PUBLIC UTILITY AND SPECTACULAR DISPLAY: THE PHYSICS CABINET OF THE ROYAL MUSEUM IN FLORENCE (1775)

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ABSTRACT

The Royal Museum of Physics and Natural History opened to the public in 1775. Its outstanding Physics Cabinet included a vast range of exquisite pieces especially made for the Museum by local artisans or by prestigious foreign makers, as well as items that had belonged to the Medici family or to the Accademia del Cimento. The paper investigates the origins of the 1775 collection of physics instruments, and highlights Fontana's attempt to create an institution that would productively combine tradition and innovation, research and display, spectacle and usefulness.

Keywords: Museums, experimental philosophy, Felice Fontana.

Travelling to Italy in 1749, the famous experimental physicist Jean Antoine Nollet arrived in Florence on the 19th of August. The following day he wrote in his diary:

what I saw with greatest pleasure was a small collection of thermometers, barometers, hygrometers and precious remains of the Academy del Cimento. I learnt that most of it was transferred to Lorraine by Mr Varin, an artist attached to the Emperor; from which I presume that these instruments, so respectable for a physicist, are now in the Cabinets in Vienna.[1]

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[1] "Ce que j'y vis avec plus de plaisir, ce fut une petite collection de thermomètres, baromètres, hygromètres & c. précieux restes de l'Académie del Cimento. Et j'apris que la plus grand par-

If Nollet believed that the "precious remains" of the Accademia del Cimento were "respectable for a physicist", quite dissimilar was the reason why they had not been transferred to Vienna and were still in Florence: the "knick-knackeries" of the Cimento were judged too worthless to be even worth cataloguing.[2]

It took another quarter of a century for those "precious remains" to be properly displayed in the Royal Museum of Physics and Natural History, where they would be exhibited in a dedicated room. The Museum was inaugurated in 1775. For its director and organizer, Felice Fontana, it was the realization of an ambitious project that he began to cherish in 1766, when he was appointed physics professor at the University of Pisa, physicist to the Grand Duke, and superintendent to the Royal Cabinet of Physics.[3] The collection of physics instruments that he then supervised was far from impressive, though it was remarkable from a symbolic point of view. It consisted of nineteen instruments from the Medici collection, which included outstanding "philosophical relics", such as Galileo's compass, a lens said to have belonged to pope Leo X (a member of the Medici family), the lens of Torricelli's telescope. But five years later, in 1771, the Grand Duke ordered that the instruments usually kept in the Stanza delle Matematiche of the Royal Gallery at the Uffizi should also be entrusted to Fontana's supervision. About two hundred instruments, including several of the Cimento's "precious remains", were thus added to the first group.[4] This was the first step towards the constitution of a magnificent public museum of physics and natural history that would be inaugurated five years later, in 1775. Under Grand-ducal patronage, the Museum would display natural specimens as well as "everything that is most beautiful, most useful and most ingenious amidst the great things men have been able to find or to imagine".[5]

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ties avait été transportée en Loraine, par M. Varin artiste attaché a l'empereur; d'où je présume, que ces instruments si respectable pour un physicien son actuellement dans les Cabinets de Vienne", JEAN ANTOINE NOLLET, *Journal du Voyage en Piedmont et Italie*, 1749, Bibliothèque Municipale de Soissons, mss 150. f. 125. On Nollet's journey to Italy see my "Sparking Controversy: Jean Antoine Nollet and medical electricity south of the Alps", *Nuncius*, 2005, *20*: 153-187 and "Back from Wonderland: Jean Antoine Nollet's Italian Tour (1749)", in *Curiosity and Wonder from the Renaissance to the Enlightenment*, edited by L. Evans and A. Marr (Aldeshot: Ashgate, 2006).

[2] On the vicissitudes of the "babioles" of the Cimento, see SIMONE CONTARDI, *La casa di Salomone a Firenze* (Firenze: Olschki, 2002).

[3] See Contardi's paper in this volume.

[4] MARA MINIATI (ed.), *Catalogo del Museo di Storia della Scienza* (Firenze: Giunti, 1991).

