A DESCRIPTION

OF THE

PNEVMATIC APARATVS

MADE BY

GEORGE ADAMS

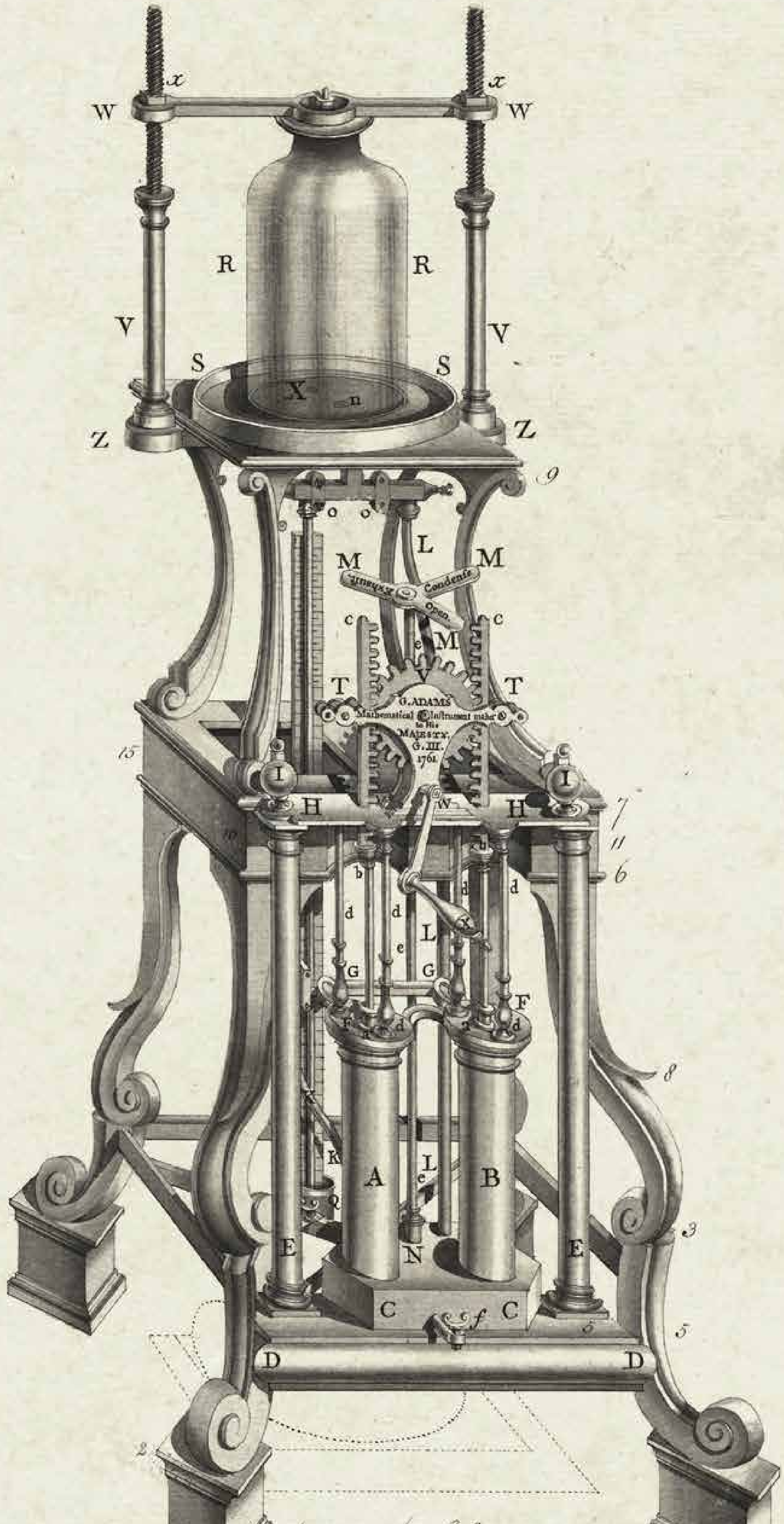
IN FLEET STREET LONDON.

1761.

A ‘peculiar Contrivance’: King George III’s double-barrelled air pump, 1761

Displayed to your left with some of its accessories is an air pump, commissioned by King George III from instrument-maker George Adams. An accompanying manual describes how to perform over 50 demonstrations on pneumatics – the properties of air. This diagram shows the pump with a bell jar attachment. Controlling the air pressure could profoundly affect anything placed inside the jar, such as gunpowder, glass, wood, metals, liquids, mechanical devices, even live animals. Adams argued that his pump’s innovative design and high-quality craftsmanship ensured greater operational efficiency than earlier models.

Fig. 1.



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Creating different atmospheric conditions

The brass condenser in figure XXIII is displayed attached to Adams's air pump. Setting the pump to 'Condense', a user could compress the air inside to increase the pressure. Alternatively, the pump's 'Exhaust' setting allowed users to create a vacuum by removing air from containers like the glass bell jar in figure XXV. The apparatus shown inside the jar is described overleaf.

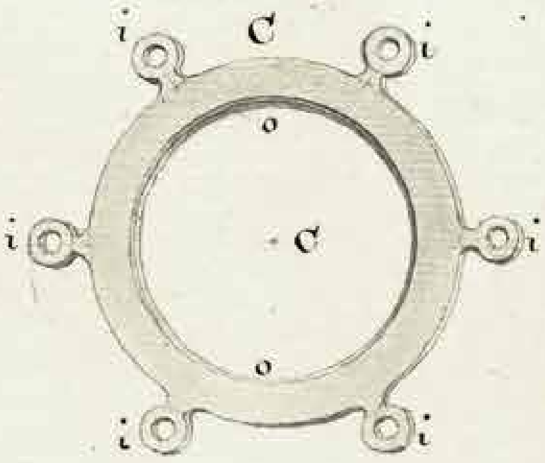


Fig. XXIV.

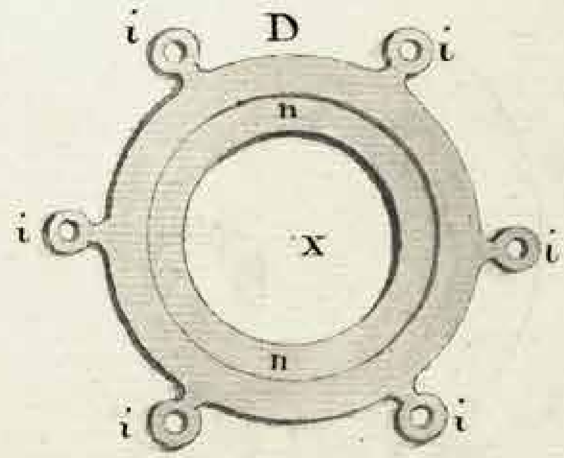


Fig. XXIII.

