eye opposite the centre of the brass ring; on each side of this ring two threads are stretched forming a cross, and he must keep his eye so that one cross appears exactly over the other; the piece of wood to which the ring is fixed must then be moved so that the two crosses are in a line with the hole into the ear. This adjustment requires a little practice. The upper surface of the wooden disc must now be adjusted to the level of the lowest point in the inverted arch in the bone under the eye. The disc must be placed touching the cheek just under the eye, and then the finger placed on its upper surface, projecting beyond its edge, and slightly pressing into the cheek so that the lowest part of the bone can be felt; the adjustment is completed when these surfaces feel level. The brass rod on which the graduations are marked is now at right angles to the plane passing through the required points in the head, and the measurement can be read off when the sliding bar just touches the highest point of the head. The instrument is graduated either in millimetres or in inches as may be desired ... ... **£8. 15s. 0d.** *Beforan.*

379. **Height.** *Height Standing.* A scale in millimetres, or in inches and tenths, is fixed in a vertical position. A horizontal arm projects from a block which slides on the vertical scale. This arm is hinged so that it can move upwards but is prevented from moving downwards by a stop. The person to be measured stands with his heels on the ground and the sliding block is then moved up or down till the head touches but does not raise the horizontal arm; the height is then read off directly from the scale. The thickness of the heel of the shoe is then measured by means of a small scale and subtracted from the former reading.

Height Sitting above seat of chair. The same instrument is used for this purpose by the addition of a low stool, the height of which is subtracted from the reading on the scale. The instrument can be graduated in millimetres or in inches. Complete **£3. 0s. 0d.** *Befriendec*

380. **Span of Arms.** This instrument consists of two long wooden staves sliding one against the other; a piece of wood is fixed at the outer ends of each, forming a plate in a plane at right angles to the direction of the slide. The instrument is held, and the inner surface of the plates are pressed with the finger tips so as to make them slide apart as far as possible, the rod being supported by the thumb and little finger of each hand. The sliding staves should pass in front of the body across the chest. It is graduated in millimetres or in inches ... ... **£1. 1s. 0d.** *Begarders*

381. **Breathing Capacity.** The Spirometer used for this purpose measures the maximum volume of air that can be expelled from the lungs by one expiration. It consists of a cylindrical vessel of known capacity, supported with its

mouth downwards in another vessel containing water. A tube passes through the water and is connected by an india-rubber tube to a glass mouth-piece. After drawing as much air as possible into the lungs the person to be tested places his mouth to the glass mouth-piece and expels the air through the tube into the inverted vessel dipping into the water. The vessel is raised and the height to which it moves is a measure of the volume of air expelled, which can be read off at once from a scale in either cubic centimetres or in cubic inches. The vessel is accurately counter-weighted, and thus remains in the position in which it is left.

£4. 0s. 0d. *Beggable.*

382. Spirometer on Cast Iron Base with scales in cubic inches and cubic centimetres ... ... **£5. 5s. 0d.** *Begild.*

383. **Strength of Hand and Arm.** We supply Salter's Hand-dynamometers for this purpose up to 50 kilogrammes (112 lbs.) ... **16s. 0d.** *Begirt.*

384. „ „ 90 „ (200 „) **£1. 0s. 0d.** *Begloom.*

385. **Keenness of Eyesight.** (Improved form of apparatus.) A wooden bar graduated in millimetres is fixed inside a case to screen it from extraneous light. A carriage containing the card of test type, with a candle for illuminating the card, slides along the graduated bar. At one end of the case a sight tube is fixed through which the observer looks at the type. By moving the carriage along the bar the greatest distance at which the type can be read is easily ascertained.