[5] "Tutto ciò che di più bello, di più utile, ed ingegnoso hanno saputo gli uomini ritrovare, o

BETWEEN TRADITION AND INNOVATION: THE ORIGINS OF THE PHYSICS COLLECTION

In 1775 the Royal Museum of Physics and Natural History could boast impressive collections encompassing several branches of natural knowledge.[6] Its Physics Cabinet included the exquisite instruments that belonged to the Medici family and several new items, which were made by local artisans in Florence or ordered from prestigious instrument-makers' workshops in Paris and London. With its mixture of ancient and contemporary objects, the Cabinet presented itself as an encyclopaedic project rooted in the celebrated tradition of Tuscan experimental science. Its collections highlighted the links between the present institution and the times of Galileo and his pupils, when experimental sciences flourished under Medici's patronage. While continuity with the past grounded Fontana's project within a glorious tradition, it also served a rhetorical function aimed at attracting the Grand Duke's patronage towards an experimental programme that was firmly projected towards the future. As Simone Contardi has shown, Fontana conceived of the Museum as the first step towards the creation in Florence of an Academy of Science modelled upon the Royal Society and the Académie des Sciences.[7] Although this is not the place for analyzing the reasons for the failure of such a project, it is important to point out that in Fontana's original plan the Museum would be an institution for research as well as for display, a place where the sciences would be cultivated with a view towards useful applications, especially in medicine and agriculture. To reach this objective it was essential that the collections be constantly updated with respect to the philosophical novelties coming from other Italian states or from abroad.

Fontana's project was explicitly ambitious. In his view, the Physics Cabinet "will become the most respectable in Europe [...] the one that is to be esteemed the most, the most useful of all".[8] The myriad of small-scale artisanal workshops that were active in Florence proved crucial to the project. Several local craftsmen copied the instruments represented in the plates of the most celebrated textbooks of experimental physics, such as the *Leçons de physique expérimentale* of the abbé Nollet (Paris, 1764)

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immaginare di grande", *Saggio del Real Gabinetto di Fisica, e di Storia Naturale di Firenze* (Roma: Giovanni Zempel, 1775), p. 2.

[6] See the papers by Marker and Cipriani in this volume.

[7] See CONTARDI, *La casa di Salomone* (cit. note 2).

[8] *Saggio* (cit. note 5), p. 34.

and the *Physice elementa mathematica experimentis confirmata* by 'sGravesande (Leiden, 1748). Because of the lack of craftsmen specialized in instrument-making, however, several artisans had to work on a single piece, each of them contributing their own expertise. A range of carpenters, blacksmiths, goldsmiths, glassmakers, cabinet-makers, goldsmiths, engravers, brass-moulders, glass-makers, stone-cutters, haberdashers, lent their craftsmanship to Fontana's project and presented their bills to the Grand Duke.[9] The result was a first-rank, princely collection, which would not fail to remind visitors of the Grand Duke's magnificence:

> where it was convenient to make use of wood, none can be seen but oriental and precious woods. Several [instruments] are made of brass, and of other metals, and their beauty is such as to seem to have been made in England, by the most skilful and expert Professors. If silver was more useful than another metal, it was used unsparingly. In conclusion, in all of them one can admire the richness, the art, and the ingeniousness of invention.[10]

However, not all the instruments could be made locally. In fact, Fontana lamented the need for "craftsmen who are also physicists" in Florence. Ability to work wood, glass and metals was not enough to make precision instruments. Thus, especially in the case of astronomical instruments, Fontana had to order the required items from the most famous makers in London and Paris. The result was that, from the beginning, his Physics Cabinet was an updated, material encyclopaedia of eighteenth-century experimental philosophy. At the time when natural philosophy entered salons and became a subject of polite conversations, cultivated visitors would not fail to recognize the fine instruments engraved in the plates of Nollet's and 'sGravesande's texts materialized in Fontana's Physics Cabinet. They would have the opportunity to admire masterpieces of experimental philosophy recently arrived from the reputed workshops of Edward Nairne, Jesse Ramsden or John Dollond; they would be able to appreciate exquisite items made by George Adams, instrument-maker to the King George III; or, they could see and judge for themselves the craftsmanship of the popular public demonstrator Benjamin Martin, who

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[9] Post-1780 bills survive in the archive of the Institute and Museum of the History of Science (hereafter IMSS) in Florence.

