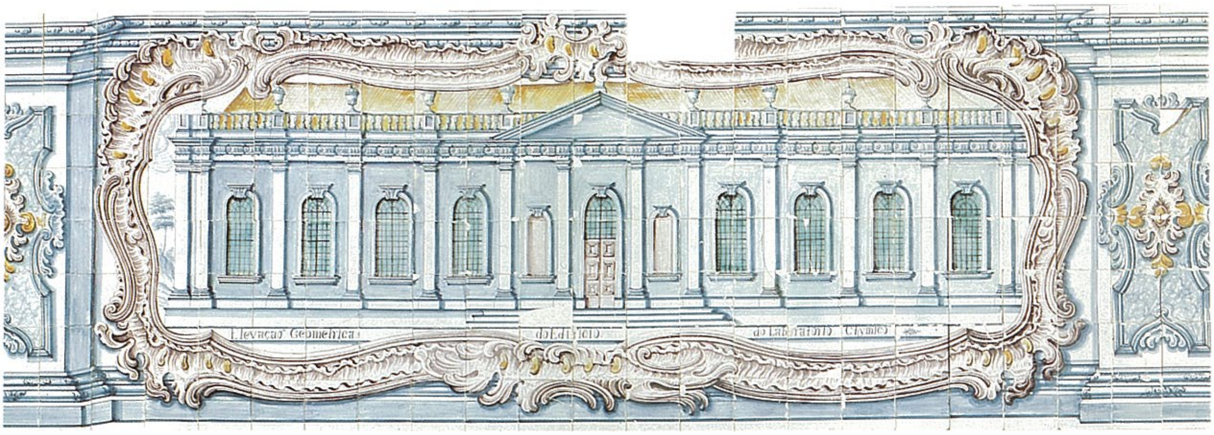
Scientific Instruments from the University of Coimbra



The Cabinet of Experimental Physics at Coimbra was created in 1772 as part of the marquês de Pombal's reform of the university. Its collection of pedagogical instruments was soon enriched by the addition of those belonging to the college of nobles in Lisbon. An inventory of 1788 lists 580 instruments or "machines," as they were then called, in the Coimbra collection. The works exhibited here indicate the astonishingly sophisticated design and fine craftsmanship that was often lavished on these early pieces.

59
REAL FÁBRICA DO RATO (?)
Portuguese
Tile Panels Depicting the Chemistry Laboratory of the University of Coimbra
c. 1773–1777
painted tiles
104 x 296 ($40\frac{15}{16}$ x $116\frac{9}{16}$)

Museu Nacional Machado de Castro, Coimbra, inv. secção C-1682, from the Old Archbishop's Palace

Rómulo de Carvalho 1978; Soares 1983; Meco 1989; Brussels 1991, III.45

Tiles of the Pombaline period may be divided into three types, the first portraying historical scenes, the second developing decorative compositions, and the third containing simple repetitive patterns. One may conclude that, although mass production of tiles had been introduced to keep pace with the reconstruction of Lisbon after the earthquake, a market remained for decorative tiles to create luxurious and ostentatious interiors. In practice—as revealed in the numerous palaces and noble houses of the period that retain their interior tiles, some with Chinese motifs and borders of highly decorative effect—the compositions do not encompass the full range of grandiloquent baroque images known from the first part of the century. On the other hand, they do not adhere to the economic and creative restrictions imposed by the waist-high tile surrounds of repetitive geometric patterns. Thus they represented a compromise solution, although some of these later tile compositions attained an enviable degree of vivacity and subtlety.

The panel on display reflects this trend; it was designed to celebrate the reform of Coimbra university initiated in 1772 under the auspices of the marquês de Pombal. It incorporates a massive border of rococo scalloping with, at the bottom, an unadorned band of tile edging. Within the scalloped frame is the chemistry laboratory designed by Guilherme Elsden (active 1763–1777).

Elsden, as head of construction projects and responsible for remodeling the original university buildings, was able to establish a modern school of architecture, which trained countless professionals. The Palladian influence apparent in the facade of the chemistry laboratory reveals a marked English influence, while the large windows are generally typical of Portuguese architecture.