The test type consist of a series of figures selected at random which have been stereotyped, in order that all instruments issued should be identical in this respect. The type used known as "brilliant" is as follows:— 1 2 3 4 5 6 7 8 9 0. The height of these figures is about 1 mm., thus at a distance of 685 mm. the vertical dimension of the figures subtends an angle of $0^0\ 5'$ at the eye. From this Snellen's formula of $v = \frac{d}{D}$ can be deduced. See "Some new Anthropometrical Instruments" by C. R. Browne, *Proc. Roy. Irish Academy.* 3rd Series, Vol. II. No. 3 ... **£2. 15s. 0d.** *Begnaw.*

386. Card of test type, each ... ... **3d.** *Begonias.*

387. **Appreciation of Colours.** The ordinary test with coloured wools is employed. The samples of wool are wound on black wooden reels and enclosed in a glass tube. The person to be tested is required to place pegs in holes opposite the four shades of green; the attendant then turns the tube by means of a handle and exposes letters attached to each reel. When the colour vision of the person tested is normal, each peg will be found opposite one of the four greens. The whole apparatus is contained in a box, which should be kept shut to prevent the colours fading. Clear daylight is required for the test ... ... **£2. 0s. 0d.** *Begrease.*

388. **Set of Holmgren's Worsteds** consisting of skeins of selected worsteds in wooden case. Complete ... ... **10s. 6d.** *Behaving.*

389. **Estimating Angular Divisions.** The instrument consists of a disc of ebonite with a radial line engraved on one face. A brass bar is arranged to turn about the centre of the disc, so that the bar and the engraved line can be set at any angle. The person to be tested rotates the disc and alters the angle between the radial line and the brass bar, until he thinks the angles are right angles. A divided arc is fixed on the back of the instrument, by looking at which, the error in half degrees in estimating squareness can be read at once. The same divided arc can be used for reading the error in judging angles of 45° and 60° ... **£1. 5s. 0d.** *Behight.*

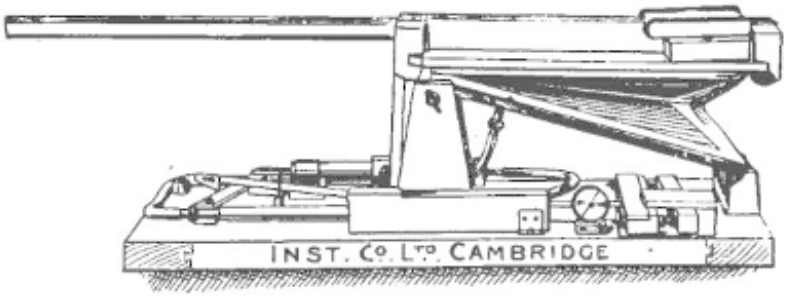
390. **Estimating the Divisions of a Line.** A strip of ebonite ten inches long has a small sliding strip of brass on it. This sliding piece carries a thread which forms a white line on the ebonite. The person to be tested moves this sliding piece until he thinks that the line divides the ebonite strip into two equal parts. On looking at the back of the instrument, he at once sees any error from a scale on the brass sliding piece itself. This scale is divided into tenths of an inch, so that the error is given in a percentage of the whole length. The scale can be also used for estimating the judgment of the eye in dividing the strip of ebonite into thirds and quarters of its whole length ... ... **10s. 0d.** *Behindhan*

391. **Dr Rivers' Line Divider** ... ... **18s. 0d.** *Beholding.*

392. **Appreciation of Differences in Musical Pitch.** This instrument has been modified since the last description was published.

The sound is produced by a closed organ pipe, and the pitch is varied by changing its length. An automatic arrangement has been adopted by which the sound is continued during one second, then there is silence during another second, then the sound is reproduced during a third second. The duration of the sound and the silence between the sounds can be varied by turning one of the screw taps.

The instrument is used as follows:—A scale is adjusted to fix the amount of movement that can be given to the sliding plug in the organ pipe. This will allow two notes to be sounded differing by any number of hundredths of a semitone. When the scale is at zero the note sounded is Ut_4 (1024 single vibrations per second) and when at 100 it is Si_3 (966·5 single vibrations per second), that is, each division on the scale corresponds to a change of 0·575 complete



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vibrations per second. It is best to begin with an interval that can be easily appreciated. If the person to be tested can, after several trials, distinguish between the notes either by saying they differ or by knowing which is the sharper, the interval between the two notes is reduced, until the limit of appreciation is found. Care should be taken to keep the air pressure constant during each experiment ... ... **£12. 0s. 0d.** *Behoovabi*