[10] "Dove è convenuto far uso del legno, non si vedono che legni orientali, e preziosi. Moltissime sono formate di ottone, e di altri metalli, ed è tale la loro bellezza, che sembrano fatte in Inghilterra dai più valenti, ed esperti Professori. Dove l'argento poteva esser più utile di altro metallo, vi è usato senza risparmio. In somma in tutte si ammira la ricchezza, l'arte, e la sagacità dell'invenzione", *Saggio* (cit. note 5), p. 2.

also marketed philosophical instruments.[11] The thousands of visitors that each year toured the rooms of the Royal Museum could also admire instruments that had not been made anywhere else: only in the Physics Cabinet of the Royal Museum could the dividing machines described by the Duc de Chaulnes be seen.[12] The creation of such "instruments for making instruments" made Fontana particularly proud.[13]

The Florence Physics Cabinet was by no means the first of the kind south of the Alps, yet it was created with the intention of outshining, in extension and grandeur, other similar institutions that had flourished in the course of the eighteenth century throughout the peninsula.[14] The Bologna Institute of Sciences – created by Luigi Ferdinando Marsili with similar ambitions to join research, learning and display – was an obvious point of reference for Fontana, who was in good relations with the Institute's members.[15] Aware that "the great scientific collection of Bologna, begun more than eighty years ago, is far from complete", he believed that it was "not even comparable to the Cabinet in Florence": even though there was "no cabinet in Europe that can be really called perfect. Yet, I dare say that the Cabinet of H.R.M. is the nearest to perfection".[16] Foreigners on tour would not hesitate to make comparisons between the various cabinets they visited. The itinerant lecturer Adam Walker, for example, remarked that when he was in Bologna (in 1787) he visited the famous Institute of Sciences where he found "a number of ill-made instruments (mostly on the plans by 'sGravesande), nothing new, except a pretty large plate electrical machine". As Giuseppe Olmi shows in his paper, Walker's impression on the collections in Florence would confirm Fontana's bold declaration.[17]

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[11] JOHN R. MILLBURN, *Benjamin Martin. Author, instrument-maker and 'country showman'* (Leyden, 1976); ID., *Adams of Fleet Street, instrument makers to King George III* (Aldershot: Ashgate, 2000).

[12] LE DUC DE CHAULNES, *Nouvelle méthode pour diviser les instruments de mathématique et d'astronomie* (Paris, 1774).

[13] *Saggio* (cit. note 5), pp. 2-5.

[14] PAOLO BRENNI, "Alcune considerazioni sulle collezioni di strumenti scientifici nell'Europa del XVIII secolo", in *La politica della scienza: Toscana e stati italiani nel tardo Settecento*, edited by Giulio Barsanti, Vieri Becagli e Renato Pasta (Firenze: L.S. Olschki, 1996).

[15] On the Bologna Institute of Sciences: MARTA CAVAZZA, *Settecento Inquieto* (Bologna: Il Mulino, 1990); ANNARITA ANGELINI (ed.), *Anatomie Accademiche*, 3 vols., vol. III: *L'Istituto delle Scienze e l'Accademia* (Bologna: Il Mulino, 1987). On Fontana's relations with the Institute's members, MARCO PICCOLINO and MARCO BRESADOLA, *Rane, Torpedini e Scintille. Galvani, Volta, e l'elettricità animale* (Torino: Boringhieri, 2003).

[16] "Io credo per quanto ho potuto rilevare dalla lettura de' libri, e dalle conversazioni coi dotti viaggiatori, che non vi sia Gabinetto in Europa, che si possa veramente chiamare perfetto. Pure io ardisco dire che il Gabinetto di S.A.R. è il più vicino alla perfezione", Archivio di Stato di Firenze (hereafter ASF), *Segreteria di Finanze, Affari prima del 1788, 480*, Fascicolo: "Direttore del Museo".

[17] ADAM WALKER, *Ideas suggested on the spot in a late excursion through Flanders, Germany,*

As a matter of fact, in the span of a few years Fontana had put together an outstanding collection. A few items were personal gifts of the Grand Duke, who donated to the Museum an electric candle-lighter, a microscope made by Adams and an oil-lamp made by Argaud.[18] Fontana himself had enriched the collection with a number of meteorological instruments that he invented and others that he contributed to make.[19] Nonetheless, when the Museum was inaugurated, there were still numerous additions that he wished the Grand Duke would approve of. In his "Supplements to be done for the Physics Cabinet, so as to make it perfect, and complete in all its parts" (*Supplementi da farsi per il Gabinetto di Fisica, acciocché sia perfetto, e insieme completo in tutte le sue parti*), he explained that "the physics rooms are the best furbished with instruments, but several things are still needed, which can partly be made here, but must in part be bought abroad. [...] The number of such machines cannot be established exactly, one would need to see most of the Cabinets in Europe, and above what there is in London, where there are whole stores of physics instruments made to be sold".[20] According to Fontana, travelling through the most important European capitals was crucial also in order to make personal acquaintances with "the people of Letters", since, he believed, "without such correspondences the Cabinet will never be complete or updated".[21] With the Grand Duke's support, he left for a five-year journey soon after the opening of the Museum.