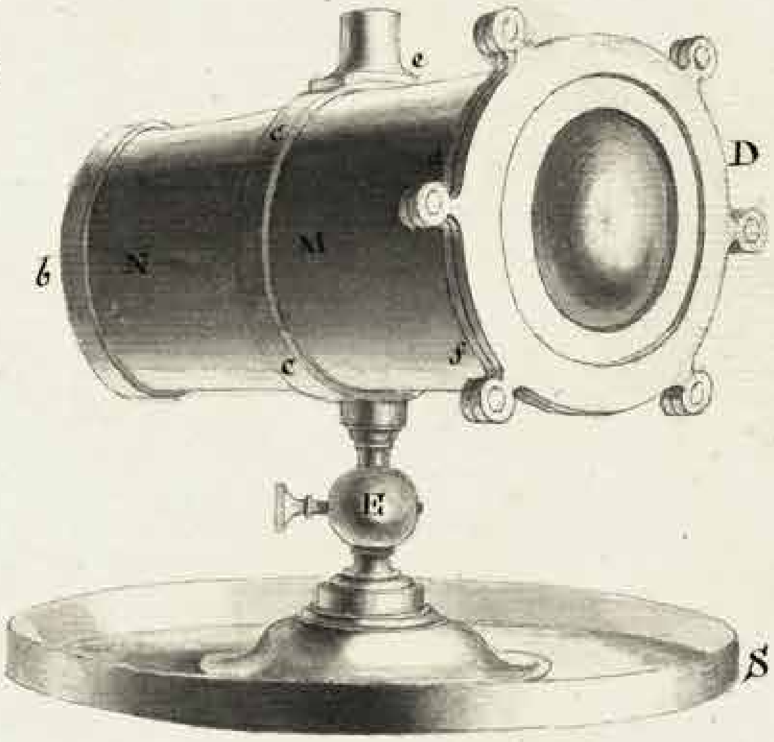
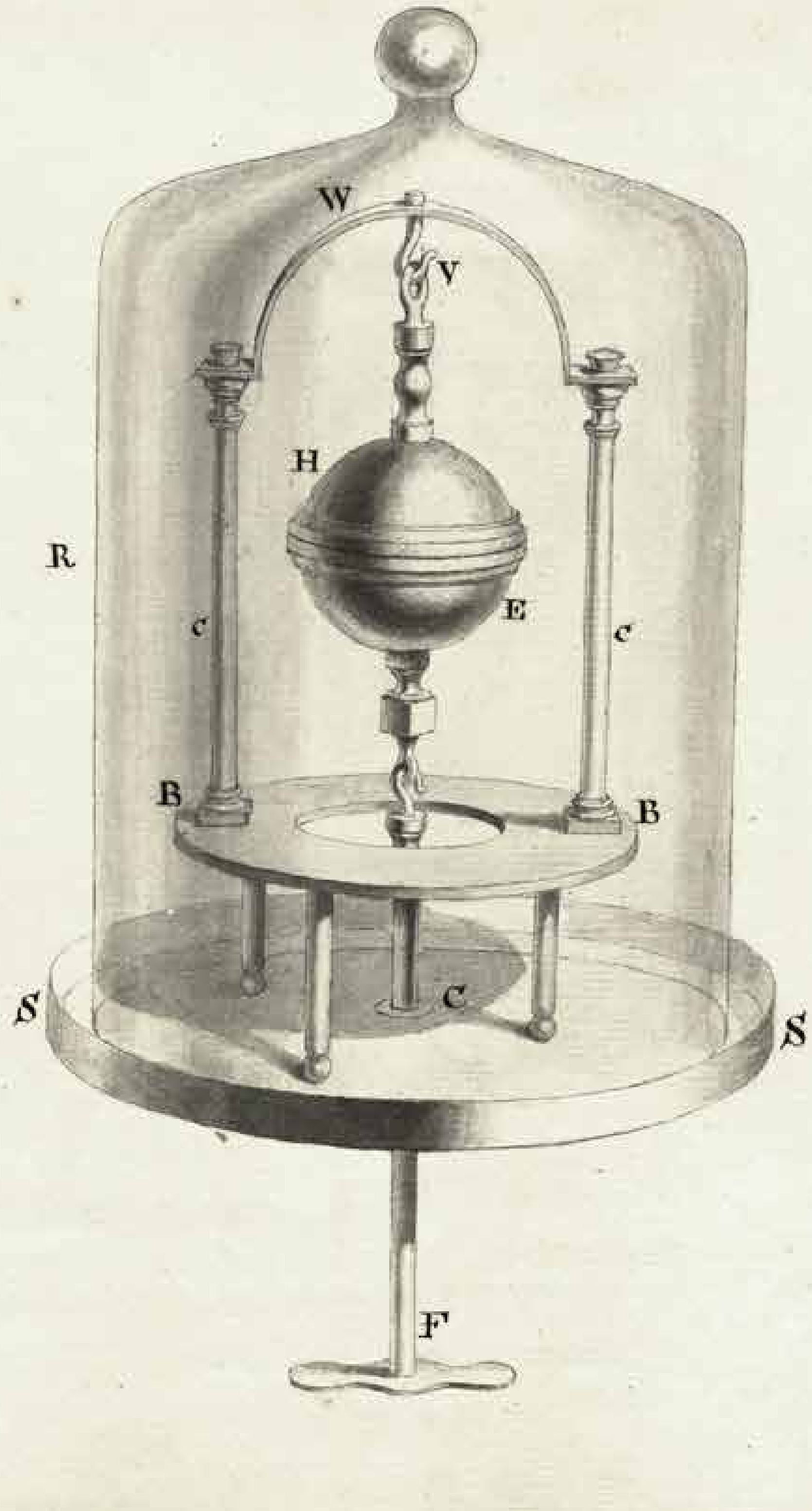


Fig. XXV.

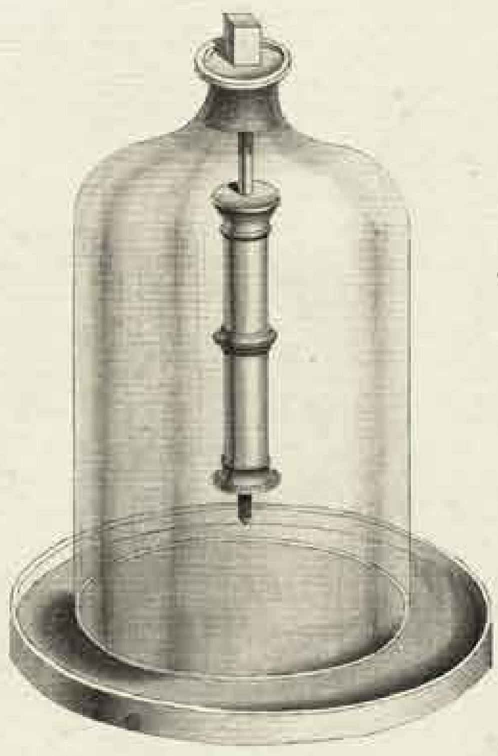


Demonstrating the power of air pressure with Magdeburg hemispheres

Invented in Magdeburg, Germany, these hemispheres (figures 21 and 22) were enduringly popular devices. Placed together and emptied of air, they exerted no pressure to resist the pressure of the surrounding atmosphere. This pushed them together so powerfully that people were unable to pull them apart. To measure the force needed to overcome this pressure, weight 'P' would be moved along the balance until the hemispheres separated.

Fig. 19

№ III, Fig. 20.



