RITCHIE'S

CATALOGUE

OF

PHILOSOPHICAL APPARATUS.

ALLICIT ALENDO.

E. S. RITCHIE & SONS,

No. 149 TREMONT STREET,

BOSTON.

1870.

RITCHIE'S

ILLUSTRATED CATALOGUE

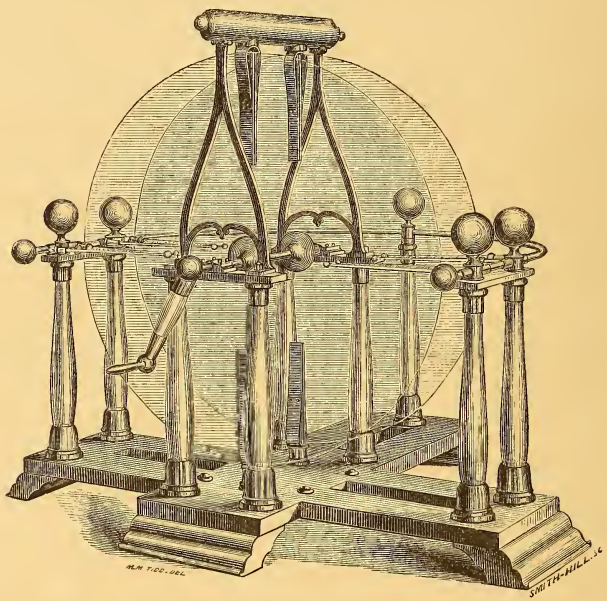
OF

PHILOSOPHICAL INSTRUMENTS,

AND

SCHOOL APPARATUS.

ROOMS, 149 TREMONT STREET,
BOSTON.



ELECTRICAL MACHINE CONSTRUCTED BY E. S. RITCHIE FOR THE UNIVERSITY OF MISSISSIPPI.

This machine is the largest ever made; the Plates are each *six feet* in diameter. The instrument is finished in the most elaborate manner, and is mounted upon nine massive cut glass pillars, and rosewood basement. A Prime Conductor of three cylinders with cut glass pillars and basement, and a Battery of 100 Leyden Jars supported upon a table with a single cut glass pillar, accompany the instrument.

Entered, according to Act of Congress, in the year 1870, by

E. S. RITCHIE & SONS,

In the Clerk's Office of the District Court of the District of Massachusetts

PRESS OF RAND, AVERY, & FRYE.

ADVERTISEMENT.

TERMS, Cash. No discount or deviation can be made from Catalogue prices.

Orders can be made by giving the numbers of each Department, and date of Catalogue.

Drafts at sight to our order, on New York or Philadelphia, received at par. For small sums, post-office money-orders are convenient.

The expense of boxing, packing, and delivery to rail-road, will be added to the bill; it usually amounts to two and a half per cent.

Great care will be used in packing, and unless the case meets with violence, every thing will be received in good order; but unless we *insure*, our responsibility ends with the delivery in good order to the public carrier. The risk of injury by ordinary *freight* lines is far less than by Express.

We insure, when desired, and the amount exceeds $25, against damage by transportation and fire; the premium will depend on the distance, and the nature of the instruments. On an average invoice and risk it will be two and a half per cent. Marine insurance will be effected, when desired, from underwriters.

Purchasers are requested to give particular directions by what route and lines to forward.

PREFACE.

THE Instruments enumerated in this Catalogue are almost exclusively of our own manufacture. The prices, though necessarily advanced since our last edition, are as low as we can fix them for the quality of the work, and are based on the cost of production; we shall adhere strictly to our rule, that every thing shall be thoroughly well made and finished, of best materials, and carefully adjusted; and every article is warranted to be so, and to correspond to the description.

Particular care is given to the lacquering, which is done in a manner that will resist the action of the atmosphere, and bear use and handling for a long time untarnished.

No discount or deviation can be made from our prices, and those who favor us with orders by mail, may rely on receiving instruments as good in quality, and at the same price, as if they came personally.

It is our aim to make, as far as possible, all the new instruments which modern research requires and calls forth; and we are prepared to make other instruments not included in this catalogue. Prices of articles left blank will be given by mail.

The great increase in our business has rendered it necessary to remove our manufactory. We have largely added to our room and facilities, and hope to be able to fill the orders of our friends with promptness. Our sample room is at No. 149 Tremont Street, two doors from West Street, fronting Boston Common.

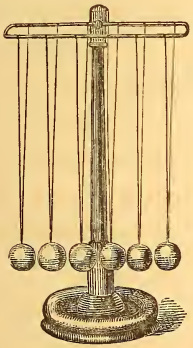
E. S. RITCHIE & SONS.

EDWARD S. RITCHIE.
THOMAS P. RITCHIE.
JOHN RITCHIE.

E. S. RITCHIE & SONS'

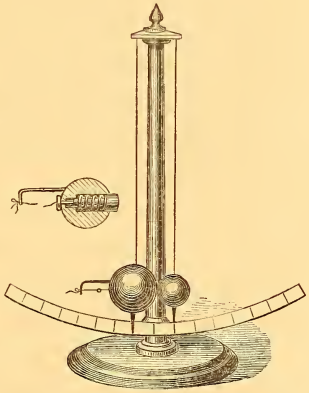
CATALOGUE.

LAWS OF MATTER AND MECHANICS.



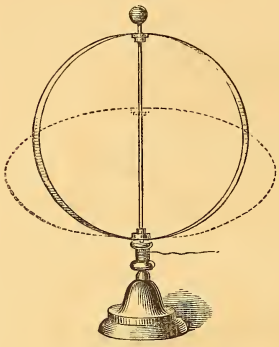
Nos. 3, 4.

No. 5.

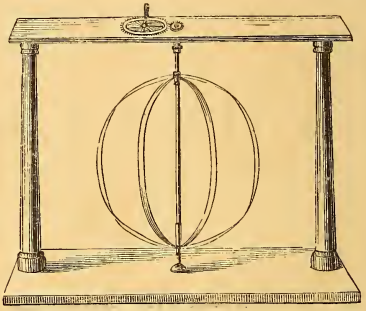


No. 7.

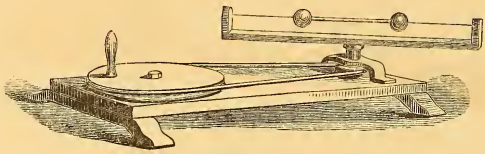
NUMBER		PRICE
1.	**Inertia Apparatus**; mahogany stand, with spring and ball, . . .	$1.75
2.	**Lead Hemispheres**; a pair, with handles, for adhesion, ...	1.00
3.	**Collision Balls**; mahogany frame, with six $1\frac{1}{2}$ inch ivory balls suspended by two silk cords; graduated ebony arc, ...	18.00
4.	**Collision Balls**; similar to No. 5, with lignum-vitæ balls, and ebony arc,	7.25
5.	**Collision Balls**; a set of five lignum-vitæ balls, $1\frac{1}{2}$ inch diameter, suspended upon a metallic bar which is fitted to attach to the pillar of the set of *Mechanical Powers* (see No. 17, *Mechanics*), ...	3.50
6.	**Collision Balls**; set of three, to attach to frame of No. 3 or 4, of diameter of $1\frac{1}{4}$, $1\frac{1}{2}$, and $1\frac{3}{4}$; of wood, 1.50; of ivory, ...	7.00
7.	**Illustration of Momentum**; two ball pendulums are suspended; one contains a spring hammer, the other is solid, of half its weight, two additional balls, of one third and one fourth proportionate weight. The spring is to be held back by a thread, which in the experiment is burned. An equal force is expended on each of the balls, which are thrown distances proportionate to their mass, ...	10.00

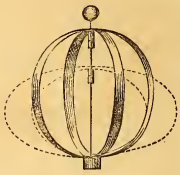


No. 12.



No. 11.





No. 13.

NUMBER PRICE

8. **Centre of Gravity**, a set of illustrations, including three blocks with centres; two balls upon a rod with centre; leaning tower with two centres; loaded wheel on stand, with centres of magnitude and gravity; double cone and inclined plane, with handles, ... 10.00

9. **Leaning Tower**, separately, ... 1.25

10. **Waltzers**; two little figures attached to a lens which rotates upon an inclined wet glass plate, ...75

11. **Whirling Machine**; illustrating the flattening of the poles of the planets, the revolution of bodies on their shortest diameter, &c.; mahogany frame, brass wheels, movable spindle; eight illustrations, . . 18.00

12. **Central Forces**; a heavy metal stand and spindle, an elastic ring, with a spool attached for a cord. By quickly drawing the cord, a rapid motion is given and the cord rewound in the opposite direction; the ring is flattened by the *centrifugal* force, ... 3.75

13. **Whirling Table**; Mahogany base, with feet; a strong metal spindle suspended in a frame, with pulley, driven by wheel and crank; the spindle has fittings to attach—

1st. A frame with a wire, upon which are placed,

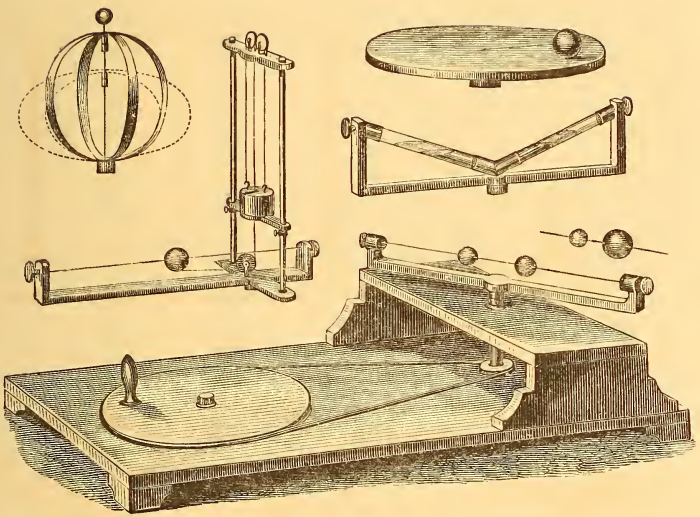
a. Two balls connected by a tube.

b. A central ball fixed upon the wire, to which is attached a smaller ball held by a rubber spring for revolution as *sun and planet*.

2d. Globe for mercury or water.

3d. Elastic Globe, illustrating the flattening of the poles, ... 37.50

NOTE. To this spindle can be attached other instruments requiring rapid revolution, such as No. 26 *Optics*, No. 47 *Heat*, and No. 174, *Electricity*, &c.

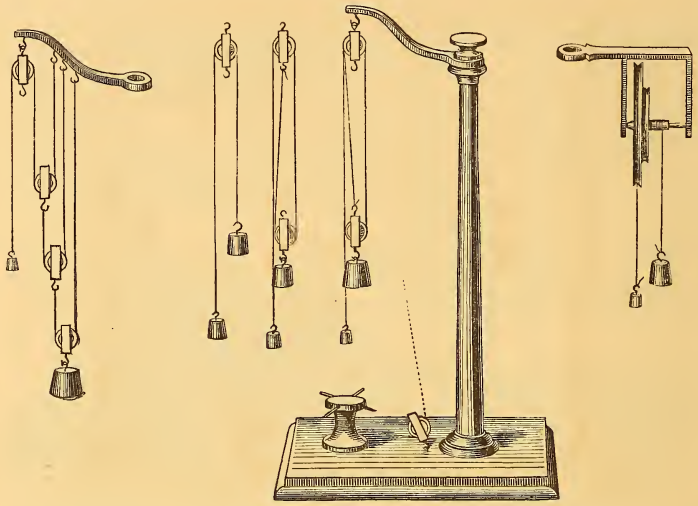


No. 14.

NUMBER PRICE

14. **Whirling Table,** illustrating the effects of centrifugal force; mahogany table; steel shaft and pulley, with driving wheel and winch. The shaft is furnished with a screw, upon which are attached,—
    1. A frame with a wire upon which are placed two balls of equal or of unequal masses.
    2. A frame with inclined glass tubes for liquids of different specific gravity, as mercury and water.
    3. A double brass elastic ring upon a spindle.
    4. A circular table, with a ball which is secured by a cord and swivel to its centre; illustrating effects of *Inertia*.
    5. An instrument for determining the centrifugal force. Upon a wire, stretched on a frame, is placed a heavy brass ball; a cord attached to it passes under and over pulleys to a weight, which is placed in the line of the centre of motion, guided by two brass pillars; the weight is in several sections, so that a greater or less amount may be applied. The ball is secured to the cord by a binding screw, so that it may be placed at pleasure at different distances from the centre of motion, and the comparative force measured by the amount of weight raised, ... 110.00

15. **Whirling Table**; in form similar to No. 14, with a governor attached in such manner that in a series of experiments the same velocity, or that of two or three times greater, may be obtained with certainty, and the great laws of central forces illustrated in a beautiful manner, 125.00



No. 5, 16, 17.

NUMBER PRICE

16. **Illustration of Pulleys**; polished mahogany basement and pillar, with a screw and nut to confine a brass bar, with hooks for the following systems; the pulleys are brass, with improved straps; in the double ones the wheels are separated by partitions; all the systems are balanced, strung with silk cords, and packed in neat boxes; height 3 feet.

1st. *Fixed Pulley*, and cord; power and weight equal.

2d. *Fixed and Movable Pulleys*, power and weight as 1 to 2.

3d. *Double Fixed and Movable Pulleys*, power and weight as 1 to 4.

4th. *System of Four Single Pulleys*, power and weight as 1 to 2, 4 or 8.

5th. *Wheel and Axle*, with four diameters, and cords, suspended in a brass frame to attach to the pillar, and giving powers to weight as 1 to 2, 4, 8, and 16.

6th. *Capstan and Levers*: a hook is placed on the base to attach a fixed pulley, to pass the cord over to a system of pulleys on the bar; the spindle of the capstan may be unscrewed and removed.

A set of brass weights from 1 to 32 ounces, ... 65.00

17. **Illustration of Pulleys**; thirty inches in height; plain mahogany base and pillar; the supports for the systems, and also the weights, are of iron, neatly japanned; the pulleys are of brass, and systems are balanced, and include —

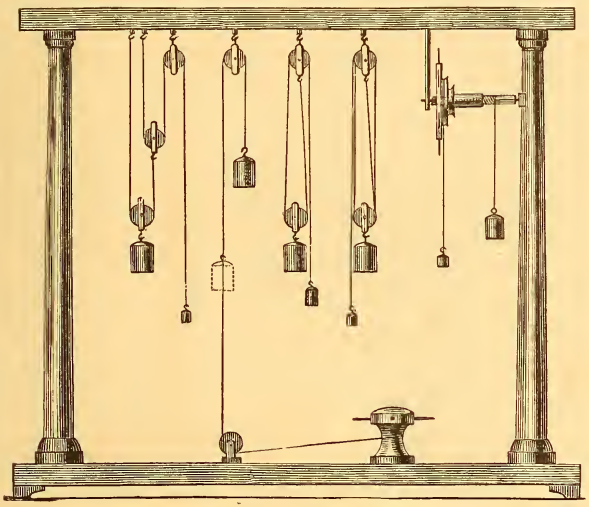
1st. *Fixed Pulley*. 2d. *Fixed and Movable Pulleys*.

3d. *Double Fixed and Movable Pulleys*. 4th. *Wheel and Axle*.

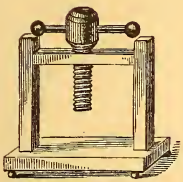
5th. *Capstan and Levers*.

A set of iron weights from one to 32 ounces, ... 20.00

NOTE. This arrangement has the advantage of requiring much less room, and also that the teacher has before his class only the system which is the subject at the time. The set of collision balls, No. 5, can be attached to the pillar.

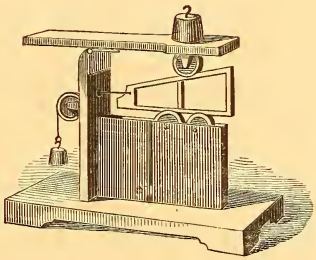


No. 18.



No. 19.

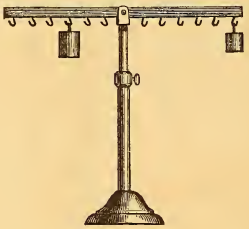
No. 20.



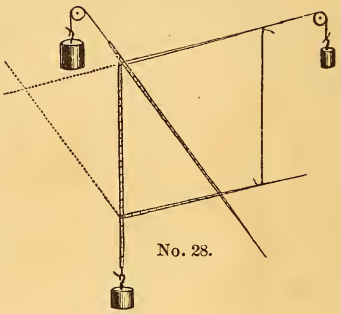
No. 21.

NUMBER PRICE

18. **Illustration of Pulleys**; polished mahogany frame, with four systems. The pulleys are large, with improved straps, with divisions, strung with silk cord and balanced.
    1st. *Fixed Pulley*, and cord; power and weight equal.
    2d. *Fixed and Movable Pulleys*, power and weight as 1 to 2.
    3d. *Double Fixed and Movable Pulleys*, power and weight as 1 to 4.
    4th. *System of four Single Pulleys*, power and weight as 1 to 2, 4, or 8.
    5th. *Wheel and Axle*, with four diameters, and cords.
    6th. *Capstan and Levers*.
    A set of brass weights from one to thirty-two ounces, ... 45.00
19. **Screw**, mounted on mahogany frame, ... 6.00
20. **Wedge** of mahogany, in two sections, separable, ... 2.00
21. **Illustration of the Wedge**; mahogany frame, brass wedge, with friction rollers; the upper bar and roller are balanced, ... 12.50

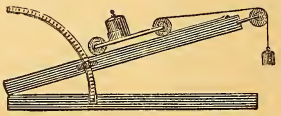


No. 24.

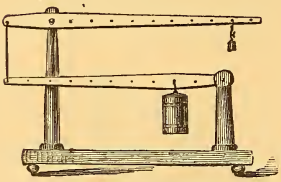


No. 28.

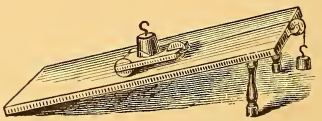
No. 22.



No. 27.



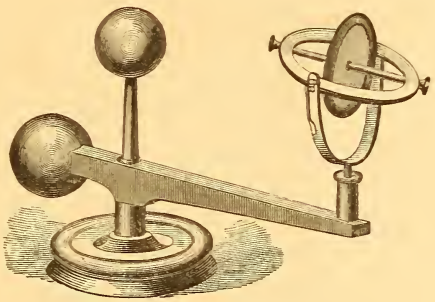
No. 23.



No. 26.

NUMBER		PRICE
22.	**Simple Lever**, with fulcrum,	1.75
23.	**Compound Levers**; mahogany base, pillar and levers,	5.50
24.	**Lever Balance** and Steelyard; brass pillar, mahogany beam, with knife edges, and hooks for weights,	15.00
25.	**Lever Balance** and Steelyard; same as No. 24, mounted on plain mahogany base and pillar,	10.00
26.	**Inclined Plane** and Car; mahogany plane, with fixed pillars; wheels and pulleys of brass,	4.00
27.	**Inclined Plane** and Car; mahogany base and movable plane, with arc and binding screws,	8.50
28.	**Parallelogram of Forces**; a light, graduated frame, with hinged joints, illustrating beautifully the composition and resolution of forces, with pulleys to attach to the frame of No. 18, or to the blackboard,	7.50
29.	**Cube Root Solids**; set of eight pieces, illustrating the extraction of square and cube roots, of mahogany, in box,	1.25
30.	**Set of 64 inch Cubes**; for same illustrations, in box,	1.75
31.	**Set of Solids**; illustrating the mensuration of solids; ten cubes, and rectangular and oblique prisms, papered, with lines,	1.50
32.	**Dissected Cone**; illustrating conic sections, viz. the circle, ellipse, parabola, and hyperbola, made in an improved manner, 3.00 and	5.00

No. 38.



No. 35.

NUMBER PRICE

33. **Gyrascope**; three inch brass wheel, accurately balanced, with gimbal for the centre; removable arm with sliding weight and binding screw, 10.50

34. **Gyrascope**; supported on gimbals, four inches diameter, accurately balanced, mahogany stand, ... 15.00

35. **Gyrascope**; mounted on gimbals, and supported upon a balanced frame. By the persistency of the wheel to revolve in the same plane as it is turned around the centre, it beautifully shows the motions of the earth around the sun; with a small weight attached to one of the axes it illustrates the *precession of the equinoxes;* four inch wheel, . . 25.00

36. **Gyrascope**; eight inch wheel, which revolves within two gimbal rings; mounted upon a mahogany [illegible] pillars, finely finished, . . 65.00

37. **Driving Pulley** and Frame, for giving motion to No. 36; the wheel and gimbal is taken from its stand and placed on pulley frame, so that its axis rests on the periphery of the pulley, and a very rapid motion can be given it, ... 20.00

38. **Plateau's Apparatus**; a glass globe ten inches in diameter, with brass cap and stand; a shaft, crank, and movable disc. A quantity of oil is poured through a tube into the globe, which is filled with a mixture of water and alcohol of the same specific gravity; it assumes a spherical form around the disc; by turning the crank the sphere becomes oblate, and finally portions are thrown off as *planets*, ... 10.50

39. **Endosmeter**; mahogany base and pillar, with adjustable screw clamps; graduated glass tube, with bell for the membrane, and jar, . . . 9.00

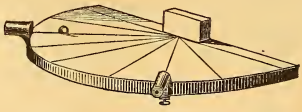
40. **Endosmeter**; graduated tube and glass bell to tie a membrane over, . 2.25

41. **Models of Crystals**, of thin plate glass, of two to three inches diameter, with threads representing their axes, ...