The journey brought new instruments to the collection. In 1779, the sum of £ 5914 was transferred to the Belgian ambassador in order to pay for the "philosophical machines made in London" acquired by Fontana for the Museum. Yet, in the course of time it became clear that it would be convenient for the Museum to have its own makers, selected among the

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France, and Italy, London, 1790. See Olmi's paper in this volume for a more detailed analysis of Walker's opinion on the Florentine collection.

[18] IMSS, *Affari* 1791, c. 52, *Affari* 1792, c. 161.

[19] *Saggio* (cit. note 5), pp. 9-28.

[20] "Le stanze di fisica sono le meglio fornite di strumenti, ma molte cose ancora mancano, che si possono lavorare qui, alcune altre è necessario tirarle di fuori. E fra queste principalmente quelle che riguardano la luce a motivo dei vetri acromatici che solo si lavorano in Inghilterra. Il numero di queste macchine non si può fissar bene, bisognerebbe aver veduto gran parte dei gabinetti d'Europa, e più di tutto quello che vi è in Londra, dove vi sono degl'intieri magazzini di macchine di fisica fatte per vendersi", IMSS, *Affari* 1789A, c. 208.

[21] "Vi restano le corrispondenze vive coi Letterati, le notizie delle loro scoperte, i libri nuovi alla fine; anche questo ricerca un viaggio, perché bisogna inspirare nelle persone di Lettere della confidenza, e insieme dell'amicizia, che più di ogni altro gli tocca. Senza queste corrispondenze il Gabinetto né potrebbe mai completarsi affatto, né sarebbe in giorno delle cose nuove", ASF, *Segreteria di Finanze, Affari prima del 1788*, 480, c. non num.

best artisans who had worked at the collections. In 1780, when Fontana was back in Florence, the artisans Clemente Susini, Giuseppe Ferrini, Mattia Matteucci and Fedele Carmine were given an increase in salary with the condition that they would work exclusively for the Museum.[22]

THE SPECTACLE OF UTILITY

As was typical for Museums of the time, Fontana's Physics Cabinet was organized according to an encyclopaedic ideal of natural knowledge. The "several hundreds" of machines and instruments forming the Physics Cabinet occupied two large rooms plus six smaller ones in the Palazzo Torrigiani, near the Palazzo Pitti. The ideal path through the Cabinet reflected the structure of the most popular eighteenth-century textbooks of experimental philosophy: starting from mechanics, visitors would proceed to pneumatics, hydrostatics, meteorology and then conclude their itinerary with magnetism and electricity through optics. The principles of symmetry, order and regularity that guided the organization of the rooms responded to Fontana's desire to make the Museum a place where spectacle and learning would be closely linked:

> The symmetry that reigns inside and outside the shelves, the order, and the regularity of the pieces is so new and such that it bewitches the observer; at the same time it instructs and delights him.[23]

In this respect, Fontana's project was not original: encyclopaedic ideals underpinned eighteenth-century Physics Cabinets and Museums of Natural History.[24] Yet the Physics Cabinet's grandeur distinguished it from similar institutions. The instruments on display struck visitors because of their number, their size, and the quality of the materials employed. Even if we limit our attention to the eighteenth-century collection, a comparison of the plates in Nollet's *Leçons de Physique* and 'sGravesande's *Physice Ele-*