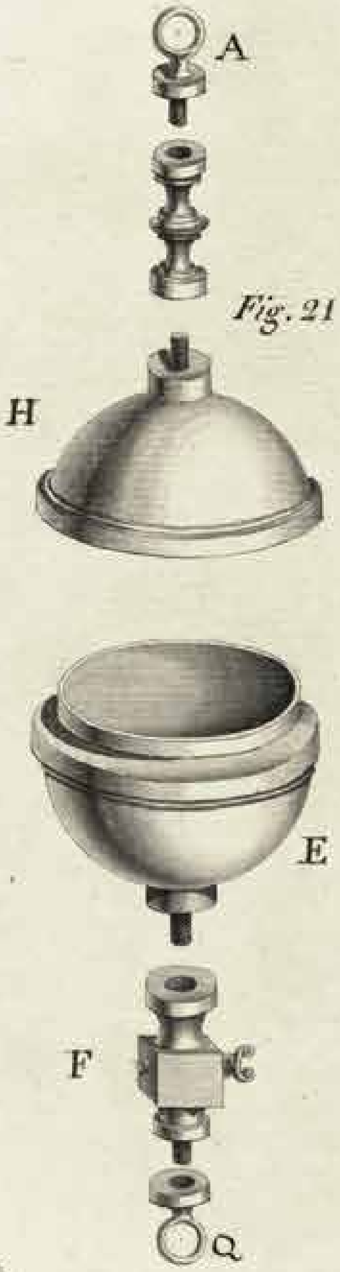


Fig. 21

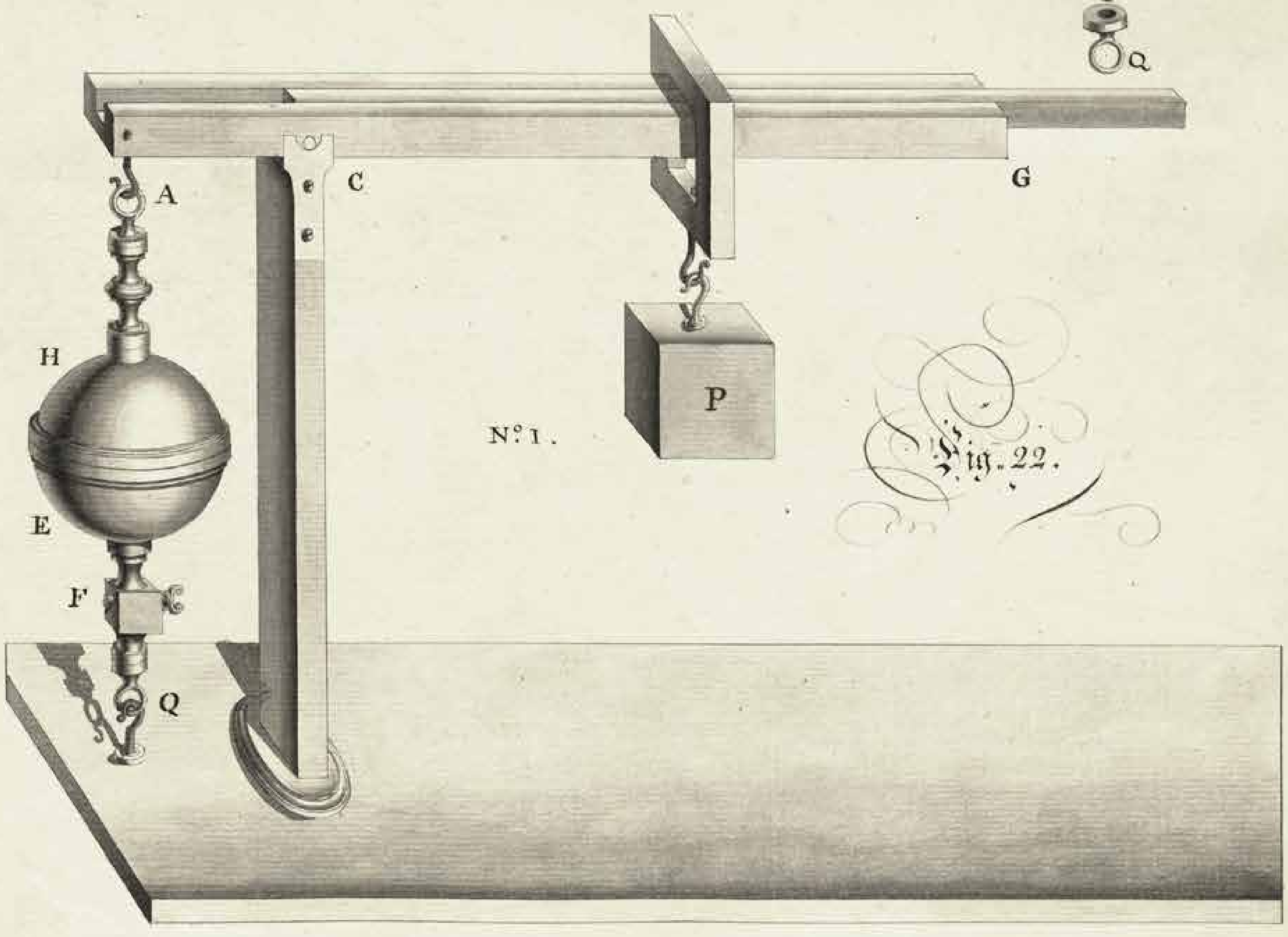
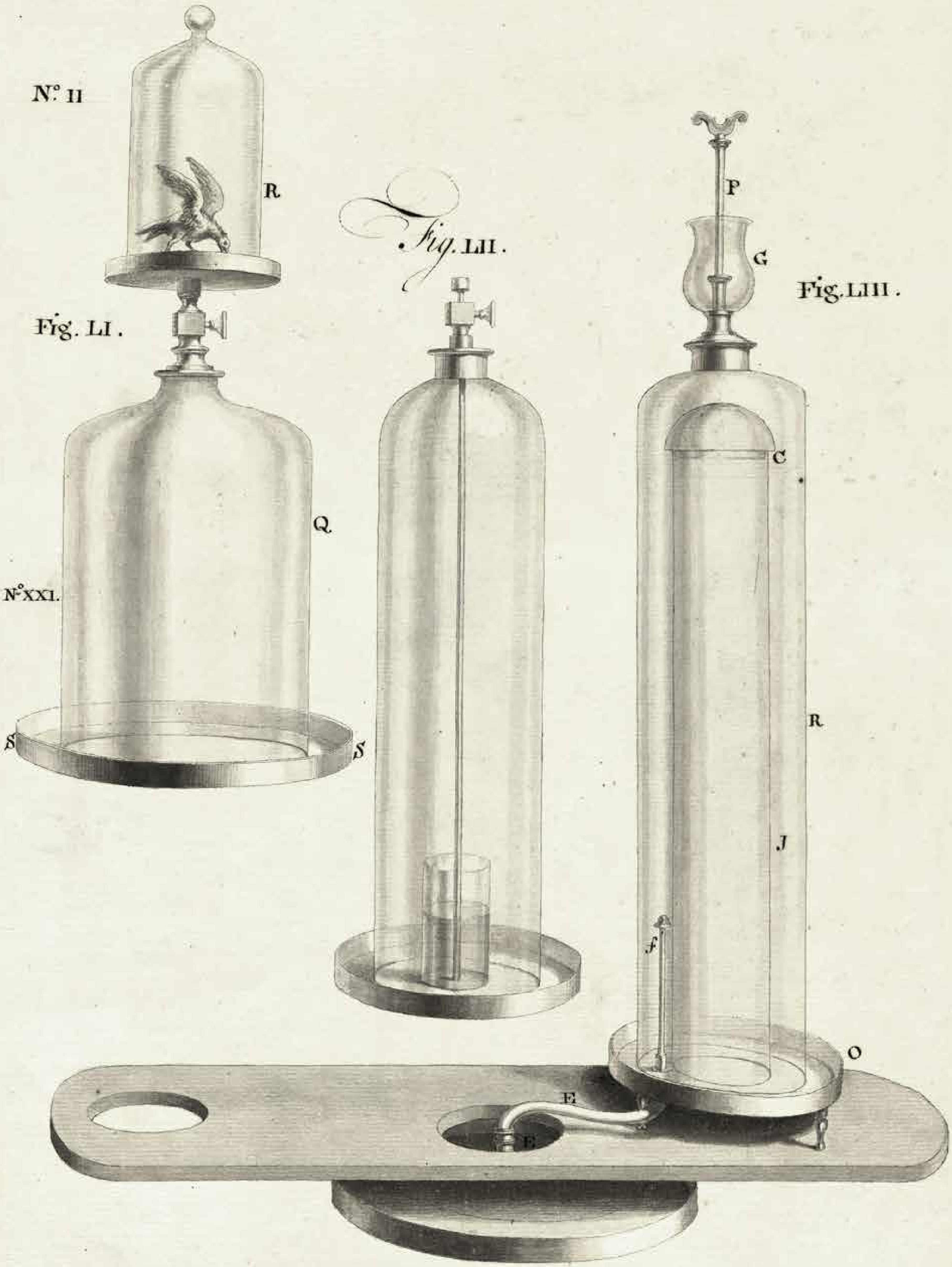


Fig. 22.