Hearing highest audible Note. This instrument consists of a whistle of very small bore with an arrangement for varying its length by an adjustable plug. It is sounded by squeezing air out of a small india-rubber bag. The whistle always makes two sounds at the same time, the high musical note best described as a very shrill squeak and the noise made by the air leaving the mouth of the whistle. To apply the test the whistle is sounded and the length of its pipe shortened, until a point is reached when the squeak becomes inaudible. With a little practice this can be easily done ; the length of the whistle is then measured by inserting a wedge-shaped ivory scale between a flange fixed to the plug itself and a flange on the whistle : the numbers engraved on the scale giving the pipe-length of the whistle in millimetres. See, "On the Measurement of the Frequency of the Notes of a Whistle of adjustable pitch." By W. N. Shaw, M.A. and F. M. Turner ; read before the Cambridge Philosophical Society, Feb. 28, 1887. See also, "On the Notes sounded by Mr Galton's Whistles for Testing the limit of Audibility of Sound," by W. N. Shaw, M.A., *Journal of the Anthropological Institute*, November, 1887.

The following table gives some of the results of these papers :

Length of the pipe of the whistle in millimetres.	Calculated number of complete vibrations per second neglecting errors.	Approximate number of complete vibrations per second calculated by the results of the experiments.
1·0	85,000	42,500
1·2	70,830	38,600
1·4	60,710	35,400
1·5	56,670	34,000
1·6	53,130	32,700
1·8	47,220	30,360
2·0	42,500	28,330
2·5	34,000	24,290
3·0	28,330	21,250
3·5	24,290	18,890
4·0	21,250	17,000
5·0	17,000	14,170
6·0	14,170	12,140
7·0	12,140	10,630
8·0	10,630	9,440
9·0	9,440	8,500
10·0	8,500	7,720

Care is taken to make all the whistles as nearly identical as possible.

The arrangement adopted by Mr F. Galton enables the tests to be made accurately and quickly. The air for the whistle is forced from a large air-bag at a constant pressure by means of weights. To make the test the attendant turns on the air to the whistle when it is so short that no audible note is produced. He then slowly increases the length of the whistle by means of a long lever, and when the note becomes audible to the person being tested reads the pipe-length on a magnified scale.

393. Price of whistle and ivory scale ... ... **£1. 5s. 0d.** *Belaudec*

394. Apparatus complete with bellows, long lever, whistle, &c. ... ... **£6. 10s. 0d.** *Belfries.*

395. **Reaction Time Chronograph.** Improved design. This instrument is for measuring the interval of time between a signal and the depression of a key by the person observing the signal. The person rests his hand on a slab with his finger on a key. On hearing or seeing the signal, as the case may be, he moves the key as quickly as possible. The time is measured by the distance through which a rod has fallen, and its amount is read off directly from graduations on the rod itself in hundredths of a second. The falling rod has an armature attached to it and is held up by an electro-magnet; on breaking the circuit the rod falls. The signal sound is given after it has fallen a definite distance by a weight which rests on the top of the rod being caught by a diaphragm. If a sight signal is required this weight is removed and the instrument is placed so that a bright light can be seen through a small aperture; the falling of the rod opens this aperture after it has fallen a definite distance. The depression of the key releases a catch which brings the rod to rest. The maximum period of time that can be measured by this instrument is three-tenths of a second. It is arranged to fix against a wall. Fitted for sound and sight signals ... ... **£8. 15s. 0d.** *Belike.*

396. **Neuramæbomometer.** This apparatus was designed by Exner for determining Reaction time for sound. It consists of a vibrating style (vibrating 100 per second) which is set in motion at the same instant that a sound is made. The observed person directly he hears the noise presses a key which lifts the style off a moving smoked glass plate. From this curve it is easy to calculate the time which has elapsed between the emission of the sound and the movement of the key by the observed person. See Stirling's *Practical Physiology*, 3rd Ed. pp. 326, 7 ... ... **£3. 2s. 6d.** *Beliming*

397. **Appreciation of Weight.** This instrument consists of a box containing ten trays which can be easily removed. Each tray contains three weights, identical in size and appearance but differing in weight from each other. The three weights in each tray form a series of gradually increasing weights in geometrical progression, and the series in each tray differ in value.

It follows from Weber's law, that if a person can just appreciate the differences between two consecutive weights in one tray, he can then also just appreciate the difference between the other consecutive pair in that tray.