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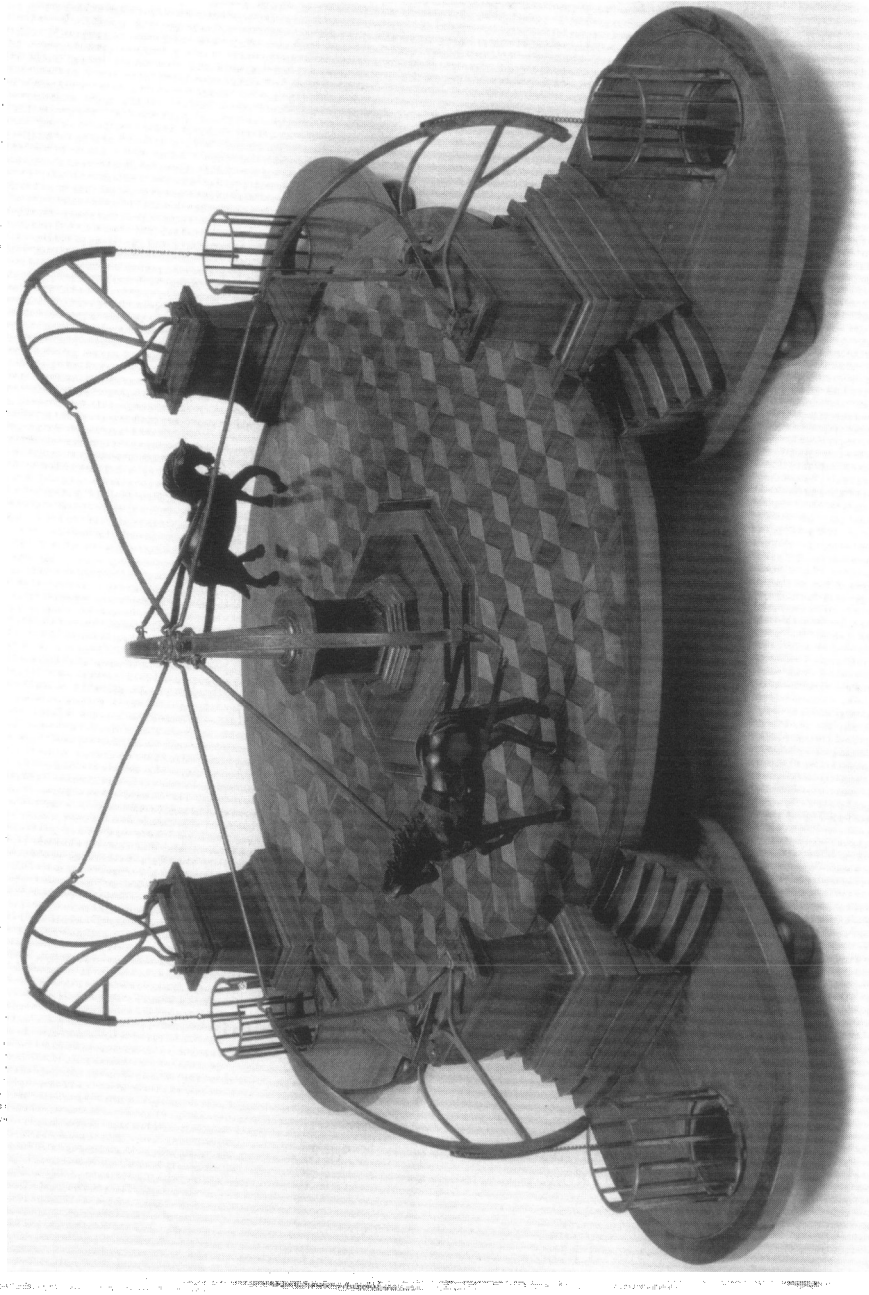
[22] ASF, *Segreteria di Finanze, Affari prima del 1788*, 480, c. non num.

[23] "La simetria [sic], che regna dentro e fuori gli scaffali, l'ordine, e la regolarità dei pezzi, è tale, e sì nuova, che rapisce l'osservatore, e nel tempo medesimo lo istruisce, e diletta", *Saggio* (cit. note 5), p. 30.

[24] GIUSEPPE OLMI, *L'inventario del mondo. Catalogazione della natura e luoghi del sapere nella prima età moderna* (Bologna: Il Mulino, 1992); BRENNI, "Jean Antoine Nollet and Physics Instruments", in *The Art of Teaching Physics. The eighteenth-century demonstration apparatus of Jean Antoine Nollet*, edited by Lewis Pyenson and Jean-François Gauvin (Sillery, Quebec: Les editions du Septentrion, 2002), pp. 11-27.



menta with the instruments that filled the rooms in Palazzo Torrigiani makes it clear that Fontana's proclaimed intention to have a complete Physics Cabinet was not far from reality. Apart from the most popular icons of experimental philosophy – such as models of Boyle's single-barrel air pump, Nollet's electrical machine and Ferguson's orrery, or originals such as Cuff's microscopes and Dollond's telescopes – the Cabinet displayed a number of machines that highlighted the usefulness of experimental philosophy: water-raising pumps, machines for extinguishing fire, hydraulic suction pumps, Archimedean screws. Most of the beautiful instruments that composed the physics collection survive in the Institute and Museum of the History of Science in Florence and modern visitors, just like their eighteenth-century predecessors, can admire the masterful craftsmanship with which they were created.[25]