60
JOAQUIM JOSÉ DOS REIS, woodwork
PEDRO SCHIAPPA PIETRA, brass
Device to Demonstrate Equilibrium
Portuguese
18th century
carved wood, brass
77 x 21.5 (30 5/16 x 8 7/16)

Museu de Física da Universidade de Coimbra, Gabinete de Física Experimental, inv. 56 (Colégio dos Nobres, inv. 168)

Index Instrumentorum 1788, II-I-179;
Charleroi 1991, no. 32

This device consists of a pulley with an axis that can be moved both horizontally and vertically. Two metal rings are attached to the axis of the pulley, with a cotton thread tied to each ring. These threads pass through the groove of a fixed pulley. There are four of these fixed pulleys altogether, all of the same size and smaller than the first one situated toward the top of the device. The threads attached to the rings on the axis of the mobile pulley are attached in pairs, with one end of each element of the pair linked to each end of the axis of the mobile pulley. A hollow brass cylinder like a small bucket hangs from each of these threads. A thread passes through the groove of the mobile pulley, with another two identical buckets hanging from each end. Small weights were placed inside the four buckets, distributed to maintain the equilibrium of the system, so that the mobile pulley remained suspended by the force created by the four threads attached to its axis.

This device, mounted as described, serves to demonstrate that if the direction of one of the forces applied to the mobile pulley is altered while the intensity of each force is maintained, the equilibrium is destroyed. This can be done by merely bending one of the threads passing through the neck of the mobile pulley, pulling it in a vertical direction. The sum of the forces applied to the pulley would then cease to be zero despite the fact that the strength of the forces on it continues to be the same. This would cause its axis to begin to rise, producing a rectilinear movement. As the pulley rises, it rotates.

The device is lavishly decorated. The pulleys are all of brass, the largest of them bearing six decorative motifs arranged in a radial formation and serving to link the axis with the ring on the pulley. The four fixed pulleys are decorated with four motifs similar to those of the pulley of the mobile axis. The fixed pulleys are mounted on a vertical column divided into two parallel branches. Each of these branches has a central groove, scored longitudinally from end to end. The axis of the mobile pulley moves along these grooves.

The device stands on a round base, from which the column rises that is surmounted by the support for the pulleys. The base and the column are of wood, with fine decorative motifs in relief.

61
JOAQUIM JOSÉ DOS REIS, woodwork
PEDRO SCHIAPPA PIETRA, metal work
Tightrope Walker Illustrating Balance
Portuguese
18th century
carved, painted, and gilded wood with brass and copper
62.1 x 22.5 x 20 ($24\frac{7}{16}$ x $8\frac{7}{8}$ x $7\frac{7}{8}$)

Museu de Física da Universidade de Coimbra, Gabinete de Física Experimental, inv. 32 (Colégio dos Nobres, inv. 87)

Index Instrumentorum 1788, B-IV-95; Charleroi 1991, no. 34

The tightrope walker is holding a bent pole with a brass sphere at either end. The device was used in physics lessons to demonstrate the importance of the position of the center of gravity of an object in relation to its base of support when in balance. The tightrope walker is supported on a small round brass disk by means of an iron spike emerging from beneath its left foot. This disk surmounts a richly carved wooden column.

The stability of the figure is achieved when the vertical passing through its center of gravity intersects the point of support of the spike on the disk. This point of support is above the center of gravity of the whole system consisting of the tightrope walker, pole, and spheres.

62

JOAQUIM JOSÉ DOS REIS, woodwork
PEDRO SCHIAPPA PIETRA, brass

Desaguliers Tribometer and Table

Portuguese
18th century
carved and inlaid wood, brass
35.4 x 36.1 x 22.5 ($13^{15}/_{16}$ x $14^{3}/_{16}$ x $8^{7}/_{8}$)

Museu de Física da Universidade de Coimbra, Gabinete de Física Experimental, inv. 102 (Colégio dos Nobres, inv. 154)