The following are the values of the weights in each tray, where $W = 1{,}000$ grains and $r = 1{\cdot}01$.

Tray	No.	2	contains	weight	Wr^0,	Wr^3,	Wr^4.
,,	,,	3	,,	,,	Wr^4,	Wr^7,	Wr^{10}.
,,	,,	4	,,	,,	Wr^6,	Wr^{10},	Wr^{14}.
,,	,,	5	,,	,,	Wr^4,	Wr^9,	Wr^{14}.
,,	,,	6	,,	,,	Wr^0,	Wr^6,	Wr^{12}.
,,	,,	7	,,	,,	Wr^0,	Wr^7,	Wr^{14}.
,,	,,	8	,,	,,	Wr^2,	Wr^{10},	Wr^{18}.
,,	,,	9	,,	,,	Wr^0,	Wr^9,	Wr^{18}.
,,	,,	10	,,	,,	Wr^4,	Wr^{14},	Wr^{24}.
,,	,,	12	,,	,,	Wr^0,	Wr^{12},	Wr^{24}.

Each weight has engraved in an inconspicuous manner the index of the power of r: thus in Tray No. 3 they have 4, 7, 10. Thus the number of each tray is the difference of the powers of r in two consecutive weights in that tray.

To perform the test, Tray No. 6 is removed and the person is asked to arrange the weights in their order of heaviness; if this is performed correctly, No. 5 is taken, and so on until a point is reached at which the person to be tested fails to put the weights in the right order. The number of the last tray correctly arranged is a measure of the dulness of the power of appreciating weight. Each tray has engraved on it the indices of r of its weights and also its number. See "On Apparatus for Testing the Delicacy of Muscular and other Senses in Different Persons" by Francis Galton, F.R.S., *Journal of the Anthropological Institute*, May, 1883.

£5. 0s. 0d. *Bellcra*

398. **Personal Weighing Machine,** fitted with sliding standard for measuring the height of the person. With weights complete. ... **£9. 0s. 0d.** *Belled.*

399. **Æsthesiometer,** by Sieveking, in case ... ... **£1. 1s. 0d.** *Belliger*

We are prepared to supply the other requisites for fitting up an Anthropometric Laboratory. These would consist of perforated cards on which the measurements taken are written in duplicate: one half is given to the person measured, the other half being left at the Laboratory. These cards would be printed to suit the requirements of the Laboratory; as a specimen, a copy of the cards used by the Cambridge Anthropometric Committee would be sent by us if specially asked for. A cabinet to contain the cards, which are numbered consecutively, would also be supplied; each drawer of which would contain 1000 cards. A book to contain the names of the persons measured and the number of their cards is also necessary.

400. **Cards,** similar to those used by the Cambridge Anthropometric Committee ... ... *per* 1000 **£2. 13s. 0d.** *Bellitude.*

"Ceres" Cabinets in Basswood fitted with V grooving to fit different sized cards.

401. 3 Drawers. Capacity 2,000 cards ... ... **£6. 5s. 0d.** *Bellow.*

402. 3 „ „ 3,000 cards ... . **£7. 5s. 0d.** *Belmetal.*

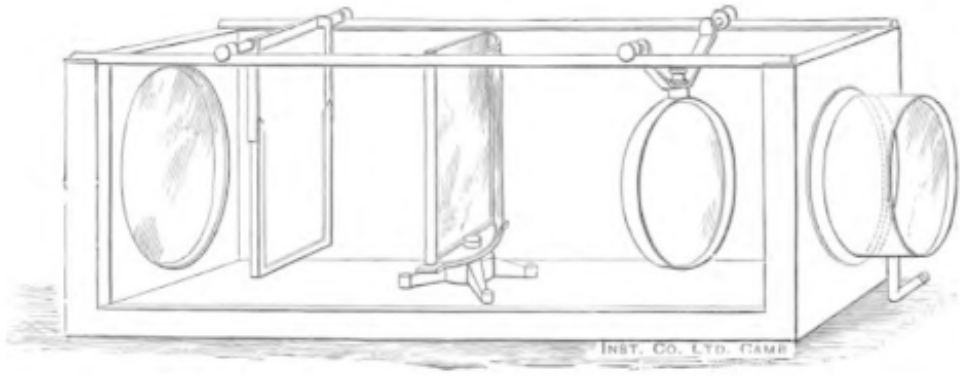
403. 4 „ „ 5,000 cards ... ... **£9. 15s. 0d.** *Belwether.*