The Museum's collection of mechanical instruments, in particular, highlights the attention that local makers paid to the aesthetic dimension of the instruments they produced. The large collection, which occupied two rooms in the Palazzo Torrigiani, included the most popular demonstration apparatus: collision pendulums, inclined planes, apparatus for the composition of forces, double cones for mechanical paradoxes, instruments for "showing the isochronism of the fall of bodies along a spiral around a paraboloid", and several other instruments that impressed visitors because of their size – often bigger than usual – and of their elegance.[26] Decorated exotic woods and elegant design added to the entertaining spectacularity of experimental demonstrations the visual pleasure of looking at rare materials and high-quality craftsmanship. To give one example pertaining to this collection, the "model of machine for operating four hydraulic pumps simultaneously", with its inlaid wooden pavement and its four black horses modelled in bronze, exemplarily demonstrates the combination of elegance and usefulness embodied in the Physics Cabinet (Fig. 1). The item was by no means an exception. While pleasing the eyes, the exceptional material quality of the collection reminded visitors of the Grand-duke's patronage of the sciences. It is worth mentioning that one of the most active artisans who contributed to making the Physics instruments was the cabinet-maker Giovanni Toussaint. Apart from most of the mechanical, pneumatical and electrical instruments displayed in the Palazzo Torrigiani, his workshop produced several pieces of furniture for the Palazzo Pitti, where the Court resided.[27]

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[25] Virtual visits at http://www.imss.fi.it/museo/index.html.

[26] BRENNI (ed.), *Catalogue of mechanical instruments* (Firenze: Giunti, 1993).

[27] ENRICO COLLE (ed.), *I mobili di Palazzo Pitti. Il primo periodo lorenese, 1737-1799* (Firenze: Centro DI, 1992), p. 244.

The collection of pneumatical and hydraulic instruments was likewise sumptuously extensive. The debts with Nollet's work are particularly visible in the single-barrel air pump that was part of this collection, and in the so-called Hero's fountain: both pieces were decorated in the fashion of Nollet's instruments, with black varnish and gold finish. Yet, whereas several pieces were copied from Nollet's and 'sGravesande's texts, others came from foreign workshops. Among the remarkable pieces made abroad, the most impressive was a beautiful double-cylinder, Hauksbee-type, air pump, made by Fortin in Paris (Fig. 2). The instrument cost 550 lire (a considerable amount of money when compared to the curator's annual income which was approximately 6000 lire), even though on its arrival in Florence the instrument had to be sent back to Paris in order to be repaired. Its decoration, which includes the Lorraine coats of arms, illustrates the relevance that the piece had for the collection.[28] Acquisitions of pneumatical instruments continued until the end of the century.[29]

Even a glance at the five-volume inventory of the Museum (1776) gives the idea of the scope of Fontana's enterprise. Thanks to his journey to Paris and London he had been able to identify a number of instruments that he deemed necessary to improve the collection. Items coming from the most prestigious instrument-makers' workshops in Paris and London were symbols of the high standards that Fontana had set for his Museum: the instruments and machines on display were not intended as mere evidence of the results achieved by experimental philosophy, they were also and above all the tools for researchers' ordinary work. Fontana's attempt to make the Museum a place for research as well as for display and self-learning is recognisable in his plan of a chemical laboratory, which would be set up in the Museum's basement on his return from abroad. Together with the "traditional" branches of experimental philosophy, Fontana believed that new developments in chemistry and meteorology promised great benefits to public health and agriculture.[30]

Those who used the Physics Cabinet as a place to carry out research could find the best available tools for their work. Visitors would realize that the collections of instruments "serve admirably to demonstrate the true, and right laws of nature, and to discover truths that, up to the pre-

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[28] WILLEN HACKMANN (ed.), *Catalogue of pneumatical, magnetical and electrical instruments* (Firenze: Giunti, 1995), p. 36. On the expenses and repairs for the air pump: IMSS, *Spese* 1780, c. 418, *Spese* 1783, c. 400*v*, *Spese* 1784 doc. 16.

[29] See IMSS, *Spese* 1781, c. 464; *Spese* 1791, doc. 19, 37, 85, 150, 154; *Spese* 1792, doc. 61, 72, 92, 98, 124, 131, 141.

[30] *Saggio* (cit. note 5), p. 28.