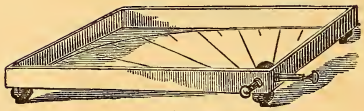
42. **Models of Crystals**; in wood, to order, ...

43. **Models of Crystals**, 13 pieces; giving the primary forms, according to Dana, in large size, ... 3.25

44. **Geometrical Solids**; set of thirteen, including three and six-sided prisms, cylinders, cone, pyramid, frustums of cone and pyramid, sphere, hemisphere, oblate and prolate spheroids, neatly made in fine wood, and in box, ... 2.00



No. 45.



No. 46.

No. 50.

NUMBER PRICE

45. **Apparatus** for reflection of motion; marble semicircle with spring pistol, ivory ball and receiving cup, showing that the angle of incidence is equal to the angle of reflection, ...

46. **Spring Table**; mahogany table, with spring pistols and ball, for illustrating composition of forces, ... 15.00

47. **Capillary Tubes**, a set of six, of different calibres, with stand, . . . 1.75

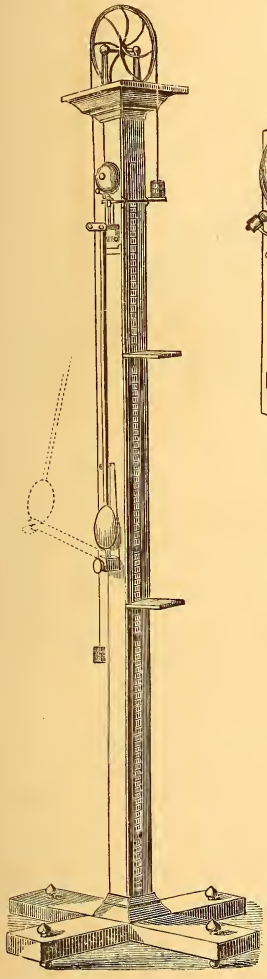
48. **Capillary Plates**, of plate glass, held together by mahogany clamps; showing the hyperbolic curve, 1.50 and 3.00

49. **Marble Disc and Ball**, to illustrate elasticity; disc 10 inches diameter, ivory ball, ... 3.50

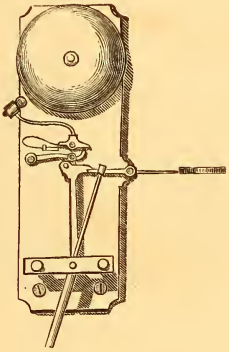
50. **Illustration of the Pendulum**; mahogany base and pillar, a boxwood and brass ball, with silk cords of equal length; balls, with cords of one fourth and one ninth proportionate length, ... 12.00

51. **Atwoods Machine**, with Ritchie's Automatic Action; mahogany pillar, with base, levelling screws, and sliding platforms. The large pulley is supported upon steel pivots; the balanced weights are made in three sections, each of 1000 grs., with holder of 500 grs., making the sum of 7000 grains, or one pound. The cut No. 51A, shows the position of the parts as ready for an experiment. By depressing the bar which retains the pendulum, as shown by the dotted lines, it is set free. At the instant of passing the perpendicular a pin in the extension of the rod above the centre strikes a detent, releasing the drop-table without striking the bell; but at each *return* of the pendulum to the centre of oscillation, the bell is struck, marking the seconds of time during the experiment with the greatest precision. The instrument is made with great care, and every experiment can be performed as *easily and perfectly* as with the most elaborate machine, . . . 110.00

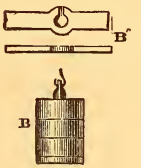
52. **Atwoods Machine**; Ritchie's Electro-Magnetic Movement. The instrument is made in every respect similar to No. 51, except in the movement. A point, E, upon a pendulum passes at the centre of each oscillation through a drop of mercury, completing the circuit of a bat-

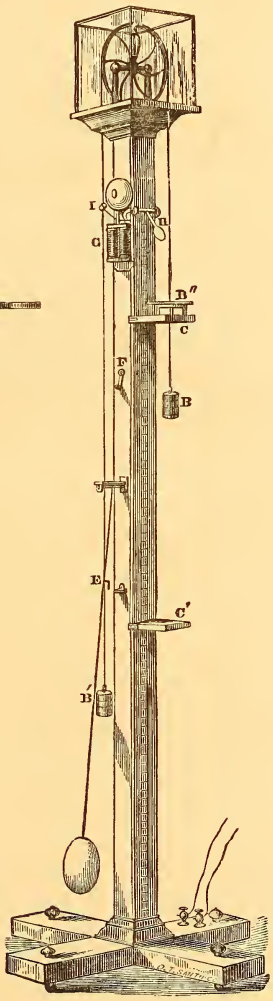


No. 51.



No. 51A.





No. 52.

NUMBER PRICE

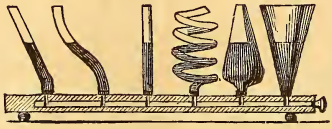
tery, which gives an instantaneous motion to the armature of an electro-magnet, G. The *first* connection drops the table, and each *subsequent* connection strikes a bell. A sliding breakpiece, F, cuts off the current from the battery until the experiment is ready to be performed, ... 160.00

53. **Plate Glass Cover** to either form of Atwoods Machine, ... 12.00

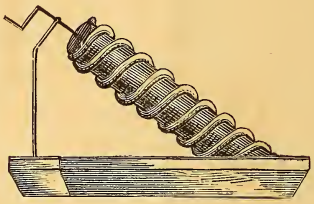
54. **Friction Rollers** to either form of Atwoods Machine, additional, . . 35.00

NOTE. We make no Atwoods without automatic movement; they are of no value.

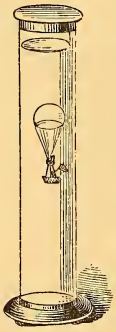
HYDROSTATICS AND HYDRAULICS.



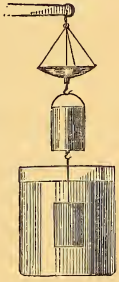
No. 2.



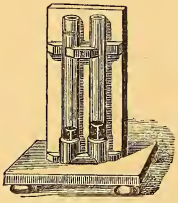
No. 9.



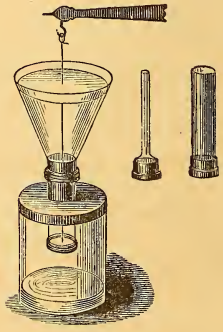
No. 8.



No. 5.

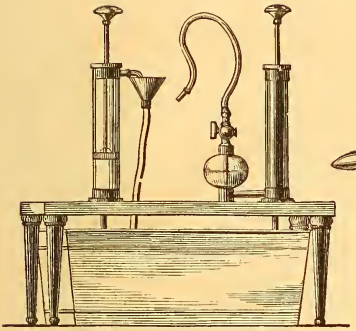


No. 7.

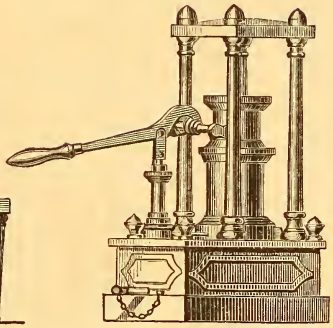


No. 6.

NUMBER		PRICE
1.	**Equilibrium Tubes**; a set of six forms with brass caps, connected by screws to a brass tube, mounted on a mahogany base, ...	12.50
2.	**Equilibrium Tubes**; set of six with brass caps; mahogany base, . .	6.50
3.	**Equilibrium Tubes**; four forms with brass caps, mahogany base, . .	5.00
4.	**Upward Pressure of Liquids**; a glass cylinder, and heavy brass plate ground to fit the cylinder, with hook and cord, 3.00, and	4.50
5.	**Archimedes Principle**, brass cup and cylinder, 2.50, and	6.50
6.	**Hydrostatic Paradox**—Masson's; a glass jar with brass cap, to which may be screwed the graduated glass vessels of different forms; a cylinder of glass extends below the cap, its lower edge is ground to fit a brass plate which is attached by a cord to a balance, ...	25.00
7.	**Liquid Equilibrium Apparatus**, for liquids of different densities; mahogany frame, graduated glass tubes, with iron sockets and tube, .	9.50
8.	**Hydrostatic Balloon** and Car in Jar; fifteen inch jar, 5.00; eighteen inch jar, 6.00; and twenty-four inch, ...	7.50
9.	**Archimedes Pump**, with stand and cistern, block-tin pipe, ...	8.00

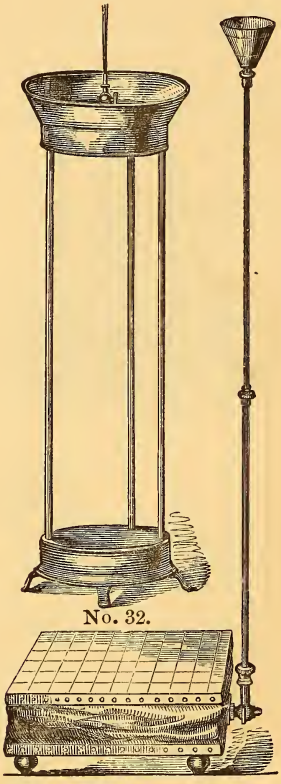


No. 28.



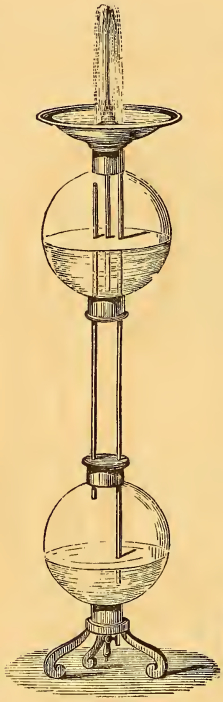
No. 10.

NUMBER		PRICE
10.	**Hydraulic Press**, improved form, handsomely mounted on a strong iron frame, with brass pillars, brass cylinder and force pump, with attachment to show the power of the press by breaking bars of cast iron and wood,	60.00
11.	**Hydrometers**, graduated to Baumé's and others' scales, for spirits, water, acid, &c.,	1.25
12.	**Glass Hydrometers**, large size, zero or water mark in the centre of the scale; adapted to all liquids,	2.50
13.	**Hydrometer Jar**, with foot and lip, 1.25 and	1.50
14.	**Nicholson's Hydrometer**, of brass, fitted for substances heavier and lighter than water, 6.00 and	9.00
15.	**Specific Gravity Balance**; brass elevating stand, brass beam and scale pans. (See No. 42, *Pneumatics*),	17.50
16.	**Specific Gravity Balance**, similar to No. 16, with fine wood beam,	16.00
17.	**Hydrostatic Balloon** and Car in Jar; fifteen inch jar, 5.00; eighteen inch jar, 6.00; and twenty four inch,	7.50
18.	**Cartesian Devil** in Jar, with rubber,	2.25
19.	**Brass Siphon** with Suction Tube,	2.25
20.	**Glass Siphon**, .50; with suction tube,	1.50
21.	**Wurtemberg Siphon**, of glass,	1.00
22.	**Liquid Cohesion**, Glass Plate and Cord, to attach to balance,	1.50
23.	**Tantalus Cup**, illustrates intermitting springs,	2.00
24.	**Diving Bell**, of glass, with lead ring, cap and tube,	6.50
25.	**Vacuum Siphon**, or Fountain Siphon; glass globe, cap and tubes,	4.50
26.	**Force Pump**; glass cylinder and air chamber, hose and jet,	11.00
27.	**Lifting Pump**; glass cylinder, with funnel and tube,	9.00
28.	**Water Pumps**, Force and Lifting Pumps, with stand and cistern,	22.50
29.	**Water Wheels**, Overshot, Undershot, and Breast Wheels; in frame,	12.00
30.	**Hydraulic Ram**, a reservoir mounted upon three pillars, with spiral tube for flow of water, and cistern; the tube from the air-chamber ends in a jet above the reservoir,	

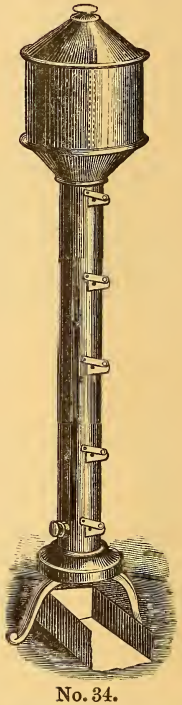


No. 32.

No. 31.



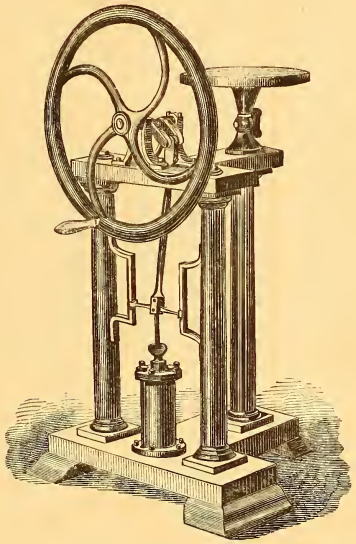
No. 33.



No. 34.

NUMBER		PRICE
31.	**Hydrostatic Bellows,** of improved form and construction; 12 inches square, with patent leather sides, lined with vulcanized rubber; brass socket, two brass tubes, with screw connections and funnel, . . .	25.00
32.	**Hero's Fountain,** of copper, with jet, ...	12.00
33.	**Hero's Fountain,** of glass, brass mountings, ...	
34.	**Spouting Fluid Apparatus,** Ritchie's improved form; cylinder of brass upon a tripod stand; large copper vase with screw cover, fitted as a *Mariotte's Vase*, by which the water-level is effectively constant, with gates arranged so that the flow may be through orifices with thin sides, or through cylindrical or conical tubes, for Savart's experiments; a rod connects the gates, so that all or any of them may be opened and closed at the same moment; a horizontal tube, with vertical jets, showing the friction of the tube on the water flowing through it by the pressure remaining at different points in its length; the apparatus is arranged for the beautiful experiment of the total reflection of light in a liquid vein (see *Optics*); a long copper cistern to receive the flow the apparatus is very perfect and complete, ...	

PNEUMATICS.



No. 1.

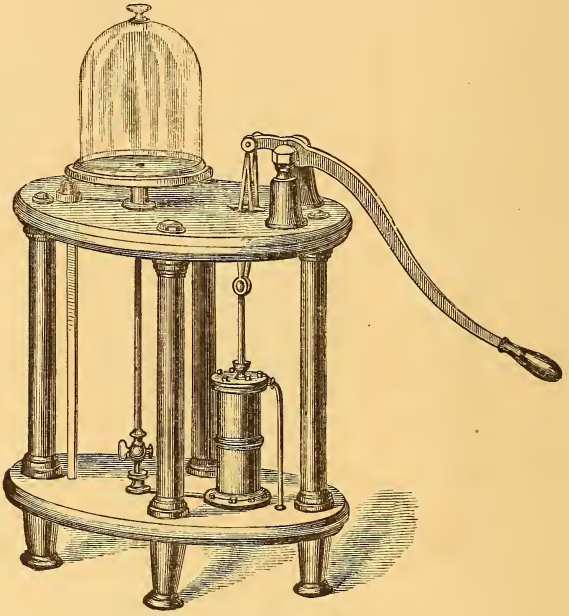
DESCRIPTION OF RITCHIE'S PATENT AIR PUMP.

The cylinder is made in the usual form. The motion may be given to the piston-rod by crank or lever. The peculiarities are in the construction of the piston and valves, and also in the manner in which motion is given to the valves.

Fig. A is a section showing the valves, &c., much exaggerated for distinctness.

The lower valve is conical, held in place by a triangular stem fitting the tube; it is raised by the *valve-rod* passing up through a stuffing-box in the piston; an enlarged section (fig. B), shows the manner in which the attachment is made, which allows a motion of the rod sidewise, so that any slight change of form of the packing of the piston, or stuffing of the rod, cannot prevent the valve from shutting properly. The cone of the valve is ground to a perfect fit to its seat, but the valve is also furnished with a disc of oiled silk which projects just beyond its outer edge, and touches the flat surface of the valve seat; the valve-rod extends up, and its upper end is secured in a hole drilled in the upper plate, of depth to allow motion vertically to open the valve.

The *piston* is of thick brass made in two parts, the upper piece has a hole drilled larger than the piston-rod; the lower part of conical form, ground to fit a cone on the piston-rod; this forms the piston-valve. The lower piece of the piston covers



No. 2.

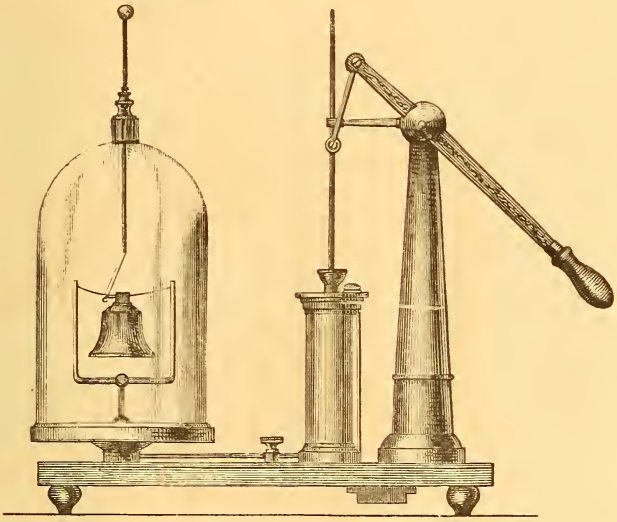
the end of the piston-rod, but allows it enough motion to open the valve; a series of small holes through the plate gives a free passage for the air to the valve.

A third valve is placed outside the cylinder, made of oiled silk in the usual way.

In the thickness of the upper plate of the cylinder is inserted a steel lever, one end of which covers the valve-rod; the other end, when the lower valve is closed, is *flush* with the plate; but when the valve is raised, it projects into the cylinder.

In action, the first motion upward of the piston-rod closes the piston-valve; the first motion of the piston opens the lower valve; as the piston ascends, the air above it is forced out through the upper valve; and air from the receiver flows unobstructedly into the cylinder. The piston strikes the tail of the lever, and at the instant of arriving at the top, closes the lower valve. The first downward motion of the piston-rod opens the piston-valve, the air remaining in the interstices above the piston, which is always of normal pressure, distributes itself equally throughout the cylinder, but *none* can pass the lower valve back into the receiver. When the piston again reaches the bottom of the cylinder, the interstices below are filled with air (supposing the action to have been long enough continued), as *rarefied* as a pump with ordinary valves can exhaust, and *this* must, as the piston rises, be again expanded to the entire volume of the cylinder, or draw still further from the receiver. The working parts are very substantial, not likely to be deranged, and are readily accessible.

The result is that almost a *Torricellian* vacuum is obtained; a true mercury gauge can be brought to within one fiftieth of an inch. The Aurora Tube with the discharge of an Induction Coil is *filled* with brilliant stratified light. Water is frozen *without acid* for absorption of vapor, &c.



Nos. 3, 4, 5.

NUMBER PRICE

1. **Ritchie's Rotary Air Pump**, with Patent Action; solid mahogany frame, polished. All the metallic work is of brass except the balance wheel, which is of iron. The plate is 15 inches diameter; every part is most substantially made, and finely finished. A full description, with directions for use, will be sent with each instrument.

   The ease of working the pump, the very high degree of rarefaction obtained by it, and the comparatively small space it occupies, render this pump a very valuable instrument, ... 275.00

2. **Air Pumps**, with lever movement, of construction as shown in figure No. 2, either of oval or square form, with Ritchie's patent, or Leslie's action, and plates of 12 or 15 inches diameter, will be made only to order; prices will be given when desired, ...

3. **Ritchie's Table Pump**, with Patent Action; polished mahogany base, lever movement. The cylinder is 7½ by 2½ inches; the plate is 12 inches diameter, raised but 6 inches from the table. As high degree of exhaustion is obtained as by No. 1, ... 100.00

4. **Air Pump**, made on Leslie's principle, with lever movement, mahogany base; the cylinder is 7½ by 2½ inches; plate 12 inches diameter; the valves are of oiled silk, of improved construction; the whole is substantially made, and finely finished, ... 65.00

5. **Air Pump**, similar in form and construction to No. 4; the cylinder 7½ by 2 inches, and plate 8 inches in diameter. As high a degree of rarefaction is obtained by Nos. 4 and 5 as can be by any pump without automatic valves, ... 45.00

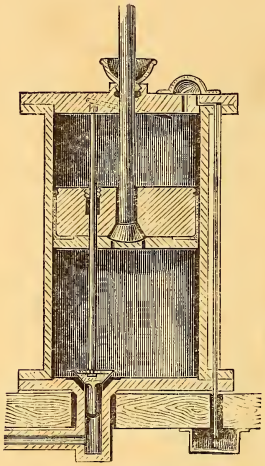


Fig. A.