The drama of animal experiments and mercury 'Fire'

Air pressure demonstrations revealed how changing conditions affected all kinds of objects, even live animals. The results could be cruel. Instrument-maker George Adams described how animals in a vacuum 'will immediately be in convulsions and fall down dead'. Liquid mercury produced equally striking effects in the other air pump attachments shown here, creating 'a surprizing appearance of a shower of Fire'.


N.° II
R
Fig. LI.
Q
N.° XXI.
S
S
Fig. LII.
P
G
Fig. LIII.
C
R
J
f
O
E
E

Observing the effects of air pressure on buoyancy

From small mammals to birds, all sorts of live animals featured in air pump demonstrations. Figure 30 shows a bell jar containing fish in a glass of water. Removing air from the jar would decrease the pressure, allowing air in the fish's bodies to expand and increasing their buoyancy. Figurines of hollow glass with perforated feet would similarly float upwards, but sink if air was readmitted to the jar (figure 28).

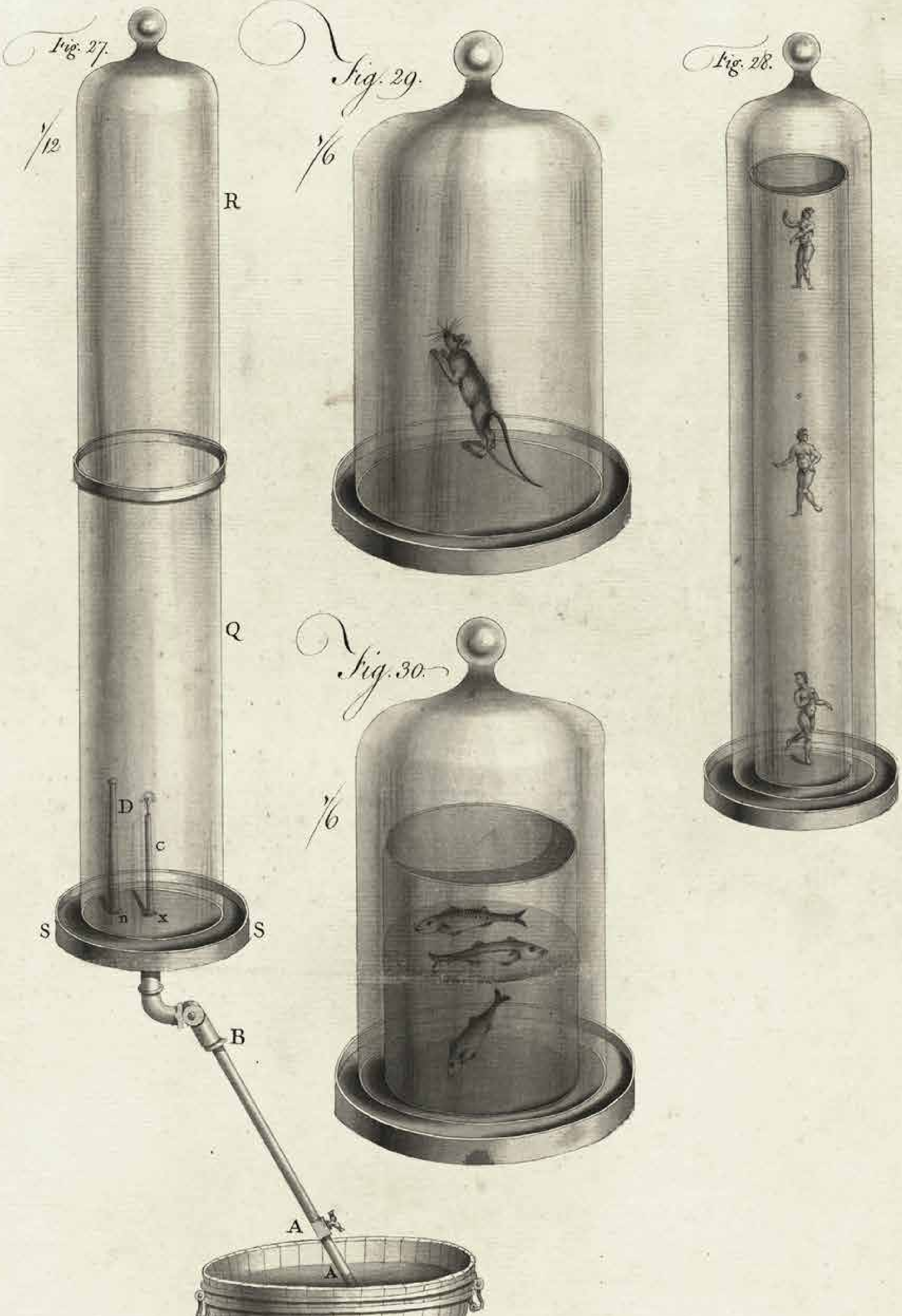


Fig. 27.
1/12
R
Q
D
C
n
x
S
S
B
A
A
V
Fig. 29.
1/6
Fig. 28.
Fig. 30.
1/6

Motion and sound in a vacuum

One popular air pump demonstration involved simultaneously dropping a feather and guinea coin from the top of a glass cylinder (figure 32). In regular air the metal guinea fell faster. But in a vacuum, without air resistance impeding either object, they landed together. In another experiment a clockwork bell in a jar rang increasingly faintly as air was removed, showing that sound needs air to travel (figure 34).

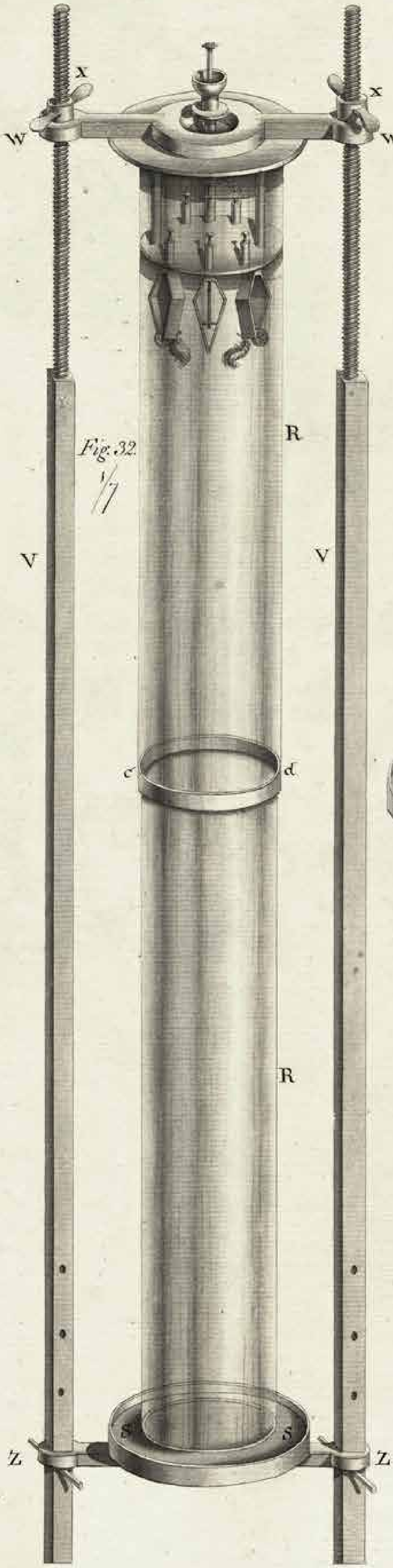


Fig. 32.