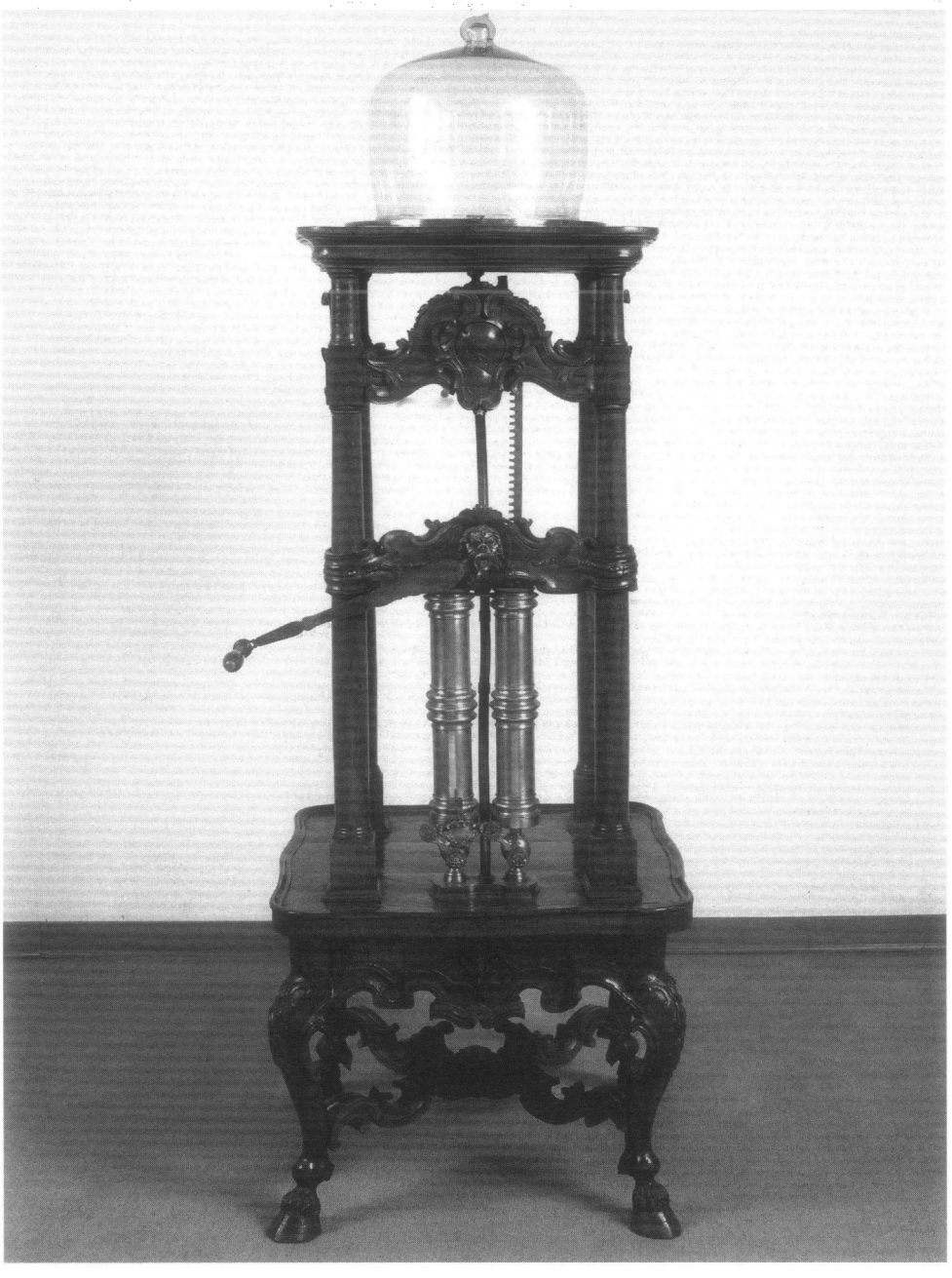

Fig. 2.

sent, have been hidden to the Philosopher".[31] Fontana's own contributions to the advancement of natural knowledge were on display in the Physics Cabinet. Like his eudiometer, his invention of meteorological instruments and his work on the standardization of weights and measures were presented under the aegis of the usefulness of experimental philosophy.[32]

For other types of visitors, the Physics Cabinet would be a place for entertainment as well as for learning. Particularly telling, in this respect, is a group of instruments that has not survived, although it was described in detail in the 1776 inventory. Placed next to the glass works of the Accademia del Cimento, the fourteen "devises serving magnetic games" had a purely entertaining function. Copied from Edmé Gilles Guyot's four-volume *Nouvelles Récréations Physiques et Mathématiques* (Paris, 1769-70), the "enigmatic, wonderful and magical dials", "the incomprehensible discovery" and "the ingenious swan" exploited magnetic attraction to create a number of games that would be played in groups.[33]