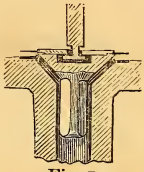


Fig. B.

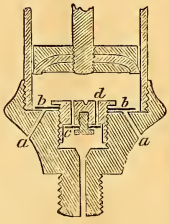
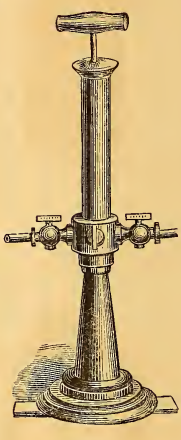


Fig. C.

No. 14.



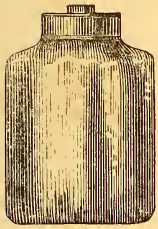
No. 15.

NUMBER		PRICE
6.	**Swelled Receivers**, two gallons, 3.50; four gallons, 6.25; six gallons, .	8.75
7.	**Swelled Open Receivers** (form of fig. 35), two gallons, 4.00; four gallons, 6.75; six gallons, ...	9.00
8.	**Cylindrical Open Receivers** (see fig. 36); two quarts, 1.50; four qts., NOTE. The plate of the *Upward Pressure* covers the open bells.	2.50
9.	**Plain Receiver** (see fig. 2); pint, .75; quart, 1.00; two quarts, 1.25; gallon, 2.00; two gallons, 3.75; four gallons, ...	6.50
10.	**Stoppered Receivers**; quart, 1.25; two quarts, 1.75; gal., 2.50; two gals.,	3.75
11.	**Capped Receivers** (see fig. 3); one gallon, 4.00; six quarts, 4.75; two gallons, 5.50; three gallons, ...	7.50
12.	**Tall Receivers**, 18 by 4 inches, 3.50; 22 by $4\frac{1}{2}$, ...	4.50
13.	**Jars** for Receivers (see fig. 36); fitted to one gallon receiver, 1.50; for two gallon do., 2.25; for tall receiver, 1.75, and	2.50
14.	**Ritchie's Improved Condenser**; the cylinder is 7 by $1\frac{1}{4}$ inches; the base cap is furnished with a screw, *d*, fig. c, the flanch of which holds the inlet valve, *b b*, in place, while the exit valve, *c*, is secured in its lower end by a pin, — the valves are thus protected, yet readily accessible; both are of oiled silk, and hold perfectly tight, . . .	9.50
15.	**Condenser**, or Transferrer; cylinder 7 inch; gas is received on one side and expelled on the opposite through stop-cocks; a stop-cock is inserted in the base so that a direct communication can be made; the cylinder is supported upon a pillar and base, with flanges for the feet.	20.00
16.	**Condenser** and Transferrer; similar to No. 15, with screw sockets for rubber hose; without stop-cocks, ...	15.00
17.	**Hand Glass**, to show the pressure of the air (see fig. 35), ...	1.25

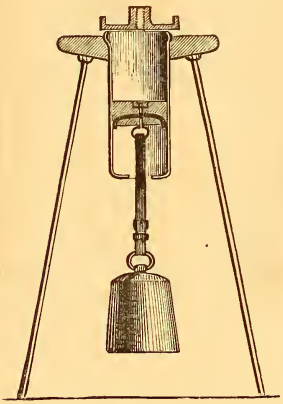
No. 18.

No. 27.

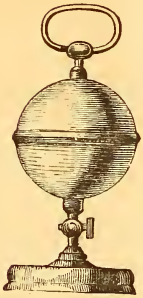
No. 29.



No. 20.

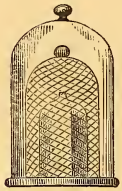


Nos. 21, 23.



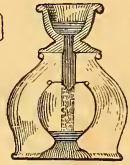
Nos. 24, 26.

NUMBER		PRICE
18.	**Condensing Chamber**, of heavy hammered copper, with dome and side sockets, and interior tubes; 4½ inches diameter, with stop-cock, . .	8.50
19.	**Condensing Chamber**, similar to No. 18, 6 inches diameter, . . .	10.00
20.	**Condensing Chamber**, of Glass; capacity two quarts; screw cap, with two inch opening, and wrench, ...	20.00
21.	**Upward Pressure Apparatus**; tripod stand brass legs, glass cylinder, 12 by 4 inches, with piston, four inch brass plate, and strap for weight,	17.00
22.	**Upward Pressure**; tripod stand 30 inches, cylinder 9 by 3 inches, brass plate, 3½ inches, and strap, ...	11.00
23.	**Upward Pressure**; tripod stand, with brass cylinder, with accurately fitting piston, and strap for attaching weight, ...	
24.	**Magdeburg Hemispheres**; five inches diameter, of extra thickness, and highly finished, with mahogany stand, ...	15.00
25.	**Magdeburg Hemispheres**; 3½ inches diameter, of extra thickness and improved construction; with mahogany stand, ...	10.00
26.	**Magdeburg Hemispheres**; 4 in. diameter; the stop-cock of brass, the hemispheres of iron, less liable to injury, handsomely finished, . .	7.50
27.	**Freezing Apparatus**; receiver, pan for acid, improved silvered water cup, and supporting frame; six inch, 4.00; eight inch, ...	6.00
28.	**Freezing Apparatus** for Ritchie's Pump, eight inch receiver, water pan of cork, ...	3.00
29.	**Bladder Cup**, with Stop-Cock and Stand, ...	4.50



No. 30, 32.

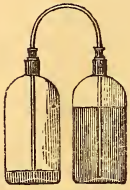
No. 34.



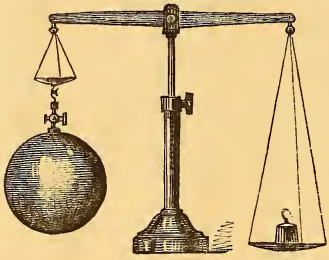
No. 35.

No. 37.

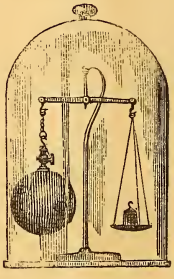
No. 36.



No. 39.



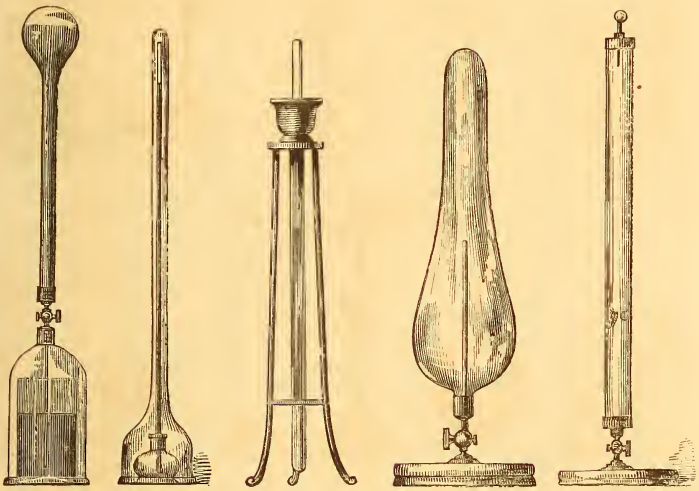
No. 42.



No. 41.

NUMBER		PRICE
30.	**Bursting Squares**; for expansion or pressure; per dozen, ...	2.50
31.	**Wire Guard**, for bursting squares, ...	1.25
32.	**Brass Cap and Valve**, for bursting squares, ...	.50
33.	**Expansion Apparatus**; receiver, bolt head and jar, with quart bell, .	1.75
34.	**Inertia Wheel**; to be placed edgewise or crosswise on the axle, . .	1.50
35.	**Mercury Tunnel**, fitted to the Hand Glass, 1,25; with cup, ...	2.25
36.	**Brass Plate** and wood cylinder, showing the porosity of wood; to use with Cylindrical Receiver and Jar, ...	1.50
37.	**Revolving Jet** and Stand, ...	3.25
38.	**Double Revolving Jet**; revolves in opposite directions, ...	4.50
39.	**Bacchus Illustration**; glass jars, with caps and tube, ...	3.25
40.	**Treble Globe**, or Liquid Transferrer; to be used under a receiver, . .	4.50
41.	**Weight and Buoyancy of Air Apparatus**; three inch globe, with stop-cock and hook; a very sensitive steel balance, with brass support and mahogany stand; a box of oz. and gr. weights, and counterpoise weight, with scale pans, ...	13.00
42.	**Balance and Globe** for weighing Air and Gas; brass beam twelve inches long, with steel knife edges; a brass stand, scale pans fitted for *specific gravity*, polished copper globe, with stop-cock and hook, . .	25.00
43.	**Globe and Stop-cock**, with hook for weighing air, 6 inch, ...	7.50
44.	**Hydrostatic Balloon**; small rubber bag, to use in tall bell and jar, . .	1.75
45.	**Apparatus** for exploding Gunpowder in vacuum, ...	6.00
46.	**Lock** for striking flint and steel in vacuum, ...	6.00
47.	**Bolt Head**, with Cap, Stop-Cock, and Tube; 30 inches, ...	4.50
48.	**Barometer Apparatus**, receiver 30 inches high, glass tube and screw cap, and mercury cistern, ...	5.25

NOTE. The mercury will not rise, after exhaustion, over from 24 to 27 inches, in consequence of the resistance of the mercury to the escape of the air from the tube.



No. 47. No. 48. No. 54. No. 50. No. 51.

NUMBER		PRICE
49.	**Improved Barometer Apparatus**; receiver 33 inches, tube fitted with a cap, and silk valve, permitting free escape of the air, ...	6.00
50.	**Fountain in Vacuum**; improved, heavy glass receiver with stop-cock, jet, and mahogany stand, 26 inches, ...	8.00
51.	**Guinea and Feather Tube**; improved, capped at each end, with stop-cock and stand, and made heavy and strong for showing the increased resistance of condensed air, fitted with points for Aurora Tube for Electricity; 2½ feet, 8.50; 4 feet, ...	10.50
52.	**Mariotte's Law Apparatus**; an upright support of wood, 46 inches high, neatly finished and painted, to which is attached a bent glass tube, the shorter branch with a closed end and the longer one furnished with a funnel; a graduated scale is attached to each, . . .	12.00
53.	**Mariotte's Law Apparatus**; support similar to No. 52; the tubes with iron sockets and screws, connected by an iron tube; a stop-cock and cistern to receive the mercury; an additional tube of 33 inches in length is attached by iron screw couplings, ...	25.00
54.	**Mariotte's Law Apparatus**, for pressure of less than one atmosphere; tall mercury cistern with closed tube and graduated scale, . . .	10.00
55.	**Wood Cylinders, and Weight** for sinking when the air is removed from the pores, ...	.25
56.	**Bell for Vacuum**, with clock-work movement; the whole is suspended by cords to a frame, ...	
57.	**Bell for Vacuum**, with stand; it is to be screwed into pump plate (see figure No. 3), ...	3.25
58.	**Water Hammer**; strong glass tube, with cap, stop-cock, and stand, .	4.50

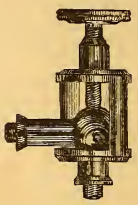

No. 71.


No. 68.


No. 67.

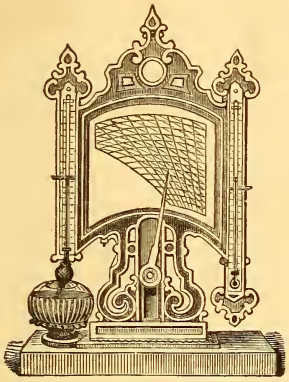

No. 69.


No. 70.

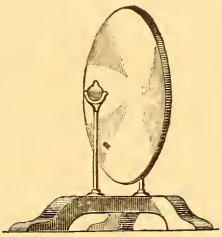

No. 83.

NUMBER		PRICE
59.	**Water Hammer**; tube, hermetically sealed, 1.25 and	2.25
60.	**Rubber Hose**, with brass screws to attach to pump; 4 feet, ...	3.00
61.	**Sliding Rod**, with ball handle, packing screw, and hook and pincers, .	4.00
62.	**Sliding Rod**, with ball handle and packing screws, ...	2.75
63.	**Air Gun Barrel**, and Balls to use with condenser, ...	1.25
64.	**Sheet Rubber Bag**, with cap and hook, 2.25; with stop-cock, . . .	3.75
65.	**Square Vials**, for use with condensed air in No. 20, per dozen, . . .	2.50
66.	**Hydrostatic Paradox** (for supporting a ball on a jet of water); tunnel and balls, water pan and tube, stop-cock, with interior and exterior jets, fitted to No. 18, ...	6.50
67.	**Plate Paradox**, with mica disc, fitted to No. 18, ...	2.25
68.	**Pipe Paradox**, with ball, fitted to No. 18, ...	2.25
69.	**Vacuum Gauge**, siphon form, in glass case, with stand, ...	4.00
70.	**Pressure Gauge**, siphon form, in glass case and stand, ...	4.00
71.	**Tunnel, Stop-Cock**, and Jet, for introducing liquids into an exhausted receiver, ...	3.50
72.	**Leather Collars**, for stop-cocks; assorted, per hundred, ...	.50
73.	**Oil**, prepared to use with Philosophical Instruments, 25 cents, and . .	.75
74.	**Stop-Cock**, large screw, ...	1.75
75.	**Stop-Cock**, small screw, 1½ inch, ...	1.50
76.	**Iron Stop-Cocks**, to use with mercury, ...	3.00
77.	**Coupler**; large interior screws, ...	.75
78.	**Coupler**; large exterior, small interior screws, ...	.75
79.	**Coupler**; large and small interior screws, ...	.75
80.	**Coupler**; large exterior screws, ...	.75
81.	**Guard Plug**, for pump plate, ...	.75
82.	**Screw Plug**, for closing brass caps, &c., ...	.75
83.	**Gallows Connecter** and Tip; Dr. Hare's; exterior screws, ...	2.50
84.	**Gallows Connecter** and Tip; interior screws, ...	2.50
85.	**Long Connecter**, small exterior screws, ...	.75

HEAT.

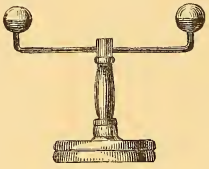


No. 13.

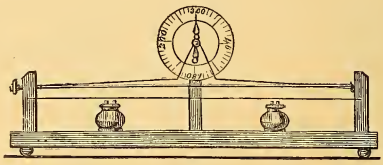


No 27.

NUMBER		PRICE
1.	**Air Thermometer**; glass bulb and tube, ...	.75
2.	**Thermometers**, japanned tin case; six inch, 75 cents; eight inch, 1.00; ten inch, ...	1.25
3.	**Thermometers**, japanned case, superior quality, either centigrade or Fahrenheit scale; ten inch, 2.00; twelve inch, ...	2.50
4.	**Thermometers**, copper case and thick scale; eight inch, 2.00; ten inch,	2.50
5.	**Thermometers**, boxwood mounting; eight inch, 2.00; ten inch, . .	2.50
6.	**Thermometers** (Six's), self-registering, ten inch, with magnet, . . .	11.00
7.	**Spirit Thermometers**, graduated to —120°, ...	2.00
8.	**Chemical Thermometers**, boxwood scale, with hinge graduated to 500°,	4.50
9.	**Chemical Thermometers**, graduated on the tube; 3.50 to	5.00
10.	**Thermometer**, enclosed in glass tube, ...	2.00
11.	**Leslie's Differential Thermometer**, on stand, 3.50 and	4.50
12.	**Psychrometer**, or wet and dry bulb hygrometer (Mason's), with fountain on boxwood scale, ...	4.50
13.	**Hygrodeik** (Edson's); a very valuable and convenient adaptation of a scale to the *Psychrometer*, by which all calculations from the formula are saved, and the results obtained at a glance. Viz.:—1st. The actual and sensible heat of the room. 2d. The relative amount of moisture in the air on a scale of 100 degrees, zero being absolute dryness, and 100° saturation for the *given temperature*. 3d. The dew-point. 4th. The weight of water in grains present in each cubic foot of air. 5th. The force of vapor. By following the indications of this instrument, not only health and comfort will be promoted, but also economy in the saving of fuel. Price, plain, 15.00; ornamented, .	25.00
14.	**Melloni's Thermo-Multiplier**; see No. 191, *Electricity*, ...	37.50

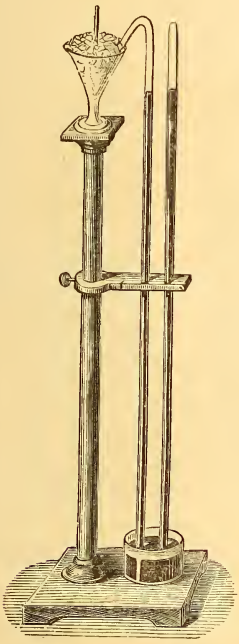


No. 15.

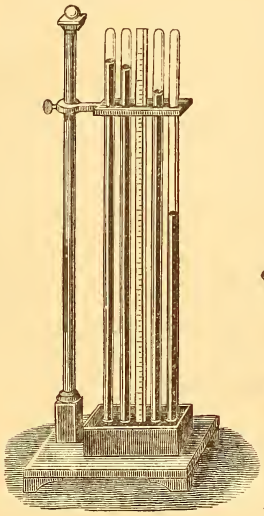


No. 17.

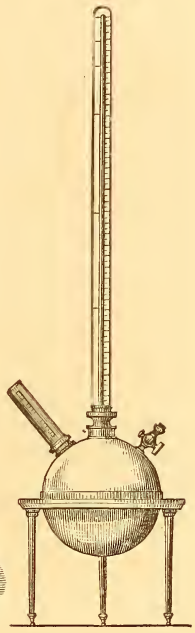
NUMBER		PRICE
15.	**Franklin's Pulse Glass**, or spirit boiler,	1.00
16.	**Spirit Boiler**, mounted on a mahogany frame, to use with reflectors,	2.50
17.	**Pyrometer**; mahogany frame, brass and iron rods, two spirit lamps; the expansion is indicated by an index revolving on a dial,	7.50
18.	**Pyrometer**; mahogany frame, brass and iron rods, and spirit lamp; the expansion of the rods gives motion to a mirror; a beam of light is to be thrown upon the mirror, and reflected upon the wall; it is sensitive to the warmth of the hand,	
19.	**Conductometer**; brass ring and plate with tripod stand, to be used over a spirit lamp; with iron, brass, copper, tin, lead, and glass rods,	4.50
20.	**Conductometer of Ingenhousz**; a copper vessel for hot water, with handle rods of different metals, glass and clay, projecting from one side,	7.50
21.	**Apparatus** to illustrate the Non-conduction of heat by water; glass funnel with air thermometer, 2.25; with stand,	4.25
22.	**Ring and Ball** to illustrate Cubical Expansion; mounted on mahogany frame; to use with spirit lamp,	4.75
23.	**Ring and Ball**, with handles,	2.25
24.	**Compound Bar**, of brass and iron; to show the unequal expansion of metals,	2.25
25.	**Compensated Pendulum**, known as the gridiron pendulum; nine rods of brass and iron, with mahogany base and pillar,	
26.	**Joule's Apparatus**, to show the *contraction* of India Rubber by heat; stand and pillar, with short iron tube enclosing the rubber tube, with spiral spring and index,	
27.	**Parabolic Reflectors**; a pair, silver plated, twelve inches diameter, highly polished, mounted on metal base, with ball and holder,	18.00
28.	**Leslie's Radiating Cubes**, a pair; the sides are painted in different colors, with shields; one has a tube for air thermometer,	3.00
29.	**Specific Heat**; base and frame supporting five balls of copper, iron, tin, zinc, and lead, of half pound weight, with glass tumblers,	14.75
30.	**Fire Syringe**; brass cylinder with box of tinder,	3.00
31.	**Fire Syringe**; strong glass barrel, brass caps and piston,	8.00
32.	**Wire Gauze**; three pieces, with handles for flame,	1.50
33.	**Davy's Lamp**; model of miners' lamp,	
34.	**Cryophorus**; Wollaston's large size, and superior quality,	2.25
35.	**Aphlogistic Lamp**, with platinum coil,	3.50
36.	**Bunsen's Burner**; single tube, on stand,	1.50
37.	**Bunsen's Burner**, with regulating ring, on stand,	1.75



No. 40.

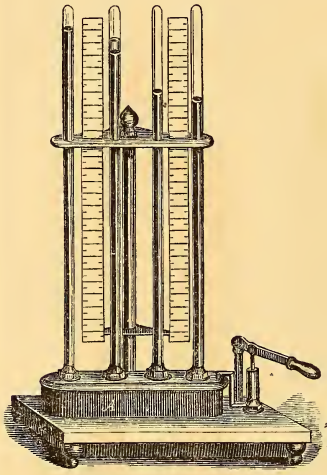


No. 41.