Brass Rod to hold the Cards in the drawers, fitted to come away in front with half a turn. per Drawer. Extra. *Benangle.*

Special size Alphabetical or Blank Guides for same. Extra. *Benask.*

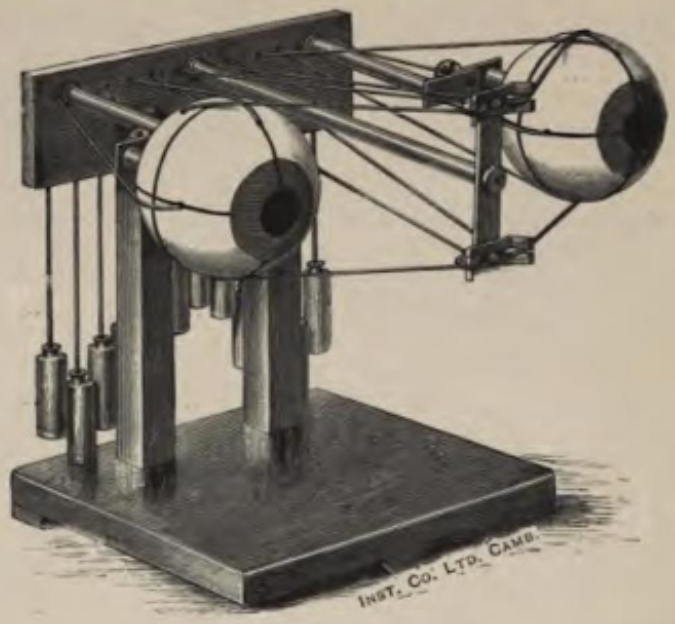
404. **Punch,** specially designed for cutting nicks in bottom of Cards to ensure their being placed in the correct position ... ... **£2. 0s. 0d.** *Beningle.*

Models.



405

405. **Kühne's Artificial Eye,** for demonstrating the chief optical phenomena of the eye. It is an optical model of the eye on a scale of about 12 to 1. The curvatures of the cornea and lens are so adjusted that the refraction is distributed between them in the same proportion as in the natural eye. The relative positions and distances of the chief optical points of the artificial eye are also the same as in the natural eye ... ... **£6. 15s. 0d.** *Benefit.*