Similarly social – and similarly attractive – was the newest branch of experimental philosophy: electricity. Since the mid-eighteenth century, a number of public lecturers – among whom the abbé Nollet – had made their own reputations thanks to the spectacular display of the properties of the "electric fire". The introduction of the Leyden jar boosted curiosity for the subject and allowed itinerant electricians to astonish audiences in public squares as well as in courts and salons. The collection of electrical instruments in the Physics Cabinet in Florence reflected the fascination exerted by the spectacular display of electric attractions and repulsions or of the crackling, livid light of electric sparks.[34] According to the 1776 inven-

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[31] *Saggio* (cit. note 5), p. 2.

[32] *Saggio* (cit. note 5), *passim*.

[33] In the original Italian, these objects are called "ordigni inservienti a giochi magnetici": "le mostre enigmatiche", "le mostre meravigliose", "le mostre magiche", "la scoperta incomprensibile", "il cigno ingegnoso". ASF, *Imperiale e Reale Corte Lorenese, 5253: Gabinetto di Fisica. Inventario del Reale Gabinetto 1776*, vol. II.

[34] On the French context, apart from Brenni's works quoted above and my own articles, see: GEOFFREY SUTTON, *Science for a Polite Society. Gender, Culture, and the Demonstration of Enlightenment* (Oxford: Westview, 1995); on the British one: SIMON SCHAFFER, "Natural philosophy and public spectacle in the eighteenth century", *History of science*, 1983, *21*: 1-43; on the Dutch: LISSA ROBERTS, "Science Becomes Electric: Dutch Interaction with the Electrical Machine during the Eighteenth Century", *Isis*, 1999, *90*: 680-714. On the German: OLIVER HOCHADEL, *Öffentliche Wissenschaft: Elektrizität in der deutschen Aufklärung* (Göttingen: Wallstein, c2003). On the Italian: PAOLA BERTUCCI, "Sparking Controversy" (cit. note 1) and ID., "Back from Wonderland" (cit. note 1); PICCOLINO and BRESADOLA, *Rane, Torpedini e Scintille* (cit. note 15); GIULIANO PANCALDI, *Volta. Science and culture in the age of Enlightenment* (Princeton: Princeton University Press, 2003). General references on eighteenth-century electricity: WILLEM HACKMANN, *Electricity from glass* (Alphen aan den Rijn: The Netherlands, 1978); JOHN HEIL-

tory, from the beginning the Museum displayed thirteen electrical machines and several other smaller instruments. They included a big cylinder electrical machine made by Nairne (for which the instrument-maker was awarded a gold medal), a Nollet-type globe machine, several Leyden jars of various size, and numerous demonstration devices.[35]

The range of luminous tubes, magic squares, electric bells and dancing puppets displayed in the Physics Cabinet were described in the most popular textbooks on electricity and entertained visitors in Florence as well as abroad. Yet the success of electrical science was not due merely to its attractive shows, but also to the controversial medical properties of the electric matter.[36] The possibility that electricity might be useful in medicine was discussed throughout the century and, at the time when Fontana became interested in the subject, the new science seemed to promise also another kind of useful applications: lightning rods. In the 1770s, thanks also to the famous controversy on whether pointed or blunt conductors would be more effective, lightning rods engendered a new generation of electrical enthusiasts.[37] While electricians engaged in heated public confrontations, instrument-makers marketed a series of small instruments (thunderhouses) designed to show the power of grounded metallic conductors to protect buildings from the effects of lightning. As the century progressed and new extraordinary natural phenomena such as lightning, thunder, earthquakes, aurora borealis and volcanic eruptions came to be incorporated in electrical systems, instrument-makers designed new electrical toys that illustrated the role of the electric fire in the economy of nature. Turned into one of the many electrical wonders, the aurora borealis could also be recreated in smaller scale thanks to the "aurora flask", an electrical instrument invented by John Canton. Books such as Ferguson's *An intro-*

BRON, *Electricity in the 17th and 18th century. A study of early modern physics* (Berkeley and Los Angeles: University of California Press, 1979).

35 BERTUCCI, "A Philosophical Business. Edward Nairne and the Patent Medical Electrical Machine (1782)", *History of Technology*, 2001, *23*: 41-58.

36 On medical electricity: BERTUCCI and PANCALDI (eds.), *Electric Bodies. Episodes in the history of medical electricity. Bologna Studies in the History of Science*, vol. 9