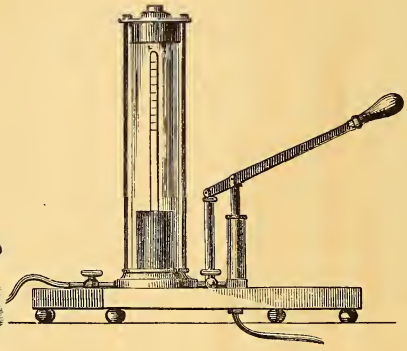


No. 44.

NUMBER		PRICE
38.	**Principles of Ventilation**; glass jar, with tube, stand for candle, and movable diaphragm; when this is inserted, the candle burns brightly in consequence of the circulation down and up the tube, ...	3.50
39.	**Tall Mercury Cistern**; on iron frame with graduated glass tube, for illustrating the tension of gases (see No. 54, *Pneumatics*), . . .	10.00
40.	**Gay Lussac's Apparatus**, to show the tension of water below the freezing point; mahogany frame, mercury cistern, bent and straight tubes, and vase, ...	8.50
41.	**Apparatus** to illustrate the instantaneous evaporation of volatile liquids in a vacuum; mahogany frame, cistern of iron for mercury, four glass tubes, and graduated scale, ...	16.00
42.	**Eolipile**, brass ball with handle and jet, ...	3.50
43.	**Wollaston's Illustration** of Low Pressure Steam Engine; copper globe boiler, brass cylinder, piston and rod, and handle, ...	5.50
44.	**Marcet's Steam Globe**, improved form; $5\frac{1}{2}$ inches diameter; upper hemisphere of brass, the lower of iron, for holding mercury; a thermometer in brass case, stop-cock and safety valve, tube and graduated scale, ...	45.00
45.	**Steam Balls**, or Candle Bombs; for exploding by candle, dozen, . .	.75
46.	**Steam Whistle**, model of locomotive whistle, ...	4.50
47.	**Tyndall's Apparatus**, Cylinder and Clamps, for boiling water by friction, to attach to No. 13 and 14, *Mechanics*, ...	

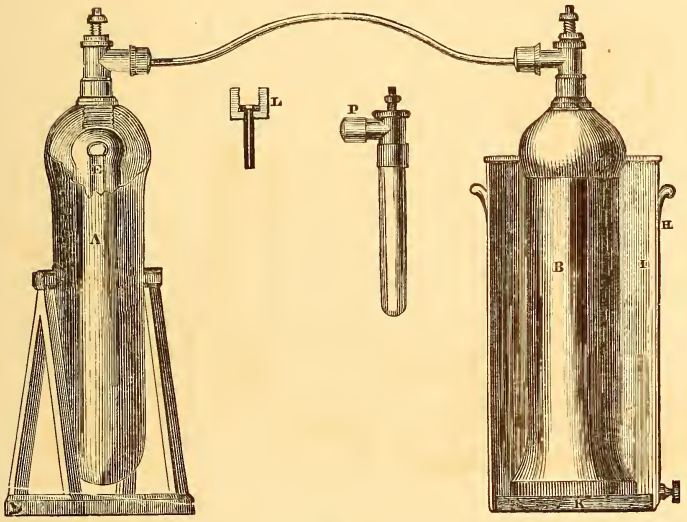


No. 53.



No. 51.

NUMBER		PRICE
48.	**Apparatus** for the Maximum Density of Water; glass jar, with copper reservoir for freezing mixture; with two thermometers, ...	17.50
49.	**Silver Capsule**, and stand, for showing the spheroidal state of liquids, .	
50.	**Steam Engine**, model of, of improved form; low-pressure engine and boiler; the apparatus is entirely of metal, handsomely painted, showing on the one side the outward appearance, and on the reverse the interior—the air-pump, condenser, force and lifting pumps having their proper motion; the boiler, also in section, showing the flues, safety valve, steam pipe, throttle valve, &c., ...	
51.	**Apparatus** for Liquefying Gas; a strong glass cylinder capable of bearing a pressure of twelve atmospheres, with brass base and cap, secured by iron rods; an opening in the cap admits an iron cistern for mercury, in which is inverted a tube filled with the gas for liquefying; a pump by which water is forced into the cylinder, forcing the mercury up into the tube, compressing and liquefying the gas; mahogany base; pan for water, globe valves, ...	55.00
52.	**Boxwood Moulds** for the regelation of ice by pressure. It may be used with the hydraulic press. See No. 10, *Hydraulics*, ...	4.50
53.	**Apparatus** for showing the identity of gases and vapors; a strong iron cistern for mercury, into which is screwed four glass tubes, three to contain gases which liquefy at different pressures; the fourth, air for a manometer, graduated to atmospheres and pressures per square inch, force pump, with stop-cocks and tubes; base with frame and graduated scales, ...	
	The phenomena of the liquefying of gases are strikingly exhibited by this instrument; the pressure exerted by the pump causes the mer-	



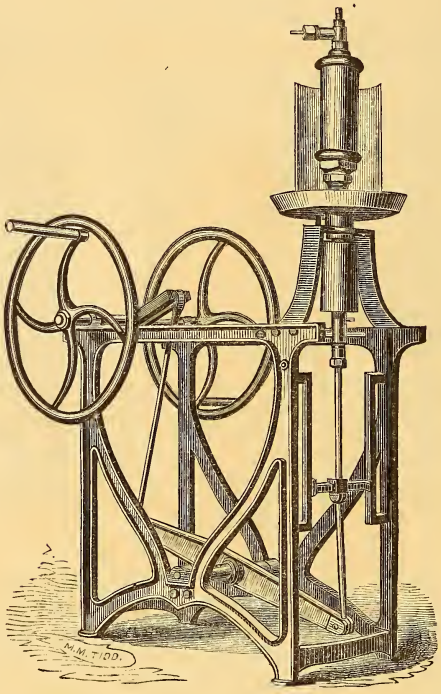
No. 55.

NUMBER PRICE

cury to rise gradually and equally in each tube, until one of the gases begins to liquefy; it then remains constant (as shown by the manometer and other tubes) until all the gas has disappeared; the mercury then rises in the three remaining tubes, until a second gas commences to liquefy, and so on.

54. **Gay Lussac's Apparatus** to illustrate the *Laws of Dalton;* mahogany frame with glass tubes, funnel and globe, with iron mountings and stop-cocks, ...

55. **Thilorier's Apparatus** for Liquefying and Solidifying Carbonic Acid Gas; the generator, A, is made of iron, and is supported by centre trunnions upon an iron frame, so that in use it can be readily inverted; into the top is screwed a heavy brass cap, which is furnished with steel vent screw, and screw for attaching a connecting tube; within the generator is placed a copper tube, E, to receive the sulphuric acid; the receiver, B, is also of iron, with a broad base, with cap and its connecting screws; a cistern, H, of copper to enclose the receiver with ice and salt; a long copper tube with connections; wrenches for the brass caps, connecting screws and vent screws, mallet, cylindrical brush; a connecter, L, is fitted to screw to the receiver, to which is attached a strong cloth bag to receive the solid carbonic acid; also a strong glass tube, P, with cap and vent screw, to exhibit it in the liquid form. In the construction of this instrument every care will be used to render it perfectly safe; the iron used is that prepared by the United States Ordnance Department for guns, and both the generator and receiver are strongly banded with *wrought iron*, ... 225.00



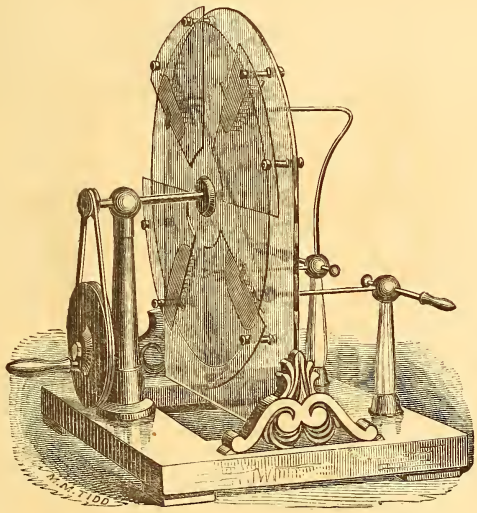
No. 56.

NUMBER PRICE

56. **Ritchie's Improved Natterer's Apparatus** for Liquefying Gases. This beautiful instrument is designed to compress gases by means of a force pump; the receiver is of bronze, and capable of resisting a pressure of 200 atmospheres; the pump is of steel, with steel piston, and is connected to the driving-crank by an inverted working-beam; by this means the receiver is brought to a convenient height; the receiver is surrounded by a copper vessel for ice and salt, and the pump is also enclosed in a cylinder, through which ice-water flows; the frame is of iron; the driving-shaft has balance-wheels and cranks; a receiver of glass surrounded by a glass cylinder for chloride of calcium, for liquid nitrous oxide, and one for solidified carbonic acid; every part of this instrument is most carefully constructed, . . .

57. **Illustration of the Geyser**; a tripod of iron which supports a pan of two and a half feet diameter, in the middle of which is screwed a brass tube of six feet in length; at the lower end and two feet above it are iron buckets to contain charcoal for heating the tube, or arranged with rings of Bunsen's burners for gas, ...

ELECTRICITY.



RITCHIE'S PATENT HOLTZ MACHINE.

The principal support to the parts of this machine is a thick plate of glass, which is mounted on a polished mahogany frame; one end of the shaft is supported by the plate, the other rests upon a mahogany pillar, which also holds the driving pulley. Upon the shaft, secured by collars of vulcanite, is the revolving plate of glass.

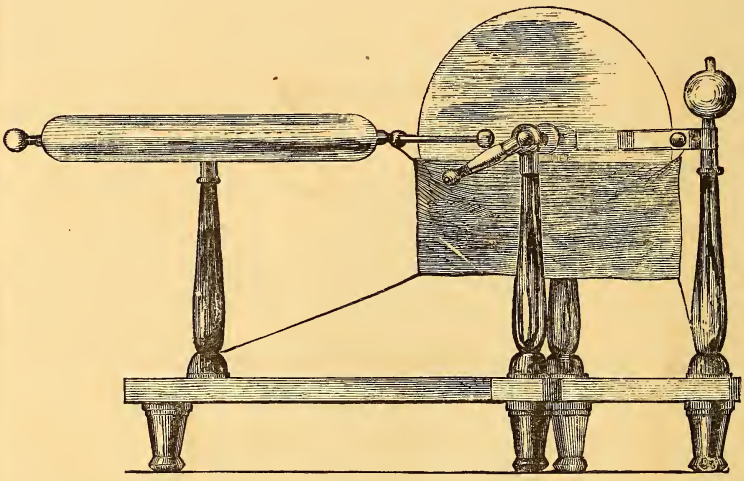
Surrounding the revolving plate are eight small pillars of vulcanite, or boxwood, upon which the sectors are held, and secured by nuts. Opposite to the sectors are four sets of points, or *combs*, held by screws which pass through the thick plate, with a ball nut, from which conductors of metal lead to the dischargers.

Two or four sectors can be used, and by simply changing the position of the connectors, any combination of the sectors with the dischargers can be made at pleasure.

The firmness with which all parts of the machine are held in their relative position, and the ease with which all desirable changes can be made, together with its simplicity and beauty, will commend this form of this very remarkable instrument.

Full directions for use will be sent with the machine.

NUMBER		PRICE
1.	**Ritchie's Holtz Machine,** with 24 inch revolving plate, ...	135.00
2.	**Ritchie's Holtz Machine,** 20 inch plate, ...	115.00
2A.	**Prime Conductor,** of large surface, mounted on a glass pillar with base similar to No. 32. The intensity of the discharge of the *Holtz Machine* is much increased by its use, ...	16.00



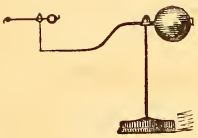
Nos. 3, 4.

Frictional Electrical Machines, with plates of thirty to sixty inches, with single or double pairs of rubbers, and with the prime conductors on the same or on a separate base, will be made to order, and descriptions and prices given when desired. The advantages that the Induction Coil and Holtz machines possess in power, convenience, and in the space and labor required, and also in the Induction Coil, of working in all states of the atmosphere are so very great, that no frictional machines will be made over twenty-four inches diameter except to order.

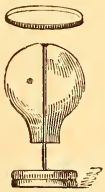
NUMBER		PRICE
3.	**Electrical Machine,** plate 24 inches diameter; polished mahogany base, insulated prime and negative conductors, improved felt rubbers, silk bag and chain, ...	65.00
4.	**Electrical Machine,** plate 20 inches diameter; polished mahogany base, insulated prime and negative conductors, improved felt rubbers, silk bag and chain, ...	55.00
5.	**Electrical Machine,** plate 16 inches; plain mahogany base, prime conductor neatly japanned, with brass ball, mounted on insulated pillar; the rubber plates are supported upon a mahogany pillar by brass springs, ...	25.00
6.	**Friction Cylinder,** of glass, ...	.75
7.	**Friction Cylinder,** of sealing-wax, ...	1.50
8.	**Friction Cylinder** of vulcanite, ...	1.25
9.	**Electrophorus,** 14 inches diameter, of vulcanite; mounted upon base of brass, with metal plate and insulated handle, ...	16.00
10.	**Electrophorus,** 11 inches diameter, similar to No. 9, ...	11.00
11.	**Electrophorus,** 11 inches diameter, of sealing-wax, mounted upon base of brass; metal plate and insulated handle, ...	9.00
12.	**Cat's Skin** for exciting the Holtz machine, electrophorus, &c., . . .	1.00
13.	**Amalgam** per box, 25 cents and	.50

No. 14.

No. 15.



No. 24.



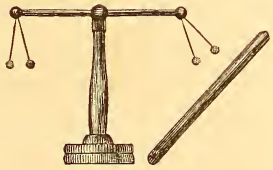
No. 27.

No. 22.

No. 16.

No. 17.

No. 32.



No. 33.

NUMBER		PRICE
14.	**Pith Ball Electrometer** and stand,	1.00
15.	**Quadrant Electrometer** and stand,	3.00
16.	**Gold Leaf Electrometer**, with ball and point,	6.00
17.	**Gold Leaf Electrometer**, with point and condensing plates; brass stand,	12.00
18.	**Coulomb's Tortion Electrometer**, for accurately measuring small quantities of electricity,	
19.	**Plate** to attach to sliding rod for dancing pith balls under a receiver,	1.25
20.	**Pith Balls**, per dozen,	.25
21.	**Head of Hair**, on stand, 2.50 and	5.00
22.	**Electrical Flier** and stand,	1.75
23.	**Electric See-saw**, with figures,	4.50
24.	**Electric Tellurian**, with point and stand; used on the prime conductor,	2.50
25.	**Electric Tellurian**, mounted on insulated stand,	6.00
26.	**Electric Wheel** and inclined plane,	6.00
27.	**Revolving Globe**, with point and stand, and movable ring,	4.00
28.	**Electric Swan** and basin,	2.00
29.	**Spider**, for attraction and repulsion,	.75
30.	**Float Wheel**, frame and stand, with point for conductor,	2.50
31.	**Siphon**, and bucket to suspend to conductor,	2.00
32.	**Insulated Conductor**, base and pillar,	18.00
33.	**Insulated Bar**, with electrometers, for induction,	8.00
34.	**Ellipsoidal Conductor**, showing the unequal distribution of electricity; of brass, supported on glass pillar and base,	25.00
35.	**Apparatus** for illustrating the tension of electricity; four brass insulated globes, of diameters one to four inches, adjustable at different distances, on mahogany base,	18.00

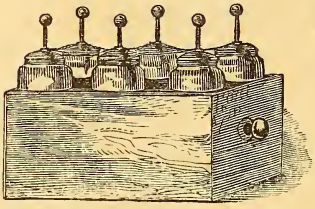
No. 36.

No. 37.

No. 38.

No. 39.

No. 40.



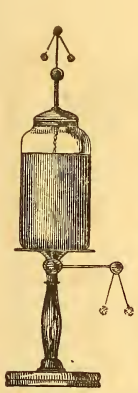
No. 44.

No. 51.

No. 52.

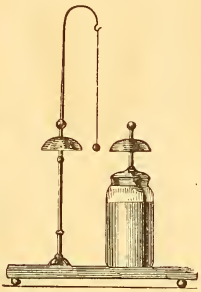
No. 53.

NUMBER		PRICE
36.	**Leyden Jars**, coated with heavy, pure tin foil; one pint, 1.50; one quart, 2.00; two quarts, 2.75; four quarts, ...	3.25
37.	**Atmospheric Leyden Jar**, with crooked stem and ball for suspension, movable ring with points; one quart 3.00; two quarts, ...	3.75
38.	**Leyden Jars**, with movable coatings, ...	3.75
39.	**Electrometer Jars**; two quarts, ...	3.25
40.	**Diamond Jars**; the spots are perforated to show the points on both sides; two quarts, 4.00; four quarts, ...	5.00
41.	**Double Leyden Jars**; one and two quart jars, with plate and ball, . .	5.50
42.	**Set of Leyden Jars**; two quart fitted as electrometer jar, a plate, which screws upon the stem in place of the ball supports a one quart jar with atmospheric ring; the set answers for Nos. 36, 37, 39, and 41, .	6.50
43.	**Leyden Jar**, with outer coat of filings, showing the zigzag lines of the current; two quarts, 3.00; four quarts, ...	3.50
44.	**Electric Batteries**, mahogany boxes; four 2 quart jars, 15.00; six 2 quart jars, 20.00, four 4 quart jars, 17.00; six 4 quart jars, . . .	25.50
45.	**Prof. Morton's Cascade Battery**; eight plates of glass ten inches square, with coatings alternately connected, mounted in a case with insulated discharging pillars, one arranged as a Lane's discharger. The effects of an electrical discharge in a vacuum, from the *Induction Coil*, are very much heightened by this battery.	
46.	**Miser's Plate**, with papered edges, ...	1.50
47.	**Miser's Plate**, mahogany frame, ...	3.00
48.	**Lightning Plate**, covered on one side by brass filings, on the reverse with tin foil, ...	2.00

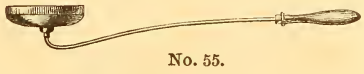


No. 56.

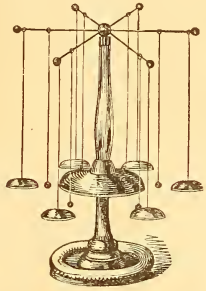
No. 42.



No. 49.

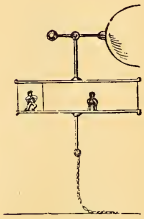


No. 55.

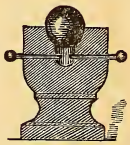


No. 60.

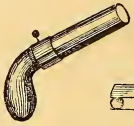
NUMBER		PRICE
49.	**Leyden Jar, with Bells**; one quart jar with base, pillar, and two 3 inch bells, for the gradual discharge of a Leyden jar,	7.00
50.	**Illustration of Leyden Jar**; plate of glass, with coatings and electrometers on each side, mounted on frame, with base,	4.50
51.	**Plain Discharger**, large glass handle,	3.50
52.	**Jointed Discharger**, large handle,	5.25
53.	**Jointed Discharger**, with two handles,	6.00
54.	**Universal Discharger**; large insulated table, swelled pillars with universal joints, sliding rods with balls, points, and pincers; mahogany base (see *Cut*, page 32),	18.00
55.	**Electric Spoon**, for igniting ether,	1.75
56.	**Insulating Stand**, and pith ball electrometer for Leyden jar,	6.00
57.	**Sportsman** and Birds; used with electrometer jar,	1.50
58.	**Electric Birds**; set of four on stand,	1.00
59.	**Electric Bells**; set of three 3 inch bells, with frame, to suspend to conductor,	4.50
60.	**Electric Bells**, mounted on base, with insulated pillar; the middle bell six inches diameter. Set of 5 bells, 13.00; set of 7 bells,	15.00
61.	**Apparatus** for piercing thick plate glass by the discharge of *Induction Coil*,	2.50
62.	**Faraday's Muslin Bag**, sustained upon an insulated ring of wire, with silk strings,	6.00
63.	**Hollow Sphere of Coulomb**, to show that electricity resides on the exterior surface; globe five inches diameter, on insulating pillar and mahogany base; an opening in the top admits the test needle,	12.00
64.	**Test Needle**; a slender rod of glass or gum lac, with disc of gold foil,	.75
65.	**Biot's Globe**; brass globe four inches in diameter, mounted on mahogany base and insulating pillar; a pair of thin hemispheres enclose the globe, with insulating handles, to prove that electricity resides only on the outside surface,	18.00



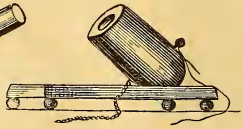
No. 66.



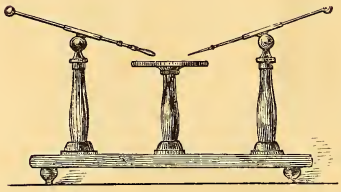
No. 72.