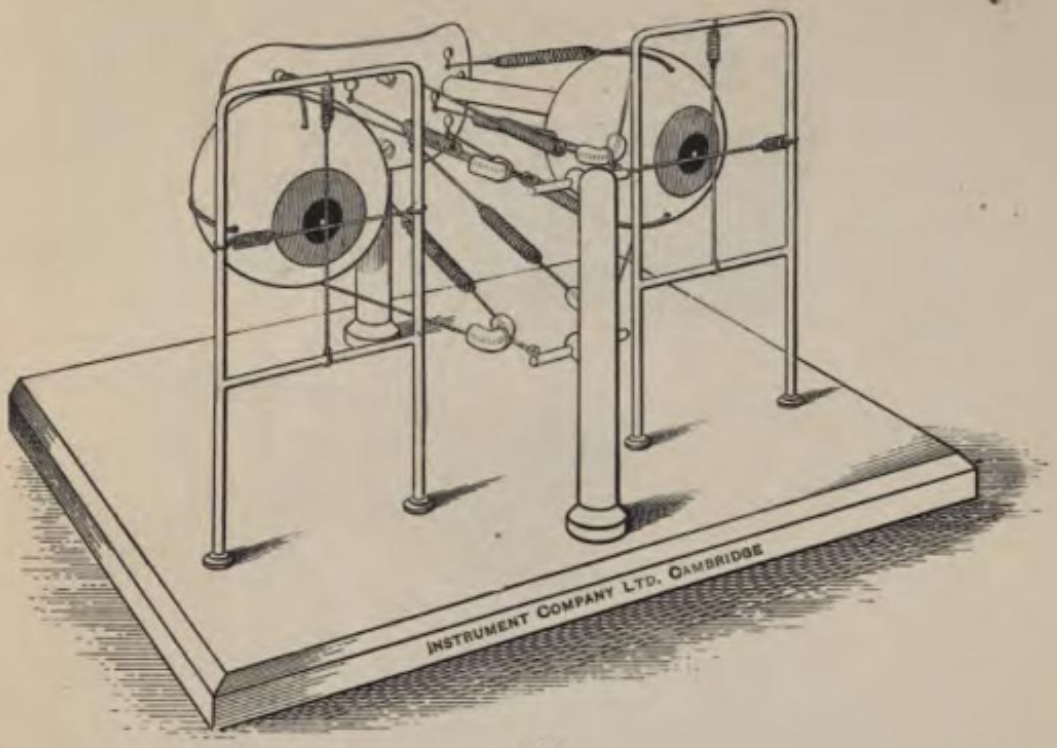


406

406. **Helmholtz's Eye-Muscle Model.** The eyeballs are represented by wooden balls supported so as to be able to turn in any direction. Silk threads are attached to these balls and are led away so as to correctly represent the various muscles. Weights are attached at the other ends of the threads to keep them tight, and they are made of different coloured silk in order to make them easily distinguishable ... ... **£7. 10s. 0d.** *Bentgr*

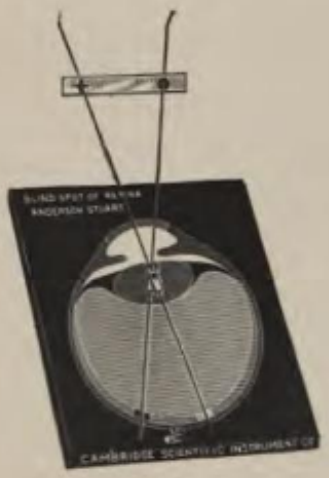
407. **Anderson Stuart's Eye-Muscle Model** to demonstrate the action of the External Muscles of the Eyeball. In this model the external muscles of the eyeball are represented by spiral brass springs which cannot be overstretched so that they retain their proper tension. A convenient stop on the cords permits the demonstration of the effect of paralysis of one or more muscles on the position of the ball as modified by the still continuing action of the other muscles. The changes of position of the ball are shewn by the adjustable frame indicator. In box complete ... ... **£2. 10s. 0d.** *Benym*

408. **Blind Spot Model.** This model designed by Prof. Anderson Stuart consists of a board on which is painted a diagram representing a horizontal section through the eyeball. Two fine metal rods representing the axes of two pencils of light turn about the optical centre of the lens in a manner very similar to a pair of scissors. The blind and yellow spots are represented on the retina by two black and yellow spots respectively. A small strip of brass on which is painted a



407

cross and spot slides along these rods, one rod passing through the cross and the other through the spot. When this piece of brass is slipped backwards and forwards it will be found that in one position the opposite end of one rod falls on the blind spot and of the other rod on the yellow spot ... ... **15s. 0d.** *Beplaited.*



408



409

409. **Corresponding points on the Retina.** This model was designed by Prof. A. Stuart to show the corresponding movement on the retina of the two eyes of a person. A board painted to represent a horizontal section through a pair of eyes, has two large concave metal mirrors fixed at right angles to the board to represent the retinae of the two eyes. These mirrors are adjustable to allow of an object being placed in the focus of both mirrors. When this object is moved in front of the mirrors the image is seen to move an equal amount in each mirror ...
£1. 1s. 0d. *Bepraise*