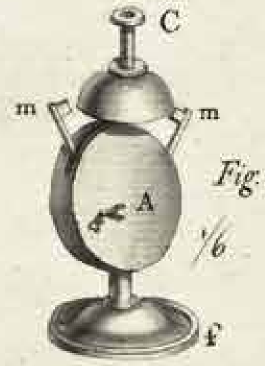


Fig. 33

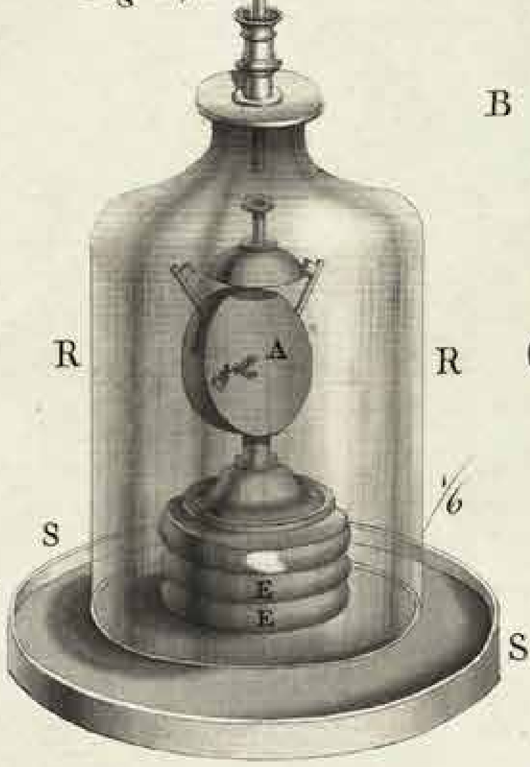


Fig. 34.

Fig. 36.

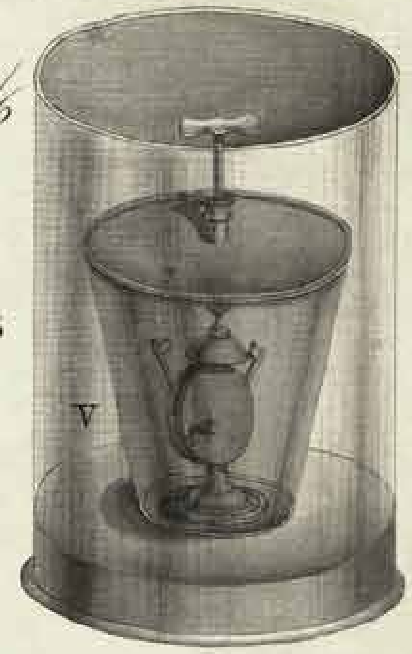
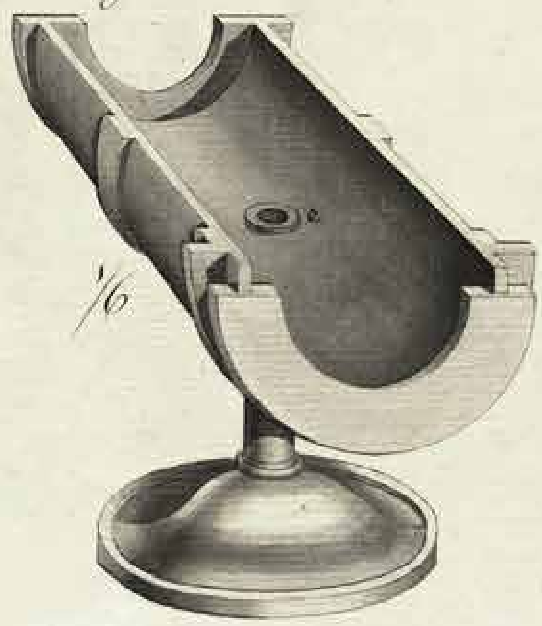


Fig. 35



Combustion and propulsion experiments

In figure XLIV Adams described how a bell jar containing air passed through ‘the flame of red hot Coals’ would extinguish burning substances placed inside. In figure XLVI mill ‘A’ ran for longer than mill ‘B’ when spun at the same speed in open air, as the arrangement of its blades met less air resistance. If set in motion in a vacuum without *any* air resistance, both mills would spin for longer *and* stop simultaneously.

Fig. XLIV.

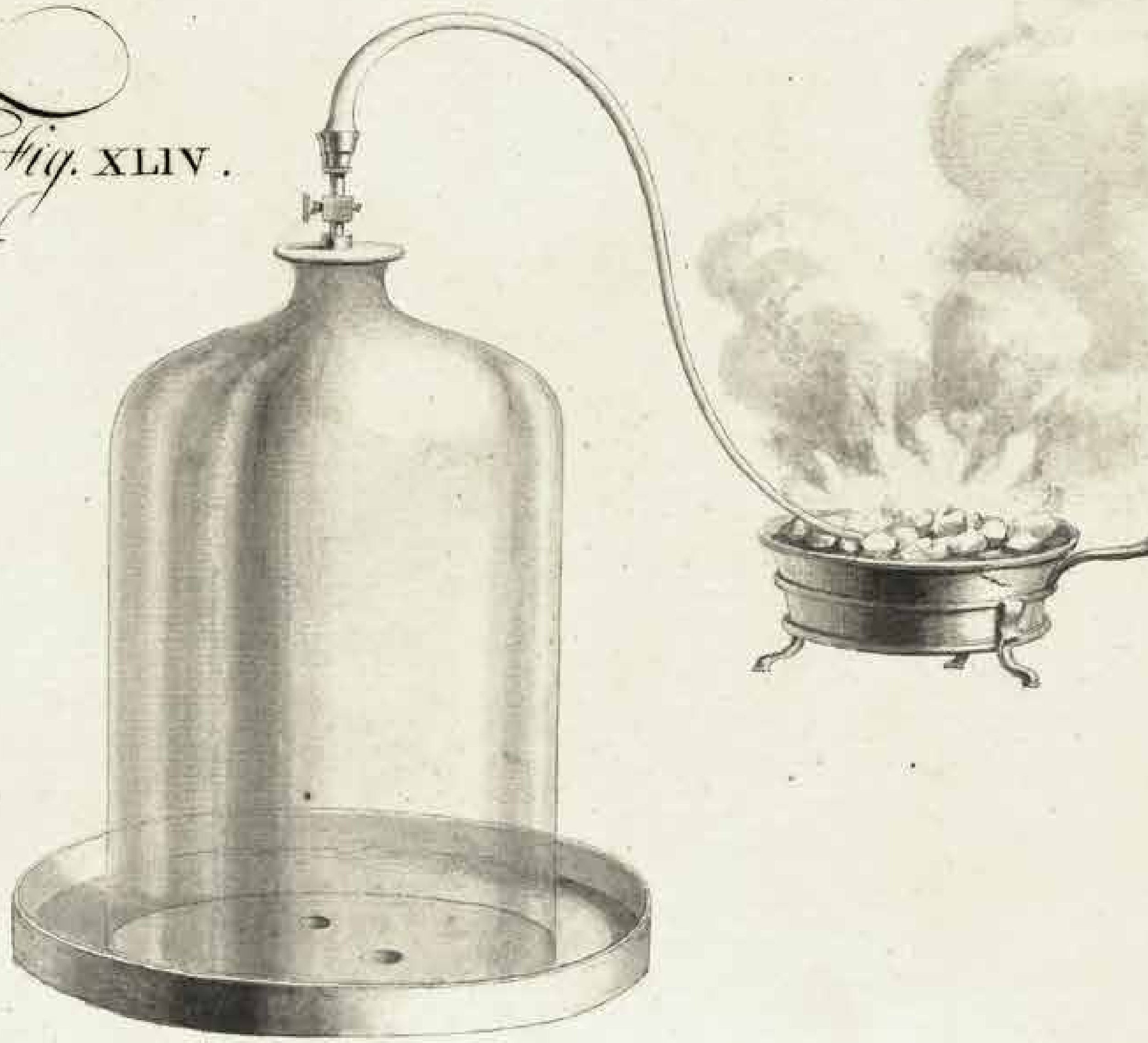
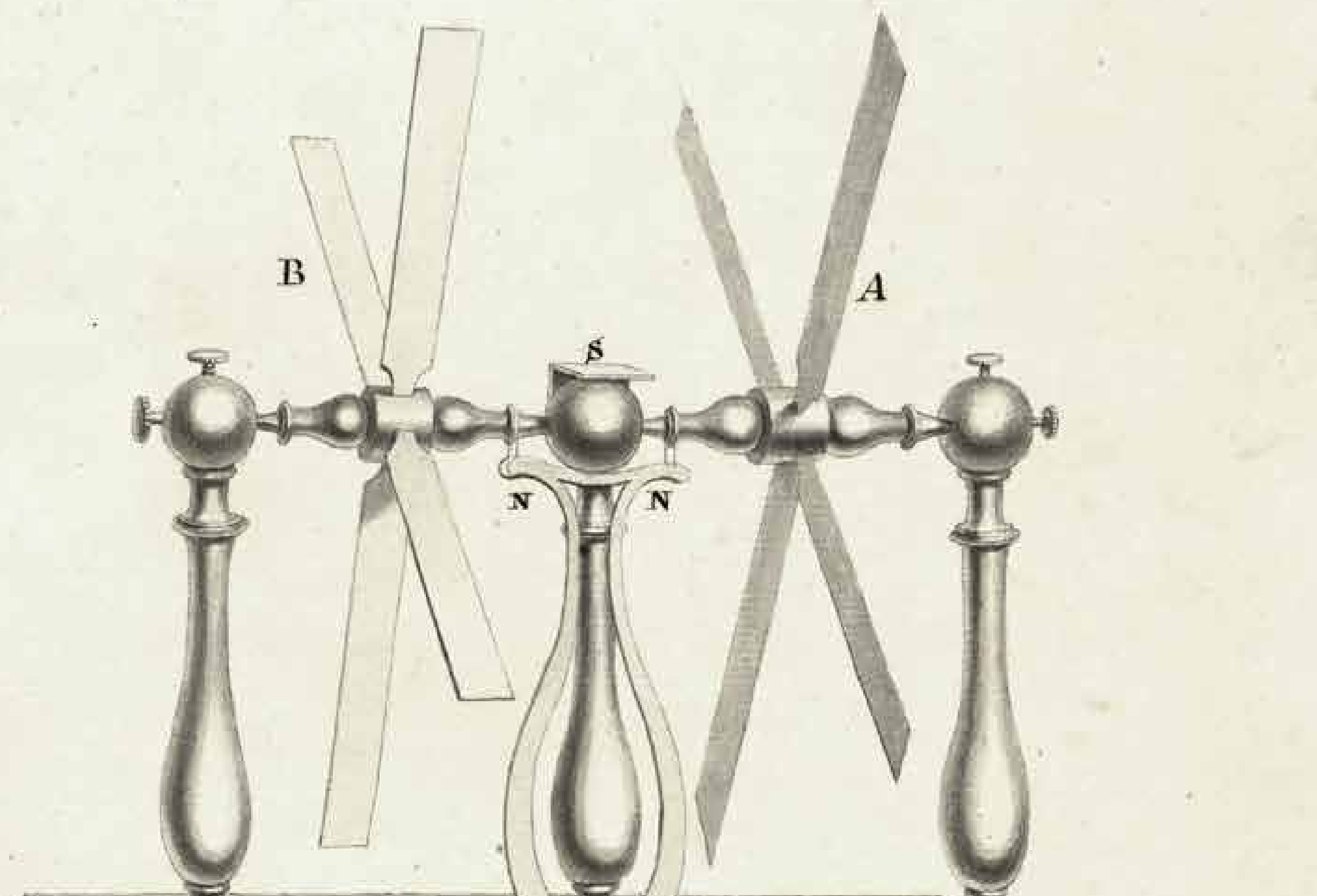