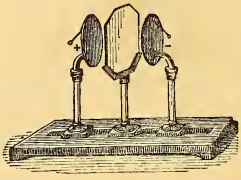
No. 70.



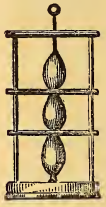
No. 74.



No. 54.



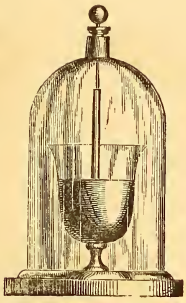
No. 75.



No. 76.

NUMBER		PRICE
66.	**Dancing Image Plates,** eleven inches diameter, to suspend to prime conductor,	3.00
67.	**Dancing Image Plates,** eleven inches diameter; the upper plate is to be suspended to conductor, the lower one is supported on an adjusting stand,	5.00
68.	**Dancing Image Plates,** mahogany base; the upper plate suspended by an insulating pillar, the lower plate adjustable,	12.00
69.	**Dancing Images** of pith, painted, per pair,	1.00
70.	**Gas Pistol,** with curved mahogany handle, fitted also for voltaic pistol,	8.50
71.	**Gas Pistol,** plain,	1.00
72.	**Ivory Mortar** and Ball,	3.00
73.	**Electrical Cannon,** mounted in brass,	8.00
74.	**Powder Bomb**; illustrates the effect of passing the discharge of a Leyden jar through water,	2.00
75.	**Condenser of Æpinus**; plate of glass mounted upon a mahogany base and pillar, with two movable metal discs supported on insulated pillar, with electrometers,	
76.	**Stand** for illuminating eggs,	2.00
77.	**Luminous Words**—"Light," "Union," etc., on glass, in frame,	7.00
78.	**Luminous Name** of Institution, or Person, on plate glass fitted for suspension,	
79.	**Luminous Star,** a plate of glass in mahogany frame, supported by pillar and base,	7.00
80.	**Profile of Franklin,** mounted on pillar similar to No. 79,	7.00
81.	**Spiral Tube,** spotted on the inside, and stand; two feet, 6.25, three feet,	7.00
82.	**Apparatus** illustrating the relation of surface and intensity; a cylinder of brass, within which is enclosed a spiral spring, supported upon a mahogany base by insulating pillars, with ball electrometers attached; a sheet of thick foil is wound upon the cylinder,	15.00

No. 83.

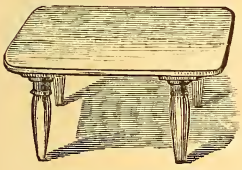


No. 84.

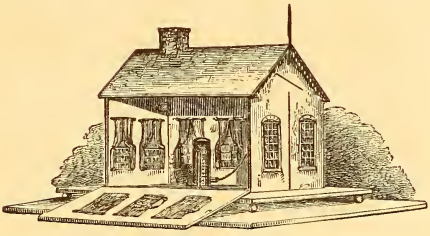
No. 86.

No. 81.

No. 88.

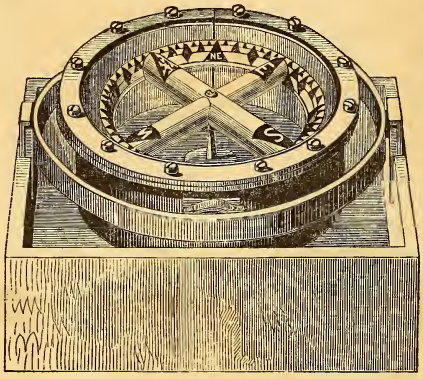


No. 89.



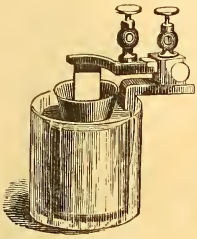
No. 91.

NUMBER		PRICE
83.	**Sets of Points** for luminous bell, to screw to pump plate and sliding rod; the electric discharge between the points, and the luminous covering of the negative wire, are very beautiful,	3.00
84.	**Gassiot's Cascade**; a glass vase coated on the inside, and a glass tube through which the sliding rod passes to connect with the inner coating. The flow of electricity is very brilliant in a darkened room,	2.50
85.	**Gassiot's Cascade**, of Uranium glass, which with the electric light becomes *fluorescent*,	4.00
86.	**Electric Egg**, a strong globe with brass caps, with sliding rod, stop-cock, and stand for exhaustion, 12.00; Uranium Glass,	14.00
87.	**Aurora Tube** (see No. 51, *Pneumatics*); 8.50 and	9.50
88.	**Abbe Nollet's Globe**; glass receiver, with thick glass globe and movable cap to admit water; by adding some sulphate of quinine the water becomes *fluorescent*; the electric flow is peculiarly beautiful; four quart receiver, 6.50; six quart,	8.00
89.	**Insulating Stool**, mahogany, braced; large swelled glass legs, with brass screw caps,	10.00
90.	**Insulating Stool**, with fixed legs,	5.50
91.	**Thunder House**, illustrating the lightning rod; the house is held together by magnets, and is blown down by the discharge of a gas pistol within,	11.00
92.	**Obelisk** to illustrate the lightning rod,	5.00

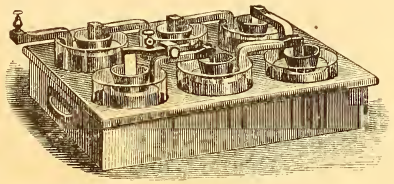


No. 120.

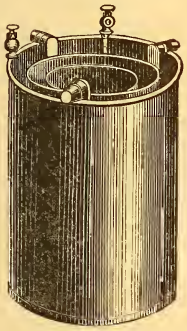
NUMBER		PRICE
101.	**Bar Magnet**, polished steel, ten inches,	1.00
102.	**Bar Magnets**, a pair with armatures, in box,	5.00
103.	**Bar Magnet**, compound, with connecting screws, 5.00 to	10.00
104.	**U Magnet**, or Horseshoe Magnet, with armature, four inch, .75; eight inch, 1.50; twelve inch,	2.25
105.	**U Magnet**, with handle, twelve inch,	3.00
106.	**Compound U Magnet**, three or more plates, 5.00 to	15.00
107.	**Wheel Armature**, revolves on No. 105,	1.00
108.	**Star Armature**,	.75
109.	**Magnetic Needle**, four inch, stand and pivot,	1.50
110.	**Magnetic Needle**, with agate cap, stand and pivot,	3.00
111.	**Dipping Needle**, 4 inch, on brass stand,	6.00
112.	**Dipping Needle**, brass base and pillars with graduated arc,	25.00
113.	**Astatic Needle**, four inch, agate cap, stand and pivot,	5.00
114.	**Pocket Compass** in brass box, agate cap,	2.50
115.	**Pocket Compass**,	1.25
116.	**Four Inch Needle** in brass case, 6 by 1½ inches, graduated arc of 20°; the sides of the base are parallel with the zero lines, accurately made and very sensitive,	10.00
117.	**Magnetic Fish**, swan, and ship,	.50
118.	**Natural Lodestone**, pieces in box,	.50
119.	**Breaking Magnet**, grooved to break into two or four,	.25
120.	**Ritchie's Patent Liquid Mariner's Compass.** The needle is enclosed in a thin copper cylinder, closed air tight, with lateral air chambers, and ring for the usual divisions. The specific gravity of the whole is a few grains more than that of the liquid (alcohol and water) with which the bowl is filled. The inertia of the liquid prevents oscillation, and buoyancy prevents the wear of the pivot. This compass has already come into general use in the United States Navy, and Mercantile Marine. Compass for illustration, four inch needle,	18.00



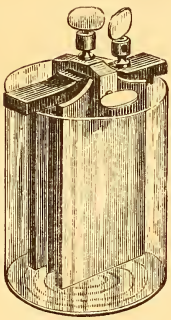
No. 123.



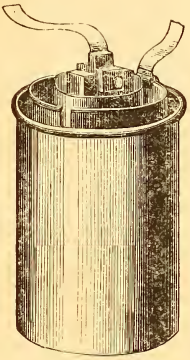
No. 125.



No. 126.

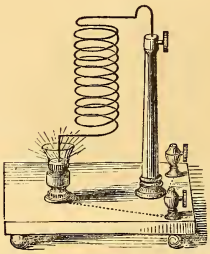


No. 128.

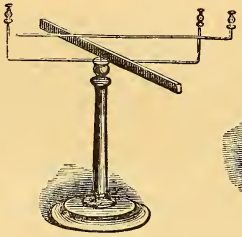


No. 129.

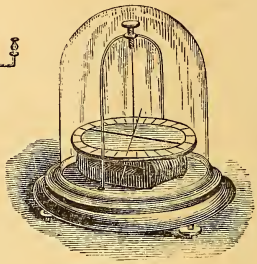
NUMBER		PRICE
121.	**Frog Battery**, of silver and zinc, insulated by a wooden bar,	1.75
122.	**Daniel's Constant Battery**, 5.00 and	7.50
123.	**Grove's Battery**, of improved form, single cell,	3.50
124.	**Grove's Battery**; four cells in box,	14.00
125.	**Grove's Battery**; six cells in box,	20.00
126.	**Sulphate of Copper Battery**; 6 by 9 inches,	6.00
127.	**Sulphate of Copper Battery**; 4 by 5½ inches,	4.50
128.	**Smee's Battery**, of improved form; glass jar seven inches high, with strong brass screw clamp,	5.00
129.	**Bunsen's Battery**; cell 9 by 5 inches; solid carbon, with improved screw clamp connections both to the carbon and to the zinc, made in a manner to permit a battery of many cells to be united readily for *intensity* or for *quantity*,	4.50
130.	**Bunsen's Battery**, large size; glass cells 12 by 6 inches; improved clamp connections,	8.00
131.	**Apparatus** for Electrolysis of Salts; bent tube upon a base with platinum electrodes,	5.25
132.	**Apparatus** for the Electric Light in a Vacuum; glass globe with stop-cock, sliding rods with carbon holders. See No. 86,	12.50
133.	**Electric Light Apparatus**; base and pillars, silver plated parabolic reflector, twelve inches diameter, adjustable carbon holders,	
134.	**Carbon Points** for electric light; per dozen,	
135.	**Powder Cup**; brass cup, with platinum wire,	1.75
136.	**Voltaic Pistol**, for gas (see No. 70),	8.50



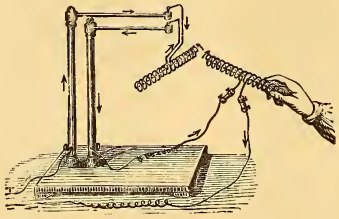
No. 141.



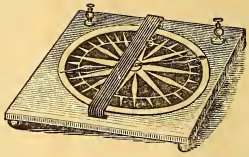
No. 144.



No. 145.

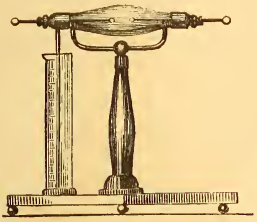


No. 139.

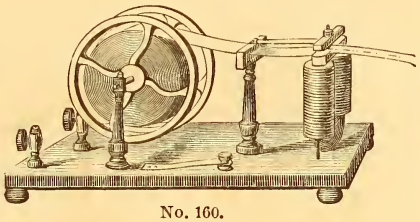


No. 143.

NUMBER		PRICE
137.	**Apparatus** for decomposing water; a strong glass receiver, capped at each end, with sliding rods and platinum electrodes; base and pillar with graduated jar to measure the gas evolved by the displacement of water; to recompose, pass the electric spark through the gas, .	18.00
138.	**Decomposing Cell**, with graduated tubes and platinum electrodes, . .	5.25
139.	**Ampère's Frame**; mahogany base, brass pillars and arms with mercury cups; a set of five forms, and solenoid of insulated copper wire, showing the action of magnets upon the currents, the action of terrestrial magnetism, and the action of currents upon currents. . .	27.50
140.	**Solenoid**, or Helix, to exhibit the phenomena of attraction and repulsion as a bar magnet, ...	2.50
141.	**Contracting Helix**; mahogany base and pillar, copper helix, . . .	5.50
142.	**Rotation** of a horizontal conductor by the earth's action, mahogany base, annular vase of mercury, with central pillar, and revolving conductor with pendants to the mercury, ...	
143.	**Galvanometer**, compass form, ...	4.50
144.	**Oersted's Galvanometer**, ...	5.50
145.	**Galvanometer**, very sensitive; astatic needle suspended by a fibre of silk; base with levelling screws, used with No 14, *Heat*, ...	35.00
146.	**Galvanometer**; a horizontal helix supported on base and pillars; the needle carries a vertical index, which is clearly visible over a white background. It is also arranged to be used with the lantern, and the image of the index *projected* upon the screen; price according to size and *sensitiveness*, — from 8.00 to	30.00
147.	**Magnet** revolving around a conductor, ...	18.00
148.	**Magnet** revolving on its axis parallel to conductor, ...	14.00

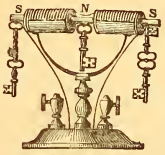


No. 137.

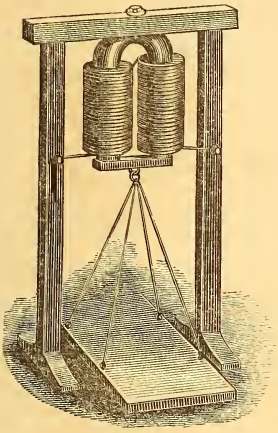


No. 160.

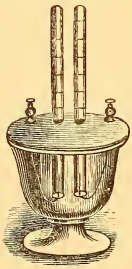
No. 153.



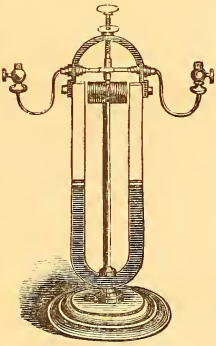
No. 152.



No. 150.

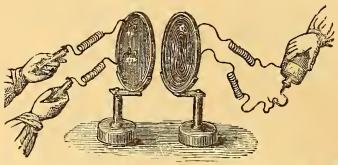


No. 138.

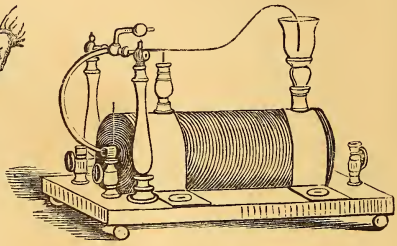


No. 159.

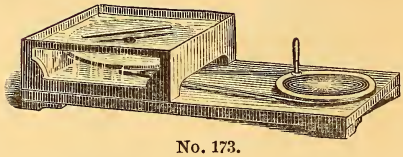
NUMBER		PRICE
149.	**Electro Magnets**, from 2.00 to	12.00
150.	**Electro Magnet** in frame, 15.00 to	40.00
151.	**Helix** on Stand, with a bar of soft iron,	4.25
152.	**Helix** on Stand, with three poles,	4.50
153.	**Helix** with ring armature, 4.25 and	6.00
154.	**Lifting Coil**, and rods for suspension, 3.00 and	5.00
155.	**Terrestrial Helix**, seven inches diameter, to use with magnetic needle,	2.00
156.	**Globe** and Helix, with iron core, and dipping needle on stand,	8.00
157.	**De la Rive's Ring**, or Floating Battery,	2.25
158.	**Page's Reciprocating Engine**,	16.00
159.	**Page's Revolving Electro-Magnet**,	8.00
160.	**Model of Telegraph**, with spool of paper and signal key, on base,	8.00
161.	**Model of Telegraph**, with spool of paper; a signal key on a separate base, and wire to extend around the room,	9.00
162.	**Model of Relay Magnet**, with pole cups for primary current and for local battery, to work No. 161,	7.50
163.	**Signal Key**, for making and breaking a battery circuit; 1.50 and	3.50



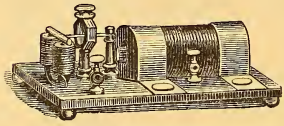
No. 167.



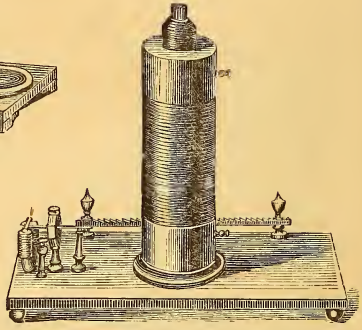
No. 170.



No. 173.

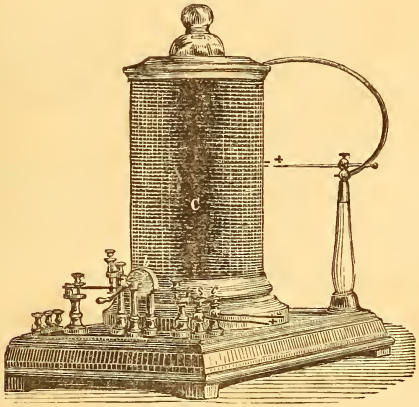


No. 168.



No. 169.

NUMBER		PRICE
164.	**Flat Spiral**; ribbon of copper, insulated, with pole screws; per lb.,	.
165.	**Henry's Secondary Currents**, of different orders, producing an intensity current from a quantity current, and the converse; series of flat helices of coarse and fine insulated wire,	.
166.	**Flat Helices**, of coarse and fine insulated wire, mounted upon, but not attached to, stands similar to No. 167, per pair,	25.00
167.	**Matteucci's Apparatus**, for induction of the voltaic current from the Leyden jar; two coils of insulated copper wire, wound in single spiral upon plate-glass, mounted on stands,	.
168.	**Page's Vibrating Shocker**, or Double Helices, with Page's vibrating electrome for showing volta-electric induction,	7.50
169.	**Page's Analysis of Shocks**, or Double Separable Helices, with vibrating electrome, and rasp break-piece	18.00
170.	**Page's Vibrating Armature** and Electrotome. The circuit break is through a cup of mercury; the *extra current* is shown by brilliant flashes,	15.00
171.	**Handles for Shocks**, with rosewood insulations, pair,	3.00
172.	**Set of Wires**, coarse and fine, for connections, insulated,	.50
173.	**Arago's Apparatus**, for showing the effects upon the needle by revolving discs of different substances,	30.00
174.	**Arago's Apparatus**; a box with parchment cover, needle and pivot, and discs of copper, lead, glass, and wood, fitted to No. 13, *Mechanics*,	12.00



RITCHIE'S IMPROVED INDUCTION COIL.

One of the most important instruments which have been brought out for many years, is the Induction Coil, by which all the effects of static electricity are produced from the battery.

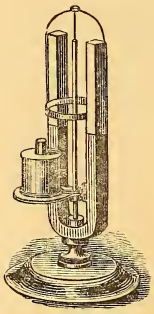
The power of this instrument is immensely greater than the electrical machine; the discharges may be made so rapidly as to appear a continuous flow, and with quantity so great that a Leyden jar can be charged and discharged as rapidly as the ear can distinguish sounds, and with almost deafening effect.

This instrument is not affected by the state of the atmosphere, occupies a small space, and is worked without labor; the battery used is Bunsen's, of intensity of only two to four cells; for fine effects, the battery should be of large size, though several of small surface can be united to produce a similar result.

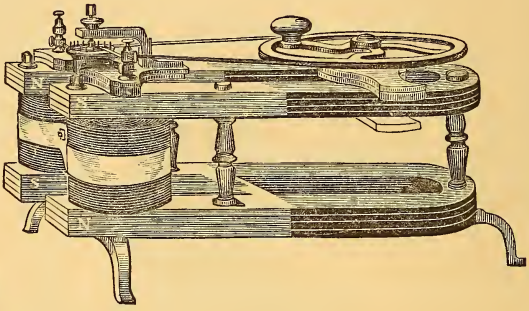
The instrument is mounted upon a mahogany base; the helix is covered with silk velvet, and rests upon a mahogany pedestal, and is finely finished.

NUMBER		PRICE
175.	**Induction Coil**, capable of throwing the spark 15 inches, ...	600.00
176.	**Induction Coil**, " " 12 "	525.00
177.	**Induction Coil**, " " 9 "	412.00
178.	**Induction Coil**, " " 6 "	337.50
179.	**Induction Coil**, " " 4 "	225.00
180.	**Induction Coil**, enclosed in a mahogany case, the break-piece and discharging pillars, and pole cups for battery current, are placed on the top; four inch spark, ...	200.00
181.	**Induction Coil**, same as No. 180; two inch spark, ...	100.00
182.	**Induction Coil**, similar to No. 180; one inch spark, ...	60.00
183.	**Induction Coil**, similar to No. 184, half inch spark, ...	50.00

NOTE. In the former arrangement of the instrument, the secondary helix and insulating bell-glass can be removed from the primary electro-magnet. In the latter form, the helices, &c., cannot be seen.



No. 187.