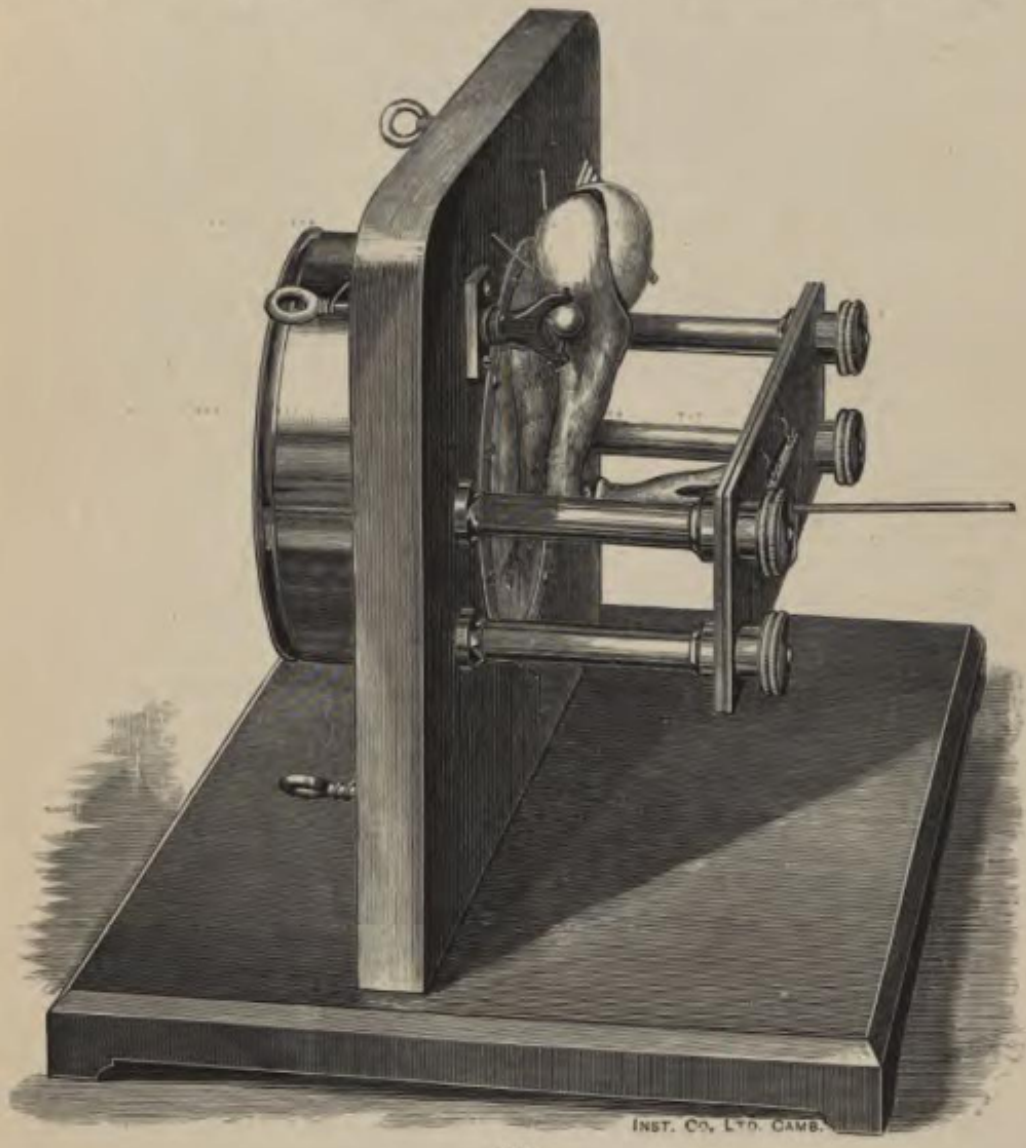
410. **Eye Model to illustrate Diplopia,** the design of Professor Anderson Stuart. By this simple device the questions of what diplopia would result from a given muscular disturbance, and conversely what muscles are at fault with a given diplopia, are answered with ease and certainty. The eyeballs are represented by two wooden spheres; they rest in small cups and can thus be made to point in any direction. A biconical hole—the anterior cone smaller—passes through each sphere; the pupil is represented by the base of the smaller cone, and the retina is represented by a piece of perforated zinc covering the base of the large cone. The axial ray of a pencil of light is represented by a sharpened wire passing through the pupil and piercing the retina where the image would fall. The yellow spot, optic nerve and disc are indicated.