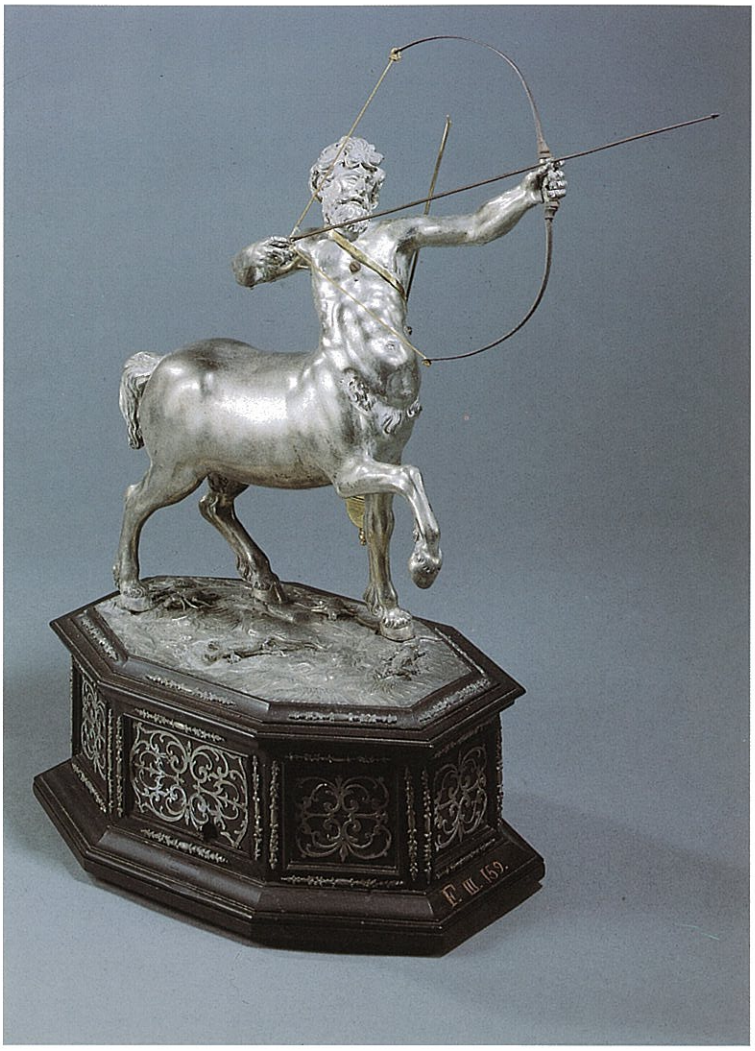
Nollet 1764, vol. 3; Index Instrumentorum 1788, G-III-164; Charleroi 1991, no. 36

This splendid example of a Desaguliers tribometer was designed to study the effect of friction on the axis of a rotating wheel. The device is mounted on an inlaid eight-legged table with octagonal lid. The brass device consists of four wheels mounted on the curved prongs of two vertical supports attached to the table at opposite vertices of an octagon inlaid in the tabletop. Two wheels are mounted on each support, with the projections from the circular planes intersecting without the wheels touching. A horizontal axis effecting a rotating movement is supported at the upper points of intersection of the wheels. This axis moves in conjunction with another somewhat larger wheel that is slightly removed from the central point of its axis. A helical spring acts on the axis of the wheel. When compressed, the spring causes the wheel to rotate. The friction thus exerted on the axis is fairly limited. As a result of the action of the spring, an alternation occurs in the direction of the wheel's rotating movement, which results from the successive compression and release of the spring, as in a watch mechanism. The whole device revolves around a position corresponding to the configuration of balance of the spring, the movement being damped by the friction. In a demonstration to a physics class, this effect would be compared with what would occur if the pointed ends of the axis were to be inserted in the two small holes in the vertical supports, thereby supporting the four wheels with no contact between the axis and the wheels. When the axis is supported in this way, friction becomes much greater, and it would be clearly apparent that the number of swings of the wheel produced by the same initial movement is considerably less than in the previous case.

This experiment shows the comparative advantages of one particular form of support. The system of supporting the axis on the points of intersection of the two wheels placed at the ends of their axes was widely used in the Atwood machine, whereby friction between the moving pieces was made minimal.

This machine also permits study of the damping effect of a lever applied to the axis of rotation of a wheel during oscillatory motion. For this purpose, a jointed plate is placed at the end, functioning as the fulcrum. This plate is kept in the horizontal, supported on the device's axis of rotation, with a weight hanging from the end. This device considerably increases the friction on the axis, with a resulting increase of the damping effect on the system's swinging movement.

The table on which the device stands is made of lignum vitae, blackwood, and boxwood and is based on a design appearing in *Leçons de Physique Expérimentale* by Abbé Nollet. It may be concluded from documents in the Arquivo Nacional in the Torre de Tombo in Lisbon on the subject of the Colégio dos Nobres (book 154, 94, 95) that this and similar tables were executed in Lisbon by Joaquim José dos Reis who worked in the library of that Pombaline institution.



63
Automaton
silver, brass, steel, ebony
39.3 x 16 x 25 ($15\frac{1}{2}$ x $6\frac{5}{16}$ x $9\frac{13}{16}$)

Museu de Física da Universidade de Coimbra, Gabinete de Física Experimental, inv. 97

Carvalho 1978; Charleroi 1991, no. 37

This apparatus consists of a silver centaur equipped with a mechanism for firing arrows. The centaur is mounted on an eight-sided ebony box with silver appliqués on each side and on the top. The box is decorated with lizards and insects in relief. The centaur holds a flexible iron bow and stands with his left arm extended and his right arm drawn back to release an arrow. He is further equipped with a baldric and a quiver containing two arrows.