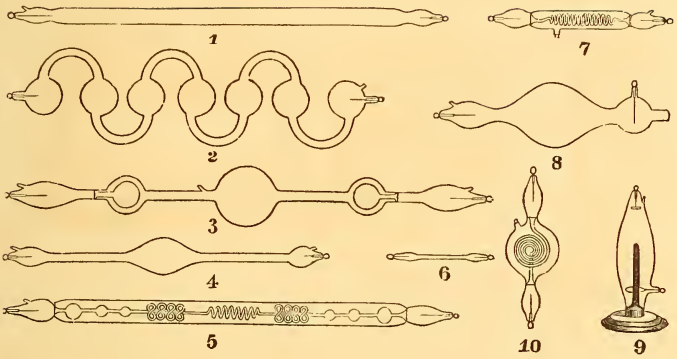
No. 184.

NUMBER		PRICE
184.	**Magneto-Electric Machine**, of improved construction; two large compound magnets, between which revolve armatures surrounded by coils of insulated copper wire; the instrument is arranged for giving shocks or for decomposing water, ...	60.00
185.	**Magneto-Electric Machine**, of smaller sizes, ...	35.00
186.	**Thermo-Electric Plates**; pair, 75 cents; series, ...	5.00
187.	**Thermo Electric Revolving Arch**, ...	8.00
188.	**Thermo Electric Arch**, between the poles of an electro magnet, . .	9.00
189.	**Double Thermo Electric Arch**, ...	10.00
190.	**T Bar** of antimony and bismuth for thermo-electric current, . . .	
191.	**Melloni's Thermo Multiplier**, consisting of antimony and bismuth bars, mounted in brass case, with conical reflectors; it is used with galvanometer No. 145, ...	37.50
192.	**Gore's Apparatus**, a double circular railway, with thin brass globe, which revolves by the heat generated at the point of contact by a battery current, ...	
193.	**Faraday's Apparatus** for Diamagnetism; Foucault's revolving disc between the poles of an electro magnet, and other apparatus which requires a large electro magnet and powerful battery current, will be made to order, and drawings and estimates will be given by letter when desired, ...	
194.	**Commutator**, or Pole Changer; by a movement of a lever the current of a battery may be reversed or broken, 5.00 to	10.00
195.	**Copper Wire** for battery circuit, plain, and covered with cotton; and for connections, insulated with cotton, silk, and gutta percha, . .	

Geissler's Tubes, for electric light; the rarefaction is nearly a Torricellian vacuum, but each tube contains a trace of the gas with which it was filled previous to the exhaustion, producing the most brilliant and beautiful colors.

It is impossible by description to give an idea of the exceeding beauty and brilliancy of these tubes with the *Induction Coil*, and many of them are shown with fine effect by the *Holtz Machine.*

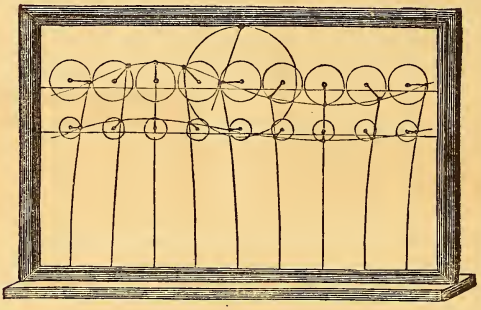
The variety of these tubes is very great; we endeavor to give an idea of some of the forms and approximate prices, on the next page.



NUMBER		PRICE
196.	**Plain Tube** (fig. 1), containing nitrogen, hydrogen, carbonic acid, &c., .	4.50
197.	**Plain Tubes** (fig. 1), of large sizes; 8.00 and	12.00
198.	**Cascade Tube** (fig. 2); in the narrow tube the stratification is peculiarly marked, and the light in the balls is *phosphorescent*, ...	9.00
199.	**Cascade Tube** (fig 2), large size, ...	18.00
200.	**Tube** (fig. 3), with two divisions, with different gases; no communication exists between the portions; the illumination of the interior bulbs by *induction* is very beautiful, ...	12.00
201.	**Tube** (fig. 3), with three divisions, large size, ...	24.00
202.	**Tube** (fig. 4). The narrow and the enlarged portions produce peculiar effects upon the intensity and color of the light, and of the stratification, ...	6.75
203.	**Combination Tubes** (fig. 5), with interior narrow tube and bulbs of different colored glass; the light and colors are very brilliant; 6.00, 9.00, 12.00, and	18.00
204.	**Small Tubes** (fig. 6), with variety of elements, ...	1.50
205.	**Tubes** (fig. 7), with interior spiral of fine tube; the outer one is to be filled with liquid for *fluorescence*, &c.; 2.25, 4.50, and	7.50
	NOTE. A solution of quinine, colorless, is of a rich blue, with electric light.	
206.	**Tube** (fig. 8), for showing stratification in broad planes, ...	6.00
207.	**Tube** (fig. 8), similar to No. 206, mounted, ...	15.00
208.	**Tube** (fig. 9), for the rotation of the current round a magnet, . . .	12.50
209.	**Globe** (fig. 10), with interior flat spiral of fine tubing; the globe may be filled with a solution of chloride of gold, quinine, &c.; 4.50, 9.00, and .	12.00
210.	**Globe**, similar to No. 209, enclosing rosette of small colored tube, . .	9.00
211.	**Tubes** similar in form to fig. 7; the interior tube forms the words "Volta," or "Galvani;" 6.00, and	7.50
212.	**Tubes** in form like fig. 7, enclosing an uranium vase; 3.00 and . . .	9.00
213.	**Vacuum Tube**, in which the vacuum is so perfect that the current *will not pass* between the wires, although they are but one fourth of an inch apart, ...	7.50

We shall keep a large variety of these tubes, at prices from 2.00 to 8.00, and of extra sizes and elaborate construction from 15.00 to 25.00.

UNDULATIONS.



Prof. Lyman's Wave Apparatus,—exhibiting not only the surface contour, but also the motions taking place in the whole mass of a liquid.

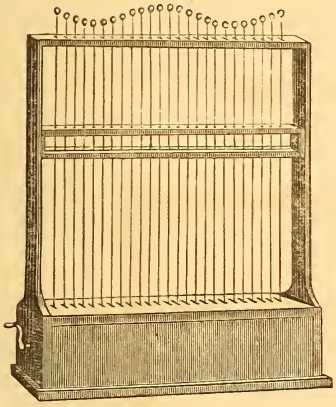
In front of a plane surface are two series of revolving cranks, the length of the lower ones being half that of the upper. Two elastic wires connect the crank-pins of each series; upright wires also connect each pair of cranks, and pass down through a plate into the base. The cranks all revolve synchronously; they thus keep their relative position, and come to any particular position successively, each in its turn.

The circles represent the orbits of as many liquid particles. The transverse wires represent continuous lines of particles, which at rest would be horizontal, and thus coincide with the lines drawn on the background, the upper being the surface line, the lower a line of particles one ninth of a wave's length below. The upright wires represent lines of particles which at rest would be vertical. Every point in these moving lines describes its own distinct orbit. The spaces between the wires show the varying distortions of sections of water originally rectangular.

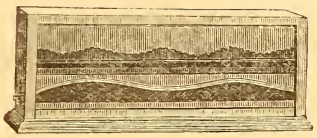
The circumference of the larger circle equals a wave's length; its radius, the height of a revolving pendulum keeping time with the wave. If this circle be rolled under a horizontal line, a point half the wave's height distant from its centre will trace the wave profile; the rolling circle for all profiles down to still water is the same. The sharper curvature of the crests than of the troughs, and its cause, are both made obvious. The wire pendulum represents the resultant of the weight and centrifugal force of a particle, and is normal to the wave surface.

Since the motions are the same essentially as in nature, the various geometrical and dynamical points of the theory of waves are strikingly exhibited. A full description, with statement of the facts and principles illustrated, will be sent with each instrument. It can also be had on application.

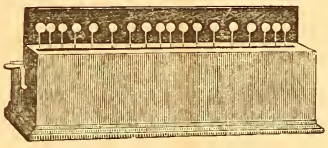
NUMBER		PRICE
197.	**Lyman's Wave Apparatus Frame,** 26 inches long, with nine pairs of cranks, ...	55.00



No. 2.



No. 4.



No. 3.

NUMBER PRICE

2. **Snell's Improved Powell's Wave Instrument,** for showing the undulations of light in plane, elliptical, and circular polarization. The frame is of mahogany, 24 inches long by 36 inches in height; twenty-four white balls are supported upon slender steel rods, to which motion is communicated by an equal number of eccentrics placed upon a shaft within the frame; the balls are arranged in two entire waves. By raising or depressing the sliding frame, which is sustained by springs, the balls may be made to move either in straight lines, ellipses, or circles, ... 85.00

3. **Snell's Illustration of Sound Waves,** or waves of condensation and rarefaction. In this species of waves, the particles simply oscillate back and forth in the line of the wave. Thirty white balls are arranged to form two and a half waves; each ball oscillates 1½ inches. A black screen is placed behind the balls; the frame, of mahogany, is thirty inches in length. The instrument illustrates longitudinal vibrations in a most striking and beautiful manner, ... 45.00

4. **Dr. Young's Interference of Waves,** as improved by Professor Snell. Fifty ebony keys arranged in a series, and kept in place by a bar in front, constitute the upper system of waves; the lower system is simply a dark board, which can be elevated by a lever at the back of the frame; when this is raised, all the ebony keys rest on its edge, so that their tops give the resulting form of both systems combined. There are four boards with different systems, illustrating musical intervals, and discord, or ocean and surface waves; mahogany frame, ... 37.50

5. **Cord of Elastic Brass Wire,** wound in a helix half an inch in diameter, for illustrating progressive wave motions, ... 3.50

6. **Elliptical Vase,** for interference of waves; see No. 70, *Acoustics*, . . 3.50

7. **Apparatus** for showing the propagation and reflection of waves; an iron trough, with two portions at right angles, for mercury, ... 2.50

NOTE. The effects of Nos. 6 and 7 can be beautifully *projected* upon the screen.

ACOUSTICS.

RITCHIE'S IMPROVED SONOMETER.

The case is of mahogany, 40 inches in length, with sounding-board of spruce, fitted for two wires, with tension-keys and wrench, and a brass lever with two weights (1 to 4), for measuring the tension (the upper line of figures is for the smaller, and the lower line for the greater weight). Two scales divided to the diatonic scale, with letters and syllables for the *intervals* of tones and semitones, and the *ratio* of length of cord, and number of vibrations; and a scale of sixty equal parts, with the numbers for division into two, three, four, eight, &c., with movable bridges for one or both wires to rest upon.

To produce the notes of the scale, move the bridge to the letters on the scale, and sound with the bow.

For the experiment to show the law that *the rapidity of vibration is as the square root of the tension*, attach one wire to the lever, place the weight on some number and tighten the wire until the lever is brought to a level, and tune the other wire to *unison*; then change the weight to a number on the lever corresponding to a *chord*; thus, from 2 to 8 will be an *octave*; 1 to 16, two *octaves*; 4 to 9, a *fifth*.

For the experiment to show that *the rapidity of vibration is inversely as the square root of its density*, place the large wire, which is four times as heavy, on the lever, and the weight to 16; tune the other wire to *unison*, then change the large wire for one of same size as the second one, and raise the weight as before; it will sound an *octave* higher; change weight to 4 and it will give the *unison*.

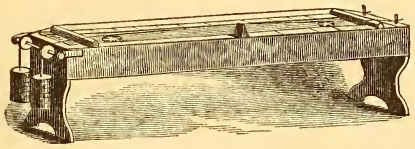
In changing considerably the weight, it will be necessary to tighten or loosen the screw to allow for the stretching of the wire.

For producing *overtones*, or *harmonics*, touch with a feather, or lightly with the finger, the wire at one of the equal divisions, and draw the bow gently across it; the wire will vibrate between the feather and fixed bridge, and also in equal divisions on the other side of the feather, but having points of rest, or *nodes*, at the divisions: e. g., touch the feather at 20, another node will be at 40; or touch at 12, other nodes will appear at 24, 36, and 48, dividing the wire into three or five equal portions, vibrating at equal times, and sounding the tone of the *second* and *fourth* harmonic of the fundamental note. A box of paper riders, blue and red, are sent to place on the wire before sounding; put some on the nodes, which will remain still, and some of another color on intermediate places, which will be instantly thrown off.

For showing *sympathetic vibrations*, tune one wire to unison or octave to the organ pipe; or sound the note with the voice, and the wire will be thrown into vibration and distinctly heard; it is essential that the unison or chord be *perfect*, or the wire will not respond. Draw the piston of the pipe while sounding it; the wire will catch and respond to the note which was for the instant of same number of vibrations.

By tuning the wires to near an unison, the effects of *interference*, or *beats*, are produced.

NUMBER		Price.
1.	Sonometer, with a set of wires, wrench, lever and weights.	35.00
2.	Sonometer, with wires and wrench the same as above, without the lever and weights.	25.00



No. 3.

NUMBER PRICE

3. **Sonometer**, of mahogany, on frame, standing 28 inches high, with sounding board of spruce, scales for the intervals of the diatonic scale, for the ratio of length of cord and number of vibrations, for divisions of the vibrating cord into equal parts for overtones and harmonics; two sets of weights, made in sections, for measuring the tension; wrench and fixed pins for straining the wire, and pulleys to use with the weights; two movable bridges, and set of wires, ... 60.00

4. **Two Wires** for Sonometer, of platinum and silver, of the same diameter; *specific gravity*, 21 and 10.5, ... 5.00

5. **Savart's Tube**, for showing the vibration in a jet of water. A large glass tube fitted for suspension, with brass cap and variable jets. As water flows from the tubes, different harmonic tones of great purity are produced, each gradually swelling and dying away. The flow should be received two feet below, upon a board placed in a tub, and inclined so as to prevent any disturbing sound, ... 18.00

6. **Trevelyan's Apparatus**, brass rocker, rod and ball, and block of lead for production of a tone by vibration; heat the rocker and rest it on the lead and set it in motion, ... 3.50

7. **Savart's Wheel**; a heavy brass ratchet wheel, supported in an iron frame and pedestal; revolve it by a cord wound around the axis, and hold a card against the teeth; a shrill musical tone will be produced, gradually falling in pitch as the speed is lessened, ... 7.50

8. **Screw Press**, of Iron, for confining Plates, Rods, &c., for vibration, with table clamp-screw, ... 7.50

Plates of Brass, for vibration. These plates are prepared with great care, to secure uniformity of vibration. To excite, hold the plate by the middle or other point, in the *Screw Press*; draw the bow across the edge, and from a sand-box held high above, scatter equally over the plate a small quantity of fine black writing sand, which will at once collect into fine lines, showing the *nodes*, and forming beautiful figures and curves; these tones are most readily obtained by touching the plate at one or two points on its edge with the finger while exciting it at different distances by the bow.

9. **Brass Plate**, 12 inches square, ... 5.50

10. **Brass Plate**, circular, 12 inches diameter, ... 5.50

11. **Brass Plate**, circular, 10 inches diameter, ... 3.75

12. **Brass Plate**, 10 inches diameter, thickness one half of No. 11, . . . 3.75

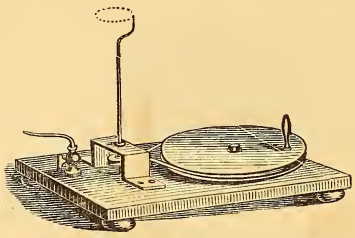
13. **Brass Plates**, triangular and polygonal, each 5.50

14. **Glass Plate**, 12 inches square, ... 3.00

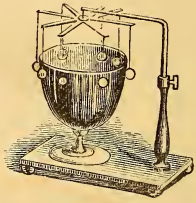
15. **Glass Plate**, circular, 12 inches diameter, ... 3.50

16. **Plates of Spruce**, circular, square and triangular, of different proportions and thicknesses, 75 cents to 1.50

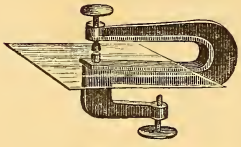
17. **Sensitive Jet**; tube and jet mounted on stand, with tube to connect to gas pipe or rubber bag, ... 3.50



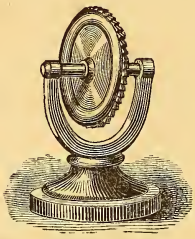
No. 18.



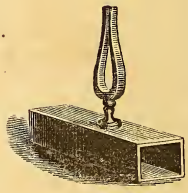
No. 19.



No. 8.



No. 7.



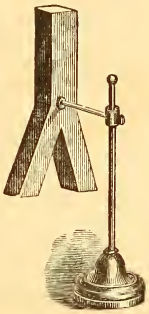
No. 20.

NUMBER PRICE

18. **Prof. W. B. Rogers' Apparatus** to show the intermittence of sonorous flames; a vertical gas jet, bent so that its point will describe a small circle within a glass tube; mahogany base and pulleys, with stop-cock, and tubes, ... 14.50
19. **Nodes** of a Bell; a large glass bell for vibrating with a bow; a heavy metal stand and frame for supporting eight balls of cork so that they may touch the outside edge of the bell, ... 12.50
20. **Diapason**, or Tuning Fork, mounted upon a resonant case; the fork is tuned to C_3 (ut_3) = 512 complete vibrations per second; the case is tuned to the same note; the vibration is produced by a bow, . . . 11.00
21. **Diapason** with handle and movable foot, ... 9.00
22. **Diapason** with hook for Melde's experiments, ... 12.00
23. **Grand Diapason**, C_2, mounted on its case, ... 30.00
24. **Four Diapasons**, C_3, E_3, G_3, C_4, on separate resonant cases, ... 40.00
25. **Eight Diapasons**, diatonic scale, C_3 to C_4, on separate cases, . . . 75.00
26. **Resonant Case**, C_3, with cup for mercury, and glass tumbler, to use with No. 20, showing transmission of vibrations through a liquid, . . 4.00
27. **Five Diapasons** for vocal sounds, to be held before the lips while the cavity of the mouth remains in the position for sounding the same vowels in a low tone, ... 40.00
28. **Lissajou's Apparatus**; two large diapasons, with metallic mirrors for the projection of sonorous vibrations by the reflection of a beam of light; each diapason is supported on an adjustable frame and base, . 75.00
29. **Violoncello Bow** for vibrating plates, &c., 2.00 and 3.50
30. **Contre-Bass Bow**, for vibrating plates. &c., ... 3.50
31. **Siren**, cylindrical pipe, with revolving fan, ... 7.50
32. **Siren** of Cagniard de Latour, an apparatus for determining the number of vibrations per second of any note of music, with dials and hands, .
33. **Double Siren** of Helmholtz (see *Tyndall's Lectures*), ...

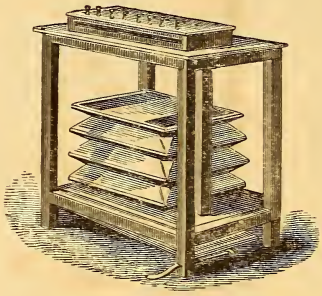
No. 35.

No. 34.



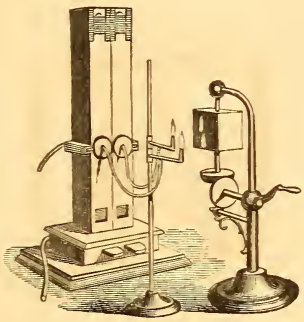
No. 36.

NUMBER		PRICE
34.	**Savart's Apparatus**, for reënforcement and direction of sound; a bell upon a pedestal for vibrating by a bow, and tube mounted on pedestal with movable piston, ...	37.50
35.	**Frame** with Membrane, for showing the vibrations produced in the air; shown by sand sprinkled upon its surface, ...	3.00
36.	**Hopkins' Tube** for interference of Waves of sound; a compound tube, with branches of equal length, base, and pillar, ...	8.00
37.	**Hopkins' Tube**; arranged to be used over a glass plate in the iron press; tube of japanned metal, with sliding joint for tuning, and collar and ring to allow a rotary motion; base and pillar, ...	10.00
38.	**Apparatus** for longitudinal vibrations; mahogany base, with brass screw clamp for holding rods of metal and wood for vibration, a support for suspending an iron ball before one end of the rod, which will be repelled with force, with brass rod one metre long, ...	15.00
39.	**Set of Rods**, for longitudinal vibrations, consisting of— A rod of steel, one metre in length, of same diameter, A tube of brass, of the same length and diameter, A rod of brass, of the same length but less diameter, Two rods of brass, of one half and two thirds metre in length, Four rods of fir, of different lengths, giving the perfect chord, . .	12.50
40.	**Rod for Vibration**, with a brass saddle for holding it in the *Screw Press*, and a stand and frame with ivory ball suspended. Place the ball against the end of the rod, and vibrate the rod by rubbing it lengthwise with a piece of resined leather, ...	3.75
41.	**Rods for Vibration**; four wooden rods fixed in a bar, to be held in the *Screw Press*. They are tuned to the chord of 1st, 3d, 5th, and 8th, .	3.50
42.	**Wheatstone's Kaleidophone**; a silver bead upon a steel wire, secured to an iron pedestal, illustrating the superposition of vibrations, . .	3.50
43.	**Kaleidophones**, pedestal with six steel rectangular rods and silver beads; producing the figures of the combination of two rectangular vibratory movements of intervals 1:1, 1:2, 2:3, 3:4, 3:5, 4:5. The light reflected from the beads describes very beautiful curves, ...	20.00



No. 45.