Fig. XLV.

Fig. XLVI.



‘A Convenient apparatus to examine a portion of air’

The apparatus in figure 57 is displayed to the right of Adams’s air pump, although only one of the two glass spheres survives. With connecting tubes controlled by stopcocks, these vessels were used with the pump to compare, combine and purify different compositions of air. Instrument-maker Adams declared that ‘Nothing is more worthy [of] our attention than an enquiry after the unknown properties of the air’.

Fig. 57.

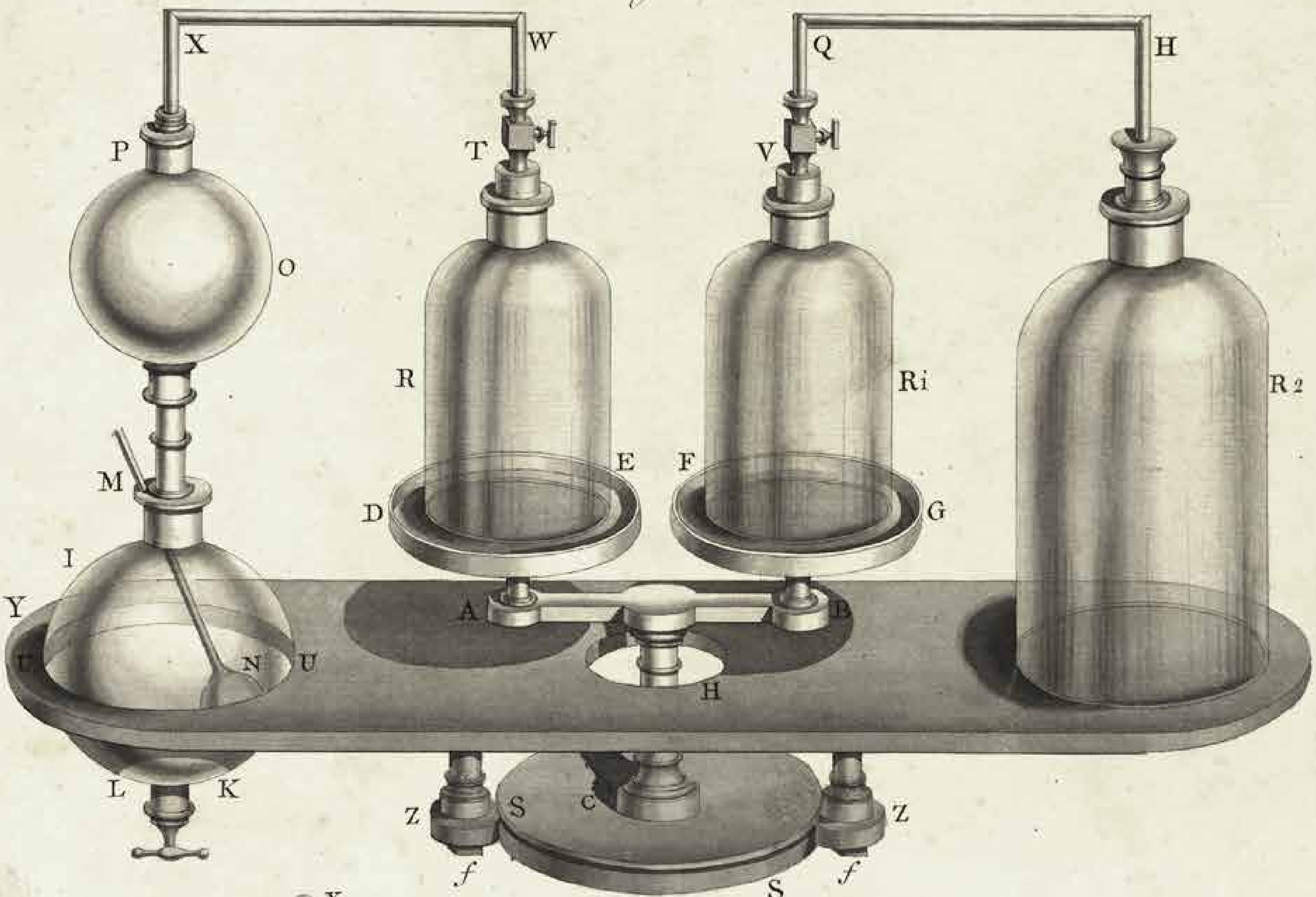
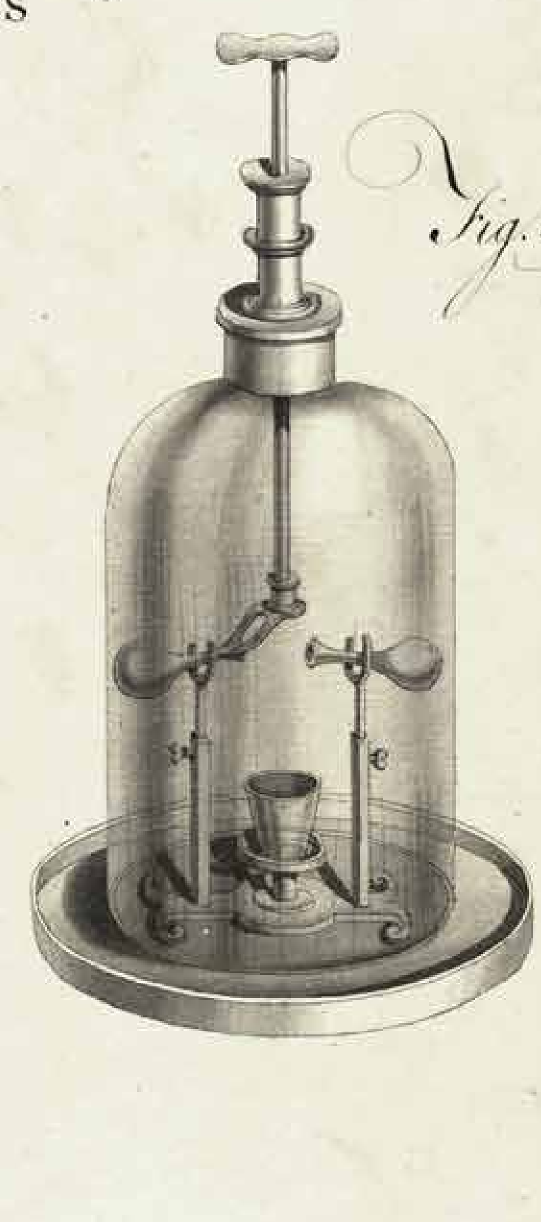