The box contains a mechanism that can be wound by a key, causing the centaur's arm to move by means of a transmission system that passes through his left front leg. The mechanism inside the wooden box was designed to have three wheels, which would stand on the floor. One of the wheels is located beneath the left leg of the centaur, and it is apparent that a second wheel is missing from the other side, beneath the right leg. There is a third wheel, smaller than the other two, at the back of the box. This wheel is attached to a vertical axis. This arrangement of wheels allows the centaur to move and even to change direction.

The automaton does not appear in the list of instruments belonging to the Colégio dos Nobres. It was purchased by António Dalla Bella to add to the collection of mechanisms for studying simple and compound machines. This is an example of a compound machine.

Silvio Bedini of the Smithsonian Institution has suggested that the device is of south German manufacture, dating from the early seventeenth century; he notes the resemblance of the form of the base and its decoration to those of a number of south German automata (see Maurice and Mayr 1980, 278 and elsewhere).

64

Mirror for Observing Anamorphic Images

18th century

wood, polished steel, and watercolor on card

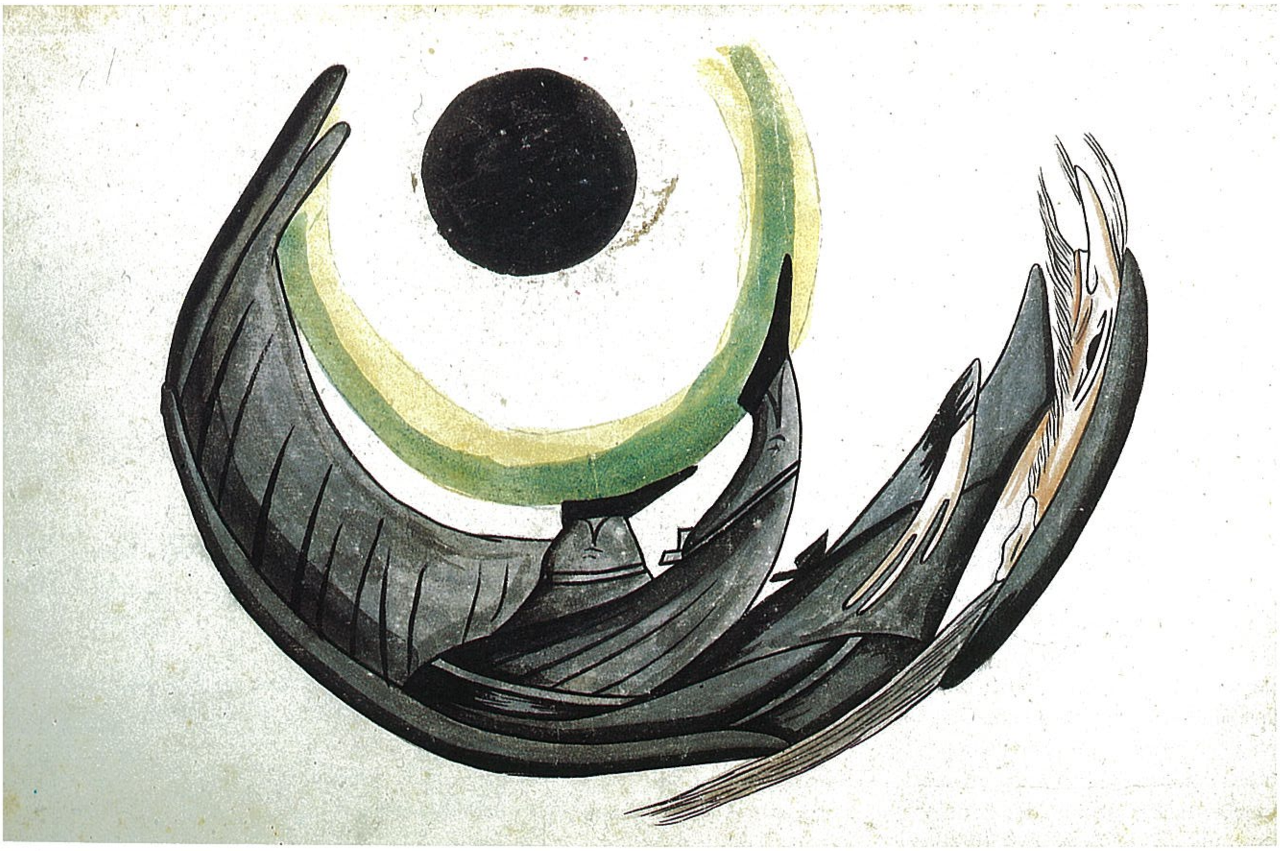
33.7, 86 ($13\frac{1}{4}$, $33\frac{7}{8}$)