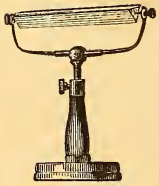
NUMBER		PRICE
44.	**Grand Soufflerie**, or organ bellows, 36 by 16 inches, constructed on the system of Cavallié-Coll, which gives a perfectly equal pressure; wind-chest, with twelve holes for pipes, with organ keys, ...	200.00
45.	**Organ Bellows**, improved bellows, insuring equal pressure; wind chest, and holes for eight pipes, ...	95.00
46.	**Wind-Chest** (see cut, No. 68), of mahogany, two holes for pipes, with sliding stops and rubber hose for the breath, or to attach to bellows, .	12.50
47.	**Organ Pipe**; embouchure of brass, three inches in diameter, with two movable glass tubes 16 and 30 inches long. In these tubes a membrane can be introduced to show the nodes, ...	18.00
48.	**Organ Pipe**, with one side of glass, a membrane and frame, ...	7.00
49.	**Pipe**, with slider which closes the tube at the node, ...	4.50
50.	**Pipe** with a slider, having holes of different diameters, sounding different notes, ...	5.00
51.	**Three Pipes** of same dimensions, with lumière of different sizes, . .	7.50
52.	**Pipe** with mouth formed to admit a lip of different forms and opening, .	7.00
53.	**Pipe** of the same size as another of the set, lined with cloth, ...	4.50
54.	**Three Pipes**, rectangular, one a cube, giving the same note, . . .	9.00
55.	**Four Pipes**, open, giving the perfect chord, ...	9.00
56.	**Eight Pipes**, closed, octave diatonic scale, ...	18.00
57.	**Four Pipes** of metal, giving perfect chord, ...	10.00
58.	**Pipe** with sliding piston, sounding two octaves, ...	4.50
59.	**Pipe**; embouchure with three tubes; of brass, wood, and paper, of same length and interior diameter, ...	7.00
60.	**Reed Pipe**, a free reed in glass chamber, and pipe in unison, with sliding tube, permitting it to be elongated to three times the length, for the experiments of Weber, ...	10.00
61.	**Reed Pipe**, free reed in glass chamber, with sliding rest varying the vibrating length of reed, with pipe, ...	4.75
62.	**Jet for Musical Tones**, to attach to hydrogen generator, ...	.75
63.	**Rose Jet**; for hydrogen or carburetted hydrogen, to use with a large tube, producing a powerful organ pipe tone, ...	4.50
64.	**Speaking Trumpet**, ...	



No. 68.

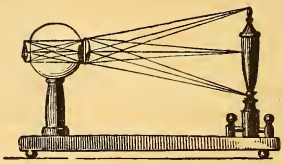
NUMBER		PRICE
65.	**Steam Whistle**, model of locomotive whistle, ...	7.00
66.	**Glass Tube** for resonance (Tyndall), to use with diapason No. 21, . .	2.00
67.	**Manometric Pipe** (Kœnig's), to render visible the compressions and dilatations of the air; an open pipe with three openings at the nodes of the fundamental note and its octave, are closed each by a thin membrane, and covered by a capsule to which is attached a tube and gas jet, a rubber tube for gas to flow into the capsules. When the fundamental note is sounded, all the jets are thrown into vibration; when the octave is sounded, the middle jet remains tranquil, ...	16.00
68.	**Apparatus** for comparison of the vibrations of two pipes by the method of manometric flames. It consists of a small wind-chest furnished with sliding stops, and a rubber hose for the breath, or to connect to bellows. Five pipes, each with sliding valves for tuning into unison or chord, or for producing *beats* sounding C_3, C_3, E_3, G_3, C_4, and each furnished with a membrane and capsule similar to No. 64; two adjustable jets are placed on a stand, connected by rubber tubes to the capsules; a revolving cube of mirrors is mounted upon a separate base for reflecting light from the jets. The images of the flame, as elongated or shortened by the differing pressure during each vibration, are detached and rendered perfectly distinct in a most beautiful manner. (See *Tyndall's Lectures on Sound.*)	85.00
69.	**Resonators** of Helmholtz, series of ten harmonics of C_2: viz., C_2, C_3, G_3, C_4, E_4, G_4, B_4, C_5, D_5, E_5, ...	45.00
70.	**Apparatus** for showing the interference of waves in an ellipse, and that waves propagated from one of the foci converge to the other; ellipse eight inches in diameter for mercury, ...	3.50
71.	**Bell in Vacuum**; a bell supported upon a frame by silk cords to prevent a transmission of vibration, with a stand (see cut, page 15), . .	3.25
72.	**Bell in Vacuum**, with clockwork movements. The frame rests on the pump plate by rubber supports, ...	
73.	**Lens** of thin rubber, or collodion, to be filled with carbonic acid for the refraction of sound, ...	

OPTICS.



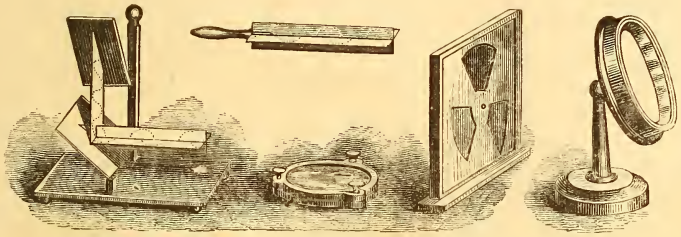
No. 2.

No. 11.



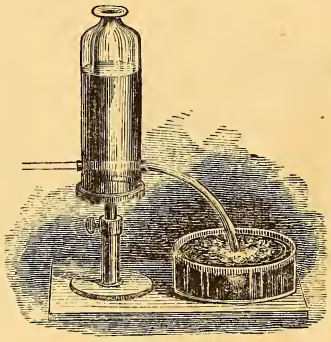
No. 12.

NUMBER		PRICE
1.	**Prisms**, of superior quality; three inches, 1.00 ; four inches, 1.50; six inches, 2.50; eight inches,	4.00
2.	**Mounted Prisms**; six inches, 6.00; eight inches,	7.50
3.	**Prisms** of crown and flint glass, mounted, to show the theory of achromatism,	
4.	**Three Prisms** for bi-sulphide of carbon, of brass, with plate glass faces, mounted in box, for projecting the spectrum,	25.00
5.	**Hollow Prism** for liquids; a glass globe with foot, with two planes of plate glass,	
6.	**Prismatic Lens**, or multiplying glass, in tube,	.75
7.	**Neutralizing Lenses**, set of six; viz., double convex and concave; plano convex and concave; meniscus convex and concave; 2½ inch diameter, very fine,	12.50
8.	**Neutralizing Lenses**, set of six; two inch,	10.00
9.	**Neutralizing Lenses**, set of four; viz., double and plano convex and concave; two inches diameter,	7.00
10.	**Artificial Eye**; brass globe of four inches diameter, with lens; concentric draw tubes with ground glass for the retina; a convex and concave lens are mounted on a frame, and revolve in front of the cornea. This instrument illustrates the use of spectacles for long and short sight,	15.00
11.	**Model** of the eye, dissected, showing the coats, retina, iris, crystalline lens, &c.; with stand,	8.00
12.	**Illustration** of long, short, and perfect sight, the projection and inversion of the image on the retina, and march of the rays through the crystalline lens,	7.00
13.	**Claude Lorraine Mirror**; convex, in case,	7.00
14.	**Mirrors**, set of seven, mounted to reunite the seven prismatic colors, and recompose white light,	25.00
15.	**Convex and Concave Mirrors**; ground and polished silvered lenses in frame; four inch, 4.50; six inch,	5.50
16.	**Cylindrical Mirrors**, similar to No. 15; four inch, 3.00; six inch,	4.00
17.	**Multiplying Mirrors**; four inch, 3.00; six inch,	4.00

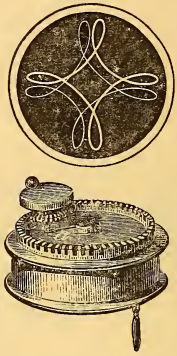


No. 19. No. 27. No. 22. No. 23.

NUMBER		PRICE
18.	**Model** of a ray of light, showing two planes of vibration, ...	3.50
19.	**Model** of the reflecting Polariscope, with mirrors, and incident and polarized ray, ...	12.50
20.	**Model** of the Tourmaline Polariscope, with rays, ...	10.50
21.	**Model** of a crystal of Iceland spar, large size, made of glass, showing the incident ray, the separation and polarization within the crystal, and the ordinary and extraordinary issuing rays, ...	12.00
22.	**Prof. Snell's Apparatus** for exhibiting the accidental colors in vision; a white screen, with three openings, each of 60°, behind which revolves a disc with the colors of red, blue, and yellow, alternating with white; in use, fix the eye intently upon a bead in the centre for a length of time, then let the disc be turned so as to present a perfectly white surface, the *complementary* colors of each of the departments will be vividly *seen*, ...	12.50
23.	**Prof. Snell's Instrument** for showing caustics by reflection, in successive orders; a ring of steel highly polished, mounted in brass, with movable joint, pillar and basement, so as to place in sunbeam; the caustics will be shown upon the white plane with great beauty, . .	18.00
24.	**Revolving Disc Apparatus**; mahogany base, metal frame, with pulleys and crank; a shaft, with screws for confining discs, ...	9.00
25.	**Set of Discs**; 24 circles of cardboard and paper, of variety of brilliant colors, including Newton's disc for recomposing white light. One set are cut in such a manner that they may be arranged so that any combination of the prismatic colors may be made in the circle; also forms to produce the graded, or the gradual, blending of one color into another, producing very interesting and beautiful effects; in box, .	2.50
26.	**Newton's Disc**, with the prismatic colors for recomposing white light by reflection; fitted to No. 13, *Mechanics*, ...	2.50
27.	**Plates** for Newton's rings; mounted in brass frame with screws; the plates are four inches in diameter, and are ground and polished with great care, ...	10.00
28.	**Plates** for Newton's rings, similar to No. 27, with one disc of black glass for projecting the images on the screen, ...	11.00
29.	**Tourmaline Polariscope**, mounted in pincers, for interposing a crystal; 5.00 to	12.00
30.	**Nicol's Prism**, for polarizer or analyzer; 4.00 to	10.00
31.	**Camera Lucida Prism**; 5.00 to	8.00
32.	**Camera Lucida**, mounted upon an adjusting stand; 8.00 to	12.00



No. 33.



No. 34.

NUMBER PRICE

33. **Apparatus** for showing the reflection of light in a liquid vein; a glass jar with brass cylindrical extension bearing a tube and jet, opposite to which is placed a lens. A ray of solar or artificial light is transmitted through the water, and into the vein as it issues from the jar, and by interior reflection follows the curvature, and forms a brilliantly luminous jet, ... 12.50

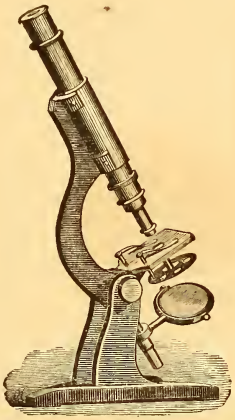
34. **Wheatstone's Photometer**; a brass cylindrical case enclosing a system of wheels giving motion to a disc upon which is placed one or more polished beads. It is founded on the endurance of the impression of light on the retina; with a single bead with two lights, a double system of curves is produced, of comparative intensity; there are also four discs with beads, which can be arranged in different forms, which produce in sunlight a great variety of most beautiful elliptical curves, ... 18.00

35. **Porte Lumière**; mirrors of silvered and black glass, mounted on brass frame, with motions in altitude and azimuth, to attach to window to reflect the solar light into a darkened chamber, the black glass for polarized rays, ... 85.00

We import from Paris, from the best makers, the following and other Optical Instruments which we cannot make at the cost of importation. The prices will depend on the value of gold, and will be given when desired, by mail.

---

36. **Duboscq's Electric Light Regulator** and lantern, ...
37. **Duboscq's Spectroscope** for projection, ...
38. **Duboscq's Polariscope** for projection, ...
39. **Conical and Pyramidal Prisms**, mounted on elevating stand, . .
40. **Prism** for direct vision, ...
41. **Reflecting Polariscope**; Norremberg's, ...
42. **Selenite Objects**; plates of crystals, &c., for polariscope, ...
43. **Large Concave Mirrors**, with vase and bouquet, ...
44. **Apparatus** for illustrating reflection and refraction, ...
45. **Dr. Auzous'** beautiful models of the eye and ear, ...
46. **Chevreul's Chromatic Scale**, ...



No. 47.

Microscopes. We shall not keep the higher cost instruments; we advise purchasers to apply directly to the manufacturers, and in particular, to the Boston Optical Works, R. B. Tolles, superintendent, or to Mr. J. Zentmeyer of Philadelphia, who make microscopes, objectives, and the accompanying instruments, of the highest perfection. We select, however, and keep for sale one microscope, which we think more than any other, at moderate cost, meets the wants of professors, chemists, and students; viz.: —

NUMBER		PRICE
47.	**Tolles's Students' Microscope**; designed under the advice of distinguished microscopists, and has been highly approved. The curved arm is supported on a trunnion of new construction, which admits of motion from horizontal to vertical; stage with spring clips; revolving diaphragm; concave mirror, with motion in all directions and attached to the arm, or placed on separate stand; coarse and fine adjustment; B eye-piece and two objectives of one fourth and one inch focal length, giving powers of 90 and 350 diameters; in black walnut case, ...	70.00
	Additions; extra eye-pieces, A and C, 4.00 each; camera lucida, 5.00; sliding stage, giving vertical and horizontal motions by the hand, and adapted to Maltwood finder, 12.00; rack and pinion 12.00; flat mirror,	3.00
48.	**French Microscopes**, in mahogany box, with triple achromatic objectives and condensers; 6.00 and	8.50
49.	**Tolles's Achromatic Triplet**, mounted in silver case; three quarters and one half inch, 12.00; one third inch, ...	14.00
50.	**Botanical Microscope**, in case, ...	2.25
51.	**Magnifying Lenses**, in horn mounting, 50 cents to	1.50
52.	**Hand Magnifiers**, in metal frames, 1.00 to	3.00
53.	**Microscopic Objects**, in mahogany box, twelve objects, ...	3.50
54.	**Opera Glasses**, from 5.00 to	20.00
55.	**Kaleidoscope**, very superior, mounted on stand, revolving cap with objects; barrel 12, by 3½ inches in diameter, ...	

THE MAGIC LANTERN.

Th Magic Lantern has now become one of the most valuable and important instruments of the lecture-room. With the oxy-hydrogen light, it is only necessary to but partially darken the room, even in the day time. The light is very easily managed, and with suitable apparatus can be used with much less trouble and loss of time than an ordinary oil light.

Diagrams that would require much time to make upon the blackboard, are far more easily and distinctly done on a plate of blackened glass, and they can be preserved; pictures illustrating most of the physical sciences are prepared at moderate cost.

The effects of chemical action or of heat in liquids, crystallization, &c., are shown in a most beautiful manner. By reflection of a beam of light minute motions, vibrations, &c., are made strikingly apparent.

We would refer to a series of papers on this subject by Prof. Morton, in late numbers of the "Journal of the Franklin Institute," and to Tyndall's Lectures.

NUMBER PRICE

56. **Magic Lantern**, specially designed for the lecture-room, and for scientific illustration. The lantern is of metal; the bottom and front are strong plates of brass, so that the lenses, the supports for objects, and magnifying lenses, or microscope, shall be accurately centred and firmly held in place. A strong flat bar projects in line of the bottom, upon which slides a frame carrying the magnifiers, so that they can be adjusted at distances required for the diagrams, for the spectroscope, or for a beam of parallel rays for the mirrors, Lissajous apparatus, &c., and leaving free space for manipulating with the tanks, or other objects in the rays from the condenser, as devised by Prof. Morton. The sides and top form a hood which is removable. The lenses are mounted in brass cells, and consist of collecting lenses giving a cylinder of parallel rays four inches in diameter, and condensing lenses of long and short foci, and of finest quality. The magnifiers are achromatic, and the oxy-hydrogen concentric jet is of new and improved form. The lantern is supported upon brass pillars and mahogany base, which gives space beneath for the stop-cocks, gallows connecters, and screws for focal adjustment. Peep-holes with colored glass are placed in the side. Two hose of rubber, each twelve feet long, with screws to connect to gasometers, ...

The necessary accompanying apparatus is (see *Chemistry*);

For hydrogen; generator No. 13, with purifier No. 14; or generator No. 10 or 11 with gasometer No. 5, or with rubber bag. Illuminating gas can be used with nearly as good effect; it is desirable to fill a gasometer or rubber bag to obtain a greater pressure.

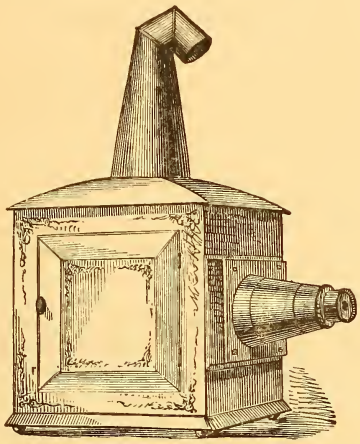
For oxygen; flask No. 8 or 9 and connecting tube, and gasometer No. 5; or with two tubes and Woolfe's bottle and rubber bag No. 7.

57. **Microscope Attachment**, mounted in brass, with tube to put in place of the magnifiers, or to attach to the Porte Lumière for solar light, with holder for objects; prices without objectives, ... 30.00

58. **Tolles's Achromatic Objectives** for the above; one inch, 8.00 and 20.00; half inch and quarter inch, each 20.00

59. **French Achromatic Triplets**, ... 12.00

60. **Objectives**, with two plano lenses, one to two inch, ...



No. 61.

NUMBER PRICE

61. **Magic Lantern**, of improved construction, made of heavy tin, handsomely japanned; the condensers are of superior quality, four inches in diameter, mounted in brass cell; the magnifiers are a combination of meniscus and plano-lenses, a late improvement, by which the spherical aberration is well corrected, and all parts of the picture brought into focus and distinctly thrown upon the screen; these are mounted in a brass draw tube with a diaphragm; an improved solar or petroleum lamp, with silver-plated reflector, and spring holder for sliders, . 40.00

62. **Magic Lantern**, similar to the above, with achromatic magnifiers, . . 50.00

63. **Oxy-hydrogen Light**, for No. 61 or 62, with improved concentric jet, stop-cocks, gallows-screw connection, and hose, each ten feet long to attach to gasometers or bags, ... 25.00

NOTE. The same accompanying apparatus is required as to No. 56.

64. **Prof. Morton's Tanks** and Accessories, viz.:

a. Simple Tank, consisting of two glass plates, a strip of rubber, and four brass clamps.

b. Tank with wires and tubes for galvanic decomposition.

c. Tank with coil of platinum wire, to show *convection of heat*.

d. Tank with inlet and outlet tubes, for a series of chemical color changes, &c.

e. Pipette, with elastic ball; price for the set, ...

65. **Prof. Hood's Sliders** for producing wave motion, ...

66. **Diaphragm** for artificial rainbow, designed to use with No. 5, *Optics*, .

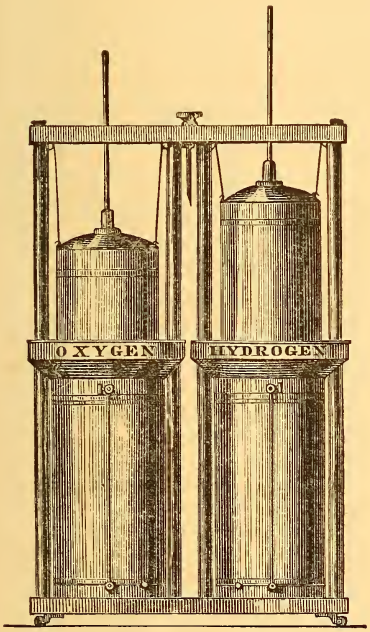
67. **Dissolving Views Apparatus**, two lanterns, Nos. 56 and 61 with base, dissolving stop-cock, and additional hose, ...

We keep a selection of sliders, American and foreign views, &c., made by W. Langenheim, of Philadelphia, and others, but cannot transfer their catalogues to our pages. We confine our assortment of pictures principally to scientific subjects, of a quality we think unequalled; a condensed list is given on next page.

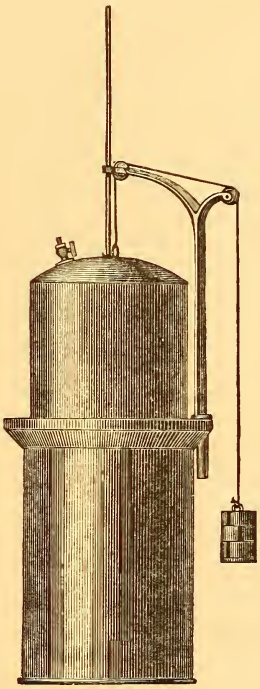
The following is a catalogue of pictures which are made especially for us by Dr. D. H. Briggs; the subjects are selected from the best authorities, photographed, and colored in the highest style of the art.