Fig. 58.

Fig. 59.



The explosive effects of air pressure imbalances

Most of these diagrams show sealed, thin-walled glass bottles inside wire cages. Pumping air out of the surrounding bell jars would decrease the pressure, allowing air trapped inside the bottles to expand until they shattered. When repeated with the bottle immersed in a glass of water, the effect was violent enough to shake the whole air pump. The cages protected the bell jars from flying glass fragments.

Fig. LX.

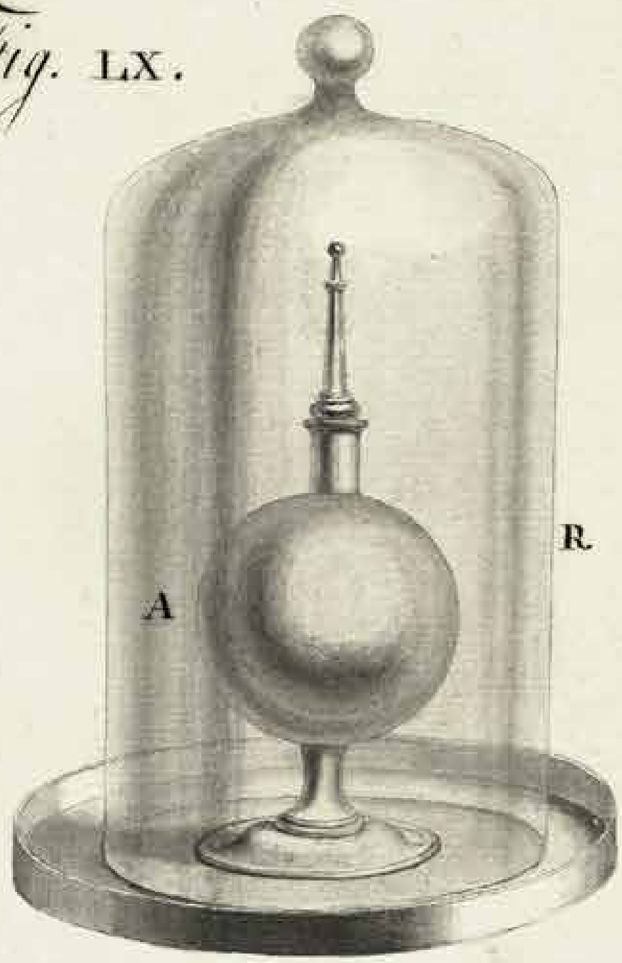


Fig. LXI.

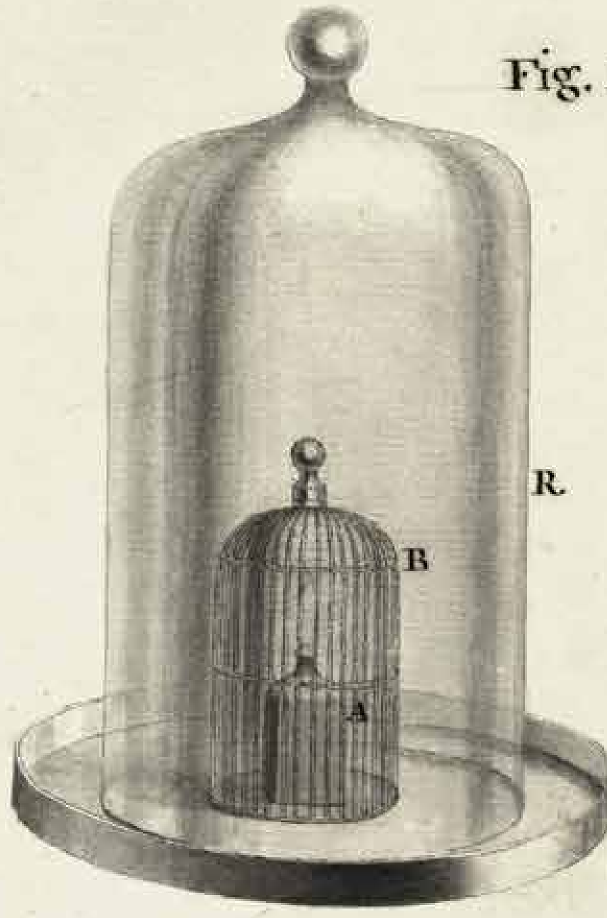


Fig. LXII.