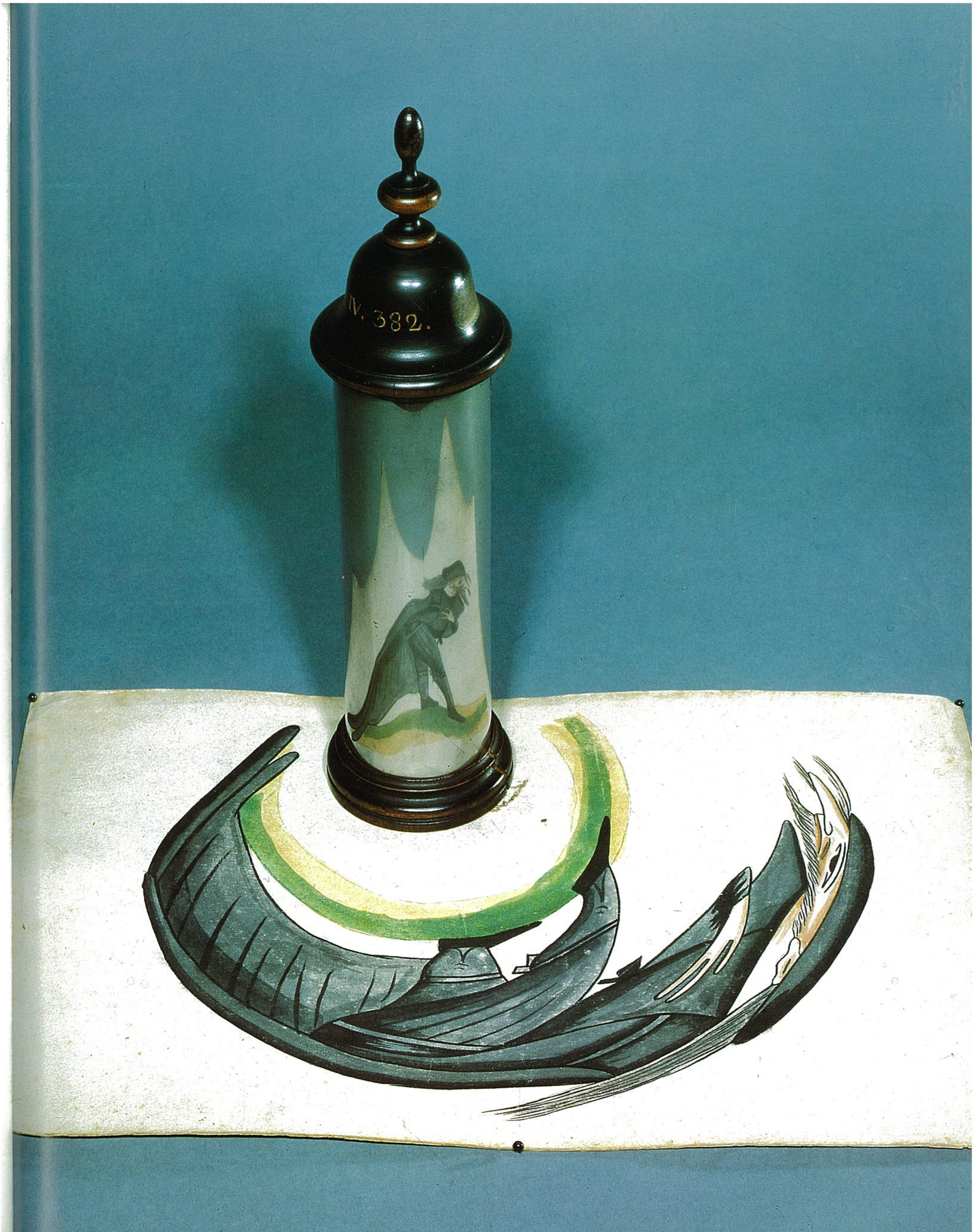
Museu de Física da Universidade de Coimbra, Gabinete de Física Experimental, invs. 699, 699/10 (Colégio dos Nobres inv. 375)

Index Instrumentorum 1788, Y-IV-382; Charleroi 1991, no. 81

The mirror, mounted on a cylinder of dark wood, permits the observation of anamorphically distorted illustrations painted on cards. The mirror is semi-cylindrical in shape, and is made of a thick sheet of polished steel, which is attached to the wooden cylinder.

An undistorted view of the anamorphic painting can be observed when the cylinder is placed in the correct position on the illustration.




N. 382.