NUMBER		PRICE
1.	**Astronomy**, set of thirty pictures, in 3 inch single sliders, in box, including diagrams and telescopic views by Naysmith, Lord Rosse, De la Rue, and Lockyer, viz.: Systems of Ptolemy and Tycho Brahe. Copernician system. Spot on the sun, as seen by a powerful telescope (Naysmith). Phases and apparent dimensions of Venus. Inclinations of the axes of the planets. Diagram illustrating refraction. Parallels, meridians, and zones. True and mean place of a planet in its orbit. Seasons, length of days, etc. Signs of the zodiac. Telescopic views of the moon. Cause of the moon's phases. Mountains on the moon (Naysmith and De la Rue). Inclination of the moon's orbit. Diagram to explain eclipses. Total eclipse of the sun (De la Rue). Illustration of the tides. Telescopic views of Mars (Lockyer), of Jupiter (De la Rue), and of Saturn. Comet of 1811. Comparative size of the sun and planets. North circumpolar stars. Orion and adjacent constellations. Star cluster, or resolvable nebulæ. Dumb-bell nebulæ in Leo (Lord Rosse). Lord Rosse's telescope.	45.00
2.	**Astronomy**; set of twenty 3 inch pictures from the above, ...	30.00
3.	**Anatomy** and Physiology; set of twenty 3 inch pictures, Human Skeleton. Skull. Section of the spine, etc. Teeth, and structure of the same. Muscles, front view. Muscles, back view. Muscles of the head, neck, and face. General view of digestive organs in place. The digestive organs. The stomach, liver, and pancreas. Thoracic duct. Heart and lungs. Diagram of circulation. Skin. Brain and spinal cord. General view of the nerves. Fifth pair of nerves. Facial nerves. Diagram of the eye. Anatomy of the ear. .	30.00
4.	**Geology**; set of twenty 3 inch pictures, including geological record, ideal section of the earth's crust, thickness of the earth's crust, section of volcano in action, Fingal's cave, grotto of Antiparos, glacier of Mount Rose, glacier tables, corals and coral islands, trilobites, ammonites, rain drop marks, pterichthys, coccostes, cephalaspis, fossil fern, a thrust in a coal mine, ichthyosaurus, plesiosaurus, pterodactyle, fossil foot marks, the mammoth restored, ...	30.00
5.	**Botany**; set of twenty 3 inch pictures, ...	30.00
6.	**Natural History**; illustrations of various classes of mammalia, birds, reptiles, fishes, insects, crustacea, annelida, mollusca, and radiata, each .	2.75
7.	**Historical Subjects**; copies of celebrated pictures; manners and customs of the East; animals and plants mentioned in the Scriptures, each	2.75
8.	**Numerous** illustrations of Bible lands, including views in Palestine, Egypt, Assyria, Petræa, &c. *Floral* subjects in variety. Prices of the above in 3 inch sliders, each	2.75
9.	**Statuary**, many of the most noted of antique and modern art, three inches diameter, with black background, 1.50; with blue, crimson, or gold background, each	2.00
10.	**Newton's Disc**; revolving slider with prismatic colors for recomposing white light, ...	7.50
11.	**Chromatropes**; a variety of beautiful chromatropes, unsurpassed in brilliancy and colors, ...	5.00

CHEMISTRY.



Nos. 1, 2, 3.

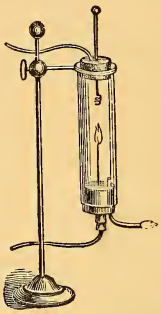


Nos. 4, 5.

NUMBER		PRICE
1.	**Gasometers**; a pair of copper mounted on base, with castors, side tubes for the balance weights, brass inlet and outlet tubes with stop-cocks, cylindrical iron pressure weights; substantially made and japanned; the bells are 9¼ inches in diameter by 31 inches in length, . .	115.00
2.	**Gasometers**; a pair of copper similar to No. 1, with bells, 7½ inches diameter, and 17 inches long, ...	70.00
3.	**Gasometers**; a pair of copper similar to No. 1, and of same size with interior cylinders, by which the quantity of water is much reduced,	125.00
4.	**Gasometer**; cylindrical inverted bell with stop-cock in a cistern; a movable metal crane with pulleys and balance weights in sections, the whole equals the weight of bell; by removing one or more of the weights, a corresponding pressure is exerted on the gas. The rising cylinder is 16 inches diameter by 26 inches high; it is made of galvanized iron. They are not affected by the action of water, and are strong, economical, and durable; capacity 22 gallons, ...	35.00
5.	**Gasometer** similar to No. 4; the bell is 11 inches diameter by 24 inches in length; capacity 9 gallons, ...	30.00

No. 8.

No. 10.



No. 15.

No. 16.

No. 57.

NUMBER		PRICE
6.	**Gas Bags** of rubber, spherical form, with stop-cocks; 4.50 to . . .	9.00
7.	**Gas Bags** of vulcanized rubber cloth, with socket, and stop-cock, 18 by 24 inches, 13.00; 24 by 30 inches, 16.00; 30 by 40 inches, ...	21.00
8.	**Oxygen Flask** of Copper, thick bottom, with screw cap, one quart, . .	5.50
9.	**Oxygen Flask**, similar to No. 8, with gallows screw cap, ...	8.00
10.	**Hydrogen Generator** of glass, with inverted bell and stop-cock, a copper basket for granulated zinc, and a solid ball of zinc; the cover is held by screws beneath a flange, ...	9.00
11.	**Hydrogen Generator** of copper with glass bell, capacity of cylinder, four quarts; similar in form to No. 10, ...	16.00
12.	**Platinum Sponge**, jet and holder, to attach to No. 10, ...	1.75
13.	**Hydrogen Generator**, of copper, 24 inches high by 10 in diameter, with handles and cover; an interior inverted bell of copper, with overflow tube, copper zinc holder and stop-cock. The generator will supply a constant flow of gas for the oxy-hydrogen light, . . .	35.00
14.	**Purifier**; a copper cylinder with screw cap; a diaphragm with holes is near the bottom; it is screwed upon the generator, and filled with pieces of lime, which purifies and desiccates the gas, ...	8.00
	NOTE. As the action ceases when the cock is closed, the generator can remain charged for months, and gas drawn at any moment. Precaution should be taken when first charged to allow the air to escape.	
15.	**Prof. Rogers' Apparatus** for the combustion of air in hydrogen; a glass cylinder on stand, with inlet and outlet pipes for hydrogen, and pipe and jet for air, sliding rod and platinum coil; the jet of air can be lighted and burned in its *atmosphere* of hydrogen, ...	10.00
16.	**Lamp Stand**, with four bows and binding screws, ...	2.25
17.	**Iron Chimney** for lamp, ...	.35
18.	**Rubber Tube** or Hose, with screw connections, four feet, ...	3.00
19.	**Rubber Tubing**, of calibre from one eighth to one inch, per foot, 20 to .	.50
20.	**Cork Borers**; set of three, 2.25; set of six, ...	3.25
21.	**Pneumatic Cisterns**, of copper or wood, made to order, ...	
22.	**Hydrogen Balloons**, of goldbeater's skin; 3.00 to	6.00
23.	**Pendent Spoon** and rod; copper, 50 cents; platinum, ...	1.50

24. **Evaporating Dishes**; porcelain, nests of six, ... 2.00
25. **Hessian Crucibles**, in nest, ...25
26. **Porcelain Mortar** and pestle; 1.00 to 3.00
27. **Agate Mortar** and pestle; 3.00 to 7.00
28. **Sheet Rubber**, piece, for square foot, ...50
29. **Dissolved Rubber**, in tin boxes, ...75
30. **Crucible Tongs**, of iron and German silver; 1.00 and 2.00
31. **Sefstroem's Retort Holder**, wood clamps, mounted on iron stand, . 5.00
32. **Nipper Tube Holder**, wood screw clamps with cork jaws, ... 3.00
33. **Copper Alcohol Lamp**, with five wicks, ... 2.25
34. **Spirit Lamp**, with ground cap, ... 1.00
35. **Plain Mouth Blowpipe**, of brass, ...50
36. **Blowpipe**, with condensing bulb, ... 1.50
37. **Test Tubes**, with mahogany stands; 12 tubes 3.25
38. **Mouthpiece** for inhaling gas, ... 2.00
39. **Filtering Paper**, in packages; 25 cents to 1.00
40. **Set for Blowpipe Analyses**, consisting of oil lamp mounted on stand, blowpipe with platinum tips, crusher, hammer and anvil, agate mortar, charcoal borer, cupels and holder, mould for charcoal crucibles, and platinum tipped forceps, ...

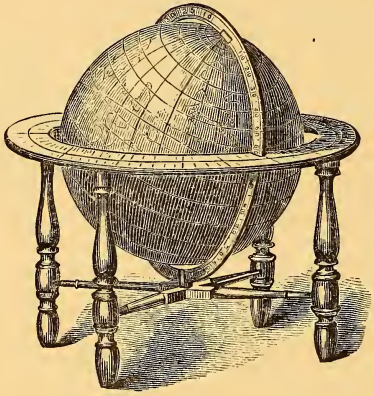
Chemical Glass Ware.

41. **Receivers** of different forms, see *Pneumatics*, ...
42. **Bolt Heads** or Matrass, pint, 50; quart, ...75
43. **Funnels**, gill, 25 cents; half pint, 35 cents; pint, 45 cents; quart, . . .60
44. **Graduated Ounce Measure**; 2 oz. 65 cents; 4 oz. 75 cents; 8 oz., . . 1.00
45. **Stirring Rods**, set of six, ...50
46. **Safety Tubes**, straight, 75; bent with bulbs, ... 1.00
47. **Pipette**, or Dropping Tube, ...50
48. **Two Bulbs** and Tube, Brand's, for condensation, ...75
49. **Glass Chemical Tubes**; per pound, ... 1.00
50. **Glass Barometer Tubes**, small and large, per pound, ... 1.50
51. **Rupert's Drops**, unannealed glass, per dozen, 50 and 1.00
52. **Bologna Vials**, unannealed, ... 2.25

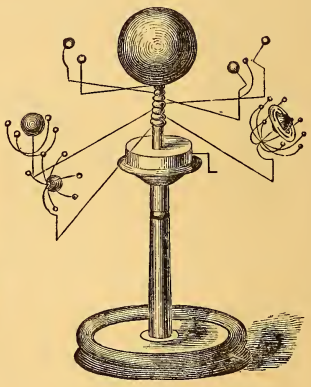
Bohemian Hard Glass without Lead.

53. **Retorts**; half pint, 40 cents; pint, 55 cents; quart, ...65
54. **Retorts**; tubulated, 3 oz., 40 cents; 4 oz., 50 cents; half pint, 60 cents; pint, 75 cents; quart, ... 1.00
55. **Flasks**, with rim necks for corks, uniformly thin throughout; 4 ounce, 30 cents; half pint, 35 cents; pint, 50 cents; quart, ...65
56. **Digesting Flasks**, with flat bottoms and rim neck; 2 oz., 30 cents; 4 oz., 30 cents; half pint, 35 cents; pint, 50 cents; quart, ...65
57. **Woulfe's Bottles**, with three necks; pints, 1.25; quarts, ... 1.50
58. **Globe Receivers**, tubulated; half pint, 50 cents; pint, 65 cents; quart, . .75
59. **Beaker Glasses**, in nest; 1.25 to 3.50
60. **Test Tubes**, with rim and lip; per dozen, 50 cents to 1.25

ASTRONOMY.



No. 2.



No. 8.

Globes.—Terrestrial and celestial globes, made by G. Joslin, of Boston (late Loring). These globes are considered the most accurate of any now made; the engravings have been corrected to late discoveries and geographical changes, and are of superior construction.

NUMBER		PRICE
1.	**Globes** on bronzed pedestal stand with castors; this style of mounting has the advantage of great stability, convenience, and beauty of design; 18 inch, 62.50; per pair, ...	125.00
2.	**Globes**, pedestal stand, similar to No. 1; 12 inch, each 37.50; pair, . .	75.00
3.	**Globes**, 12 inch, on full wood frame stand, each 22.00; per pair, . . .	44.00
4.	**Globes**, 10 inch diameter, frame stand, each 17.00; per pair, ...	34.00
5.	**Globes**, 10 inch, semi-stand, each 10.00; per pair, ...	20.00
6.	**Globes**, 6 inch, semi-stand, each 5.00; per pair, ...	10.00
7.	**Joslin's Solar Telluric Globe**, ...	15.00
8.	**Orrery**, with brass pillar and base; crank motion, new and improved wheel-work, by which a uniform motion is obtained; brass tubes; bronzed planets, ...	30.00
9.	**Improved Season's Machine**, giving the motions of the earth around the sun, the inclination and parallelism of the earth's axis, the causes of the seasons, the revolution of the moon around the earth, the moon's nodes, the revolution of the sun and earth on their axes; five inch sun, three inch terrestrial globe for the earth, ...	18.00
10.	**Movable Planisphere** (made by H. Whital), showing the position of the heavens at any given time; 16 inches square; plain, 2.00; colored, .	3.50
11.	**Rain Gauge**, of improved form; copper cylinder with exterior glass tube and graduated scale, ...	20.00

Testimonials.

BOSTON, Aug. 10, 1857.

I take pleasure in bearing testimony to the great skill, faithfulness, and ingenuity of Mr. Ritchie, as a maker of Philosophical Instruments. Uniting an ample knowledge of scientific principles to large experience in the mechanical details of his profession, his work commends itself not only to institutions seeking apparatus for lecture-room illustration, but to men of science pursuing original research.

WILLIAM B. ROGERS.

AMHERST, June 5, 1869.

I have for many years been acquainted with Mr. E. S. Ritchie, as a designer and manufacturer of philosophical apparatus, and am prepared to speak in high terms of his intelligence and mechanical skill, as well as his courteous attention to those who apply to him for counsel or aid in his line of business. I am glad to look over the new catalogue of apparatus for schools, which Ritchie & Sons are just issuing, and to recommend it to the attention of all who wish to become purchasers. The improvements which they have made in many of the common philosophical instruments, have more than doubled their value. Teachers and experimenters may rely on the strict fidelity of the Messrs. Ritchie, in regard to the quality and adaptedness of the articles which they furnish.

E. S. SNELL,
Prof. of Nat. Philosophy, Amherst College.

EAST HAMPTON, *June* 5, 1869.

Mr. E. S. Ritchie has made a large amount of philosophical apparatus for me, at different times, and it has given me great satisfaction. In simplicity of design, accuracy of operation, and perfection of workmanship, it is not surpassed. His Patent Air Pump is a very great improvement upon anything of the kind before constructed. It easily makes a vacuum nearly as complete as can be obtained by the laborious process of the mercury pump. The exhibition of the electric light in the vacua produced by it is equal to that in the best Geissler tubes.

MARSHALL HENSHAW,
President Williston Seminary.

From Mr. John P. Gassiot, Vice-President of the Royal Society.

LONDON, March 7, 1859.

DEAR SIR: I have great pleasure in assuring you that the Induction Coil, which, through the introduction of my friend, Prof. William B. Rogers, you constructed for me, answers most admirably. With five of Grove's nitric acid battery cells I obtain eleven and a half inch sparks. The Vibrating Contact Breaker, which you subsequently sent, has enabled me to repeat all the experiments with my Vacua Tubes, while the three divisions in your Coil affords facilities for varying the experiments in a manner that can be well appreciated by those who have worked with this apparatus.

Believe me, dear sir, yours truly,
JOHN P. GASSIOT.

To EDWARD S. RITCHIE, Boston, U. S. A.

United States Military Academy, West Point, N. Y., *June* 4, 1869.

The best portion of the apparatus in use in the Chemical Department at this institution, has been made under the direction of Mr. E. S. Ritchie, of Boston. In all respects, everything that has been received from him, whether ordered in person or by letter, gives complete satisfaction. His Electrical and Pneumatical Instruments are of unequalled excellence.

I have found Mr. Ritchie to be not only an entirely reliable gentleman, but one whose scientific attainments make him a valuable adviser.

H. L. KENDRICK,
Prof. Chemistry, &c., U. S. Military Academy.

Cambridge, Sept. 10, 1852.

This may certify that Mr. E. S. Ritchie is well known to us as a manufacturer of the best philosophical instruments used in academies and colleges. He is not content with supplying the usual apparatus found in all the catalogues, but he is ambitious to add to it new articles which illustrate fresh discoveries in science, or which excite a scientific curiosity. His integrity, his urbanity, and his skill all equally entitle him to the confidence of those who purchase or use philosophical apparatus.

JOSEPH LOVERING.
Hollis Prof. of Mathematics and Nat. Philosophy in Harvard College.
JOSIAH P. COOKE, Jr.,
Erving Prof. of Chemistry and Mineralogy in Harvard College.

Dartmouth College, Hanover, N. H., May 22, 1869.

I take pleasure in bearing witness to the excellence of the Philosophical Apparatus manufactured by E. S. Ritchie & Sons. I have never found anything better in respect to accuracy of workmanship, and efficiency of operation. Their efforts to promote science by being the first manufacturers in the country to construct the Induction Coil, and the Holtz Electrical Machine, have deserved and obtained for them the regard of all American scientific men, and given them even a European reputation.

C. A. YOUNG,
Prof. of Nat. Philosophy and Astronomy.

New York, Sept. 1, 1857.

It is with great pleasure that I offer my testimony in favor of the excellent Philosophical Instruments constructed by Mr. E. S. Ritchie, of Boston. I have uniformly found them accurately and carefully made, durable and elegant. Mr. Ritchie seeks not alone to equal the best foreign instruments, but to surpass them, and to keep pace with the advancement of science. I have had repeated proofs of a characteristic possessed by Mr. Ritchie, which I feel confident will be appreciated, viz., the sympathy and interest he manifests with the success of the experimenter, associated with a pride for his reputation, punctuality, and a determination to accomplish his aims.

Respectfully submitted,
R. OGDEN DOREMUS, M. D.,
Prof. Chemistry New York Medical College, and College of Pharmacy.

St. Louis, Mo., May 28, 1869.

I am now using the Philosophical and Chemical Apparatus of E. S. Ritchie & Sons. Everything which I have seen of their manufacture has borne marks of mechanical skill, scientific knowledge, and the honesty which gives skill and knowledge their best results.

C. S. PENNELL,
Prin. of Mary Inst., a department of Washington University.

UNIVERSITY OF PENNSYLVANIA, PHILADELPHIA, July 10, 1857.

Having used with much satisfaction a variety of apparatus manufactured by Mr. E. S. Ritchie, I take great pleasure in bearing testimony to his ingenuity and scientific skill as a Philosophical Instrument maker.

R. E. ROGERS,
Prof. of Chemistry in the University of Pennsylvania.

ANDOVER, March 22, 1869.

From time to time during the last ten years, I have had occasion to purchase apparatus of Mr. Ritchie, and have found every article satisfactory. Mr. Ritchie is possessed of rare skill and ingenuity, and evidently takes pride in having every piece of apparatus in perfect order before it leaves his hands.

WM. G. GOLDSMITH,
Principal Punchard Free School.

YALE COLLEGE LABORATORY, June 17, 1859.

Scientific men in the United States, and teachers generally, are under many obligations to Mr. Ritchie, not only for the general superiority of his apparatus, but especially for his enlightened enterprise in undertaking many things for which we have before depended on Europe.

I have found Mr. Ritchie ready at all times to undertake commissions out of the routine of his business, relying for his reward upon the reputation growing out of such a course.

All the apparatus which I have had from Mr. Ritchie has been exceedingly well made, and has given me entire satisfaction. His stock of Physical and Chemical Apparatus is excellent. The pieces are well made, in good taste, and of reasonable price.

B. SILLIMAN, JR.

Extract of Letter from Prof. Forbes, of the University of Edinburgh.

EDINBURGH, 16 July, 1858.

MY DEAR SIR: . . . I have been highly pleased with the instrument. I have shown it in action to many scientific men, including Sir David Brewster.

I remain, dear sir, yours faithfully,
JAMES D. FORBES.

OFFICE OF SUP'T PUBLIC STHOOLS, CHICAGO, Feb. 15, 1859.

The Board of Education of this city has recently purchased of E. S. Ritchie, of Boston, one thousand dollars' worth of apparatus, for the use of the Chicago High School. In thoroughness of workmanship and elegance of finish, it is unsurpassed by any apparatus that has fallen under my observation. Its performance is in the highest degree satisfactory.

W. H. WELLS,
Superintendent Public Schools.

NEW ENGLAND NATIONAL BANK, BOSTON, JUNE 4, 1869.

MESSRS. EDWARD S. RITCHIE & SONS.

GENTLEMEN: In my opinion, your house may be relied on for faithfully performing all its promises and obligations; and this I declare, not only from a sufficient knowledge of it, but also from an intimate acquaintance with its members of longer standing than the establishment.

With esteem, yours truly,
THOMAS LAMB, *President.*