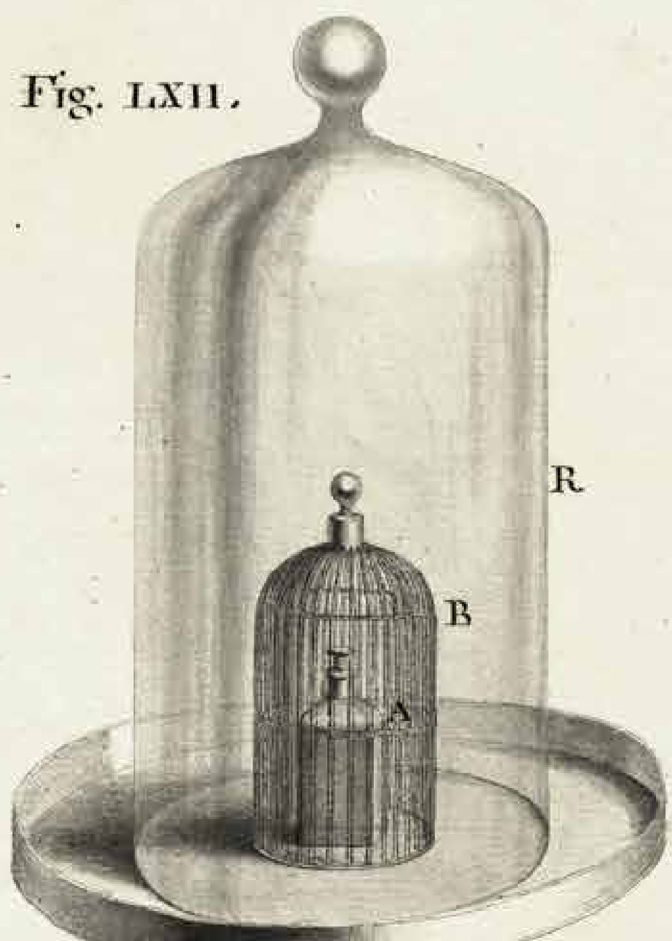
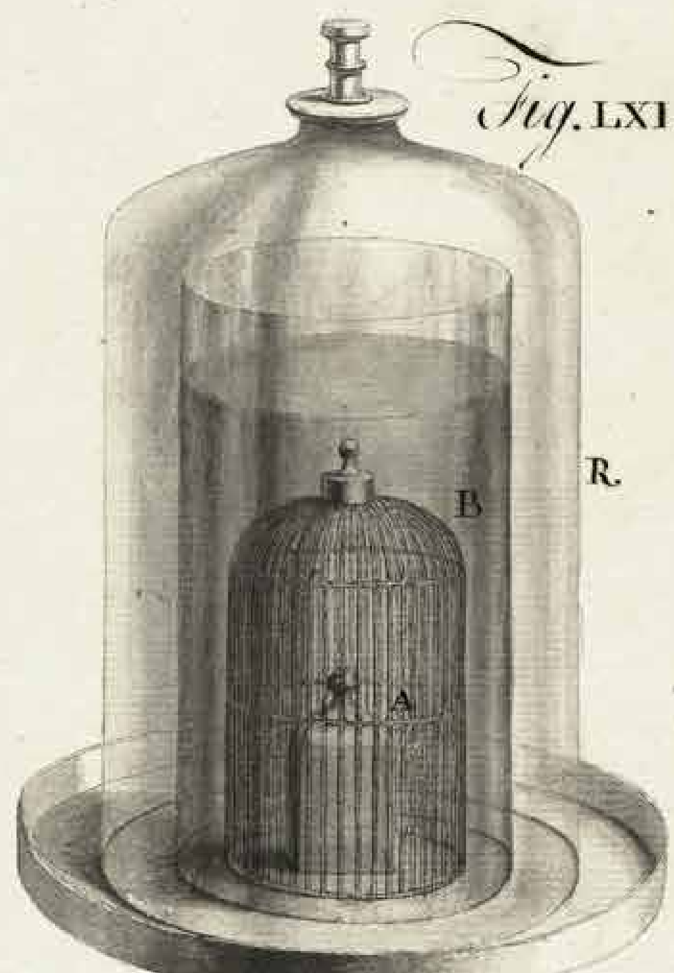


Fig. LXI. N°. II.



An 'Instrument to explain or illustrate Muscular Motion'

These veiny balloons are animal bladders, suspended on a hollow T-shaped air pump attachment through which air flow was controlled. The smaller, stringed bladders needed less air than the single large one to raise an equal amount of weight through the same distance. Adams believed that the stringed bladders behaved like muscles and so illustrated muscular motion, but this comparison was disputed.

Fig: LXIII.

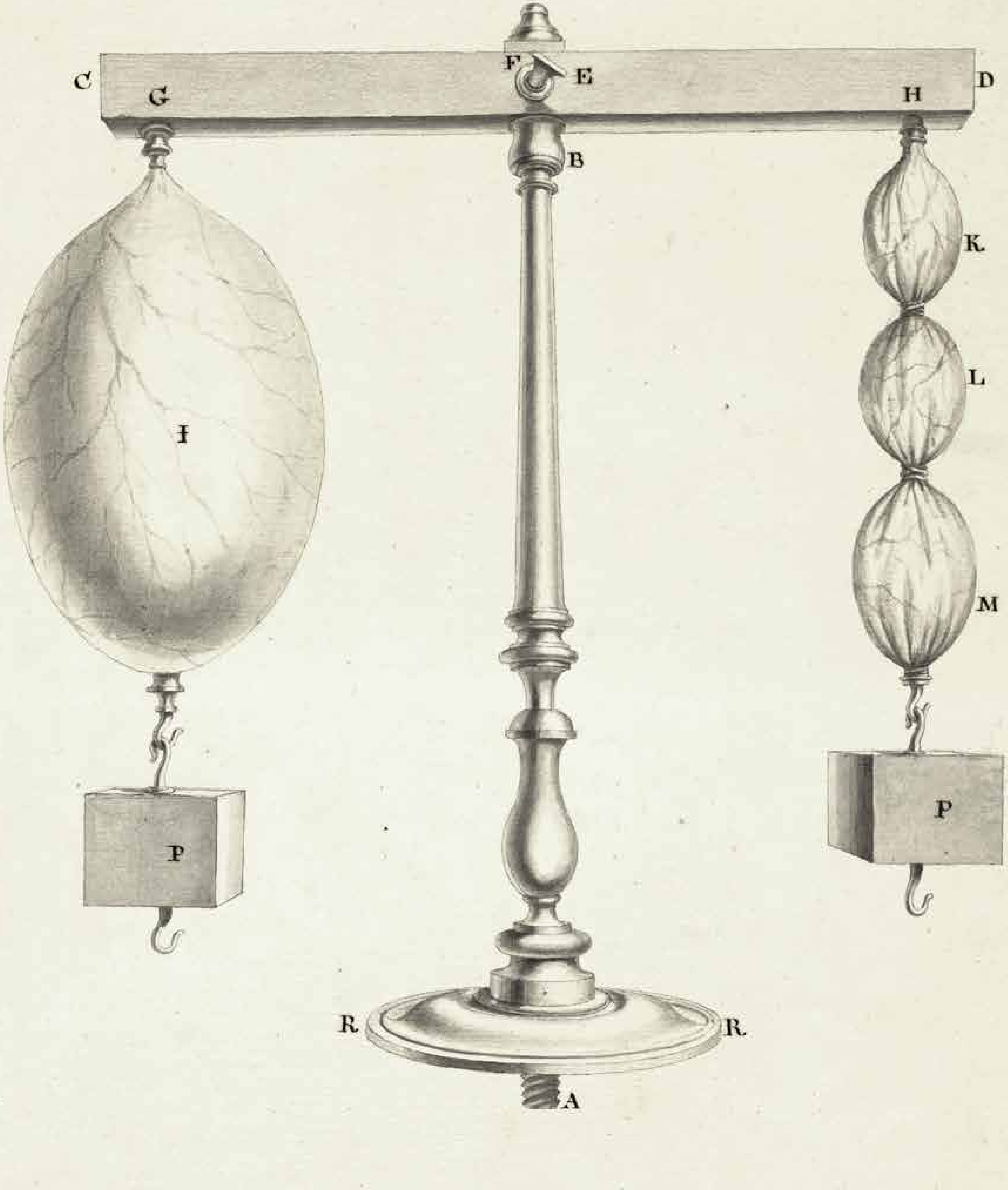
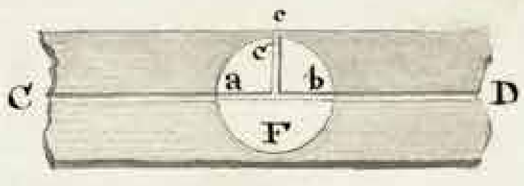


Fig. LXIV.



Using air pressure to fire a gun

Adams's final air pressure demonstrations involved the wind gun seen here. The air pump's condenser 'N-M' released compressed air into the gun 'Q-X' with enough force to shoot a bullet, shown in flight, 'to a great distance'. The quadrant 'a-b-c' and plumb line 'e-P' were used to vary the gun's angle of elevation, and consequently the bullet's path. Camel-hair darts ('C') were also fired.

Fig: LXVI.