In demonstrating—to find the diplopia for a given muscular lesion—the eyeball is displaced according to the muscular lesion, and the wire, pointing to where the object *is*, is passed through the ball till it pierces the retina. If the eye be now replaced in the normal position the wire will point to the place in the outer world where the object *would appear to be*. Conversely in determining the muscular lesion for a given diplopia, place the ball in the normal position and thrust a wire into it as if from the apparent object, turn the ball into the position in which the

wire points to the real object—for this position of the eyeball the muscles at fault may now be determined. When the yellow spot is opposite the head of the indicator, the demonstrator standing behind knows that the balls have their axes parallel.

See *Journal of Anatomy and Physiology*, Vol. XXV. p. 297. ... **£1. 5s. 0d.** *Bequeath.*

411. **Helmholtz's Ear Model** to illustrate the action of the auditory ossicles. The drum is represented by a leather diaphragm. In order to increase the action of the air an india-rubber membrane is stretched over the mouth of a tube and encloses air between it and the tympanum. On striking the membrane the air moves the leather diaphragm and the bones are moved; the motion of the stirrup bone being magnified by means of a lever ... ... **£8. 10s. 0d.** *Berattle.*



411

412. **Priestley Smith's Demonstrating Ophthalmoscope.** **£3. 10s. 0d.**

413. **Morton's Ophthalmoscope.** ... ... **£3. 12s. 0d.**

414. **Arterial Schema,** a model for demonstrating the phenomena of the Arterial System. The heart is represented by two india-rubber balls connected together by a tube. They act as a pump and force water round a closed system of india-rubber tubes. The water enters one ball through a valve, passes to the other by a short piece of glass tube containing a valve, and then into the tube through a third valve. The balls are squeezed in a manner to represent the beats of the heart. In one part of the system of india-rubber tubes, there is inserted a glass tube which is filled with pieces of sponge and represents the capillary blood-vessels. Two mercury manometers are used and are conected to the india-rubber tube by cannulæ, similar in construction to Ludwig's Arterial Cannula (p. 50). The complete apparatus includes two Mercury Manometers, Cannulæ and Sphygmograph with the Simple Stand. Complete ... ... **£10. 0s. 0d.** *Bergamo*

415. **Rutherford's Arterial Schema.** In this apparatus the heart is represented by a single ball, and is made in one piece with the necessary india-rubber tubing. The use of glass T-pieces is avoided, as the branching tubes are also made in one piece ... ... **£3. 5s. 0d.** *Bergmas*

416. **Kymoscope,** for demonstrating many of the phenomena of the circulation. This instrument was designed by Professor Anderson Stuart. A metal tube is coiled into the form of the thread of a horizontal screw; vertical glass tubes with their upper ends open are connected to the highest point of each coil; they are close together and the level at which a coloured liquid stands in them shews the pressure in each coil. The two ends of the coil are connected to the inlet and outlet of an india-rubber ball with valves, representing the ventricle of the heart. When this is compressed by the hand, the coloured liquid in the tubes forms a wave-shaped curve which moves forward. As the liquid is free to rise and fall in the glass tubes, the metal tube becomes practically an elastic tube. See *Journal of Physiology*, Vol. XII., 1891 ... ... **£5. 0s. 0d.** *Beseemec*

417. **Kymoscope** for demonstrating interference and other phenomena of Wave Motion. This instrument was designed by Professor Anderson Stuart, and differs only slightly from the last described. The coil of metal tube has two inlets joining like the limbs of an inverted Y and is blind at the other end. The inlet tubes take each one complete coil; these coils then join and are connected to the end of a coil of metal tube as described in the last instrument. An india-rubber ball without valves is connected to each inlet coil; these balls are compressed by hand and thus a wave is sent along the coils. A glass manometer tube rises from

each of the separate coils, and thus the variation of pressure produced by each of the india-rubber balls is shewn separately as well as the form of the combined wave

£5. 0s. 0d. *Beshrouded.*

418. For greater precision a pump without valves can be used in the place of the india-rubber balls. It is driven by hand or by a motor, and consists of two barrels with pistons driven by cranks fixed to the axis of a fly-wheel. The amount of water displaced at each stroke can be altered by shifting the crank pin nearer the centre; there is also an arrangement for altering the relative positions of the cranks; by these means both the phase and the amplitude of the waves can be altered absolutely and relatively. See *Journal of Physiology*, Vol. XII., 1891. Price of Pump ... ... **£5. 15s. 0d.** *Besmytan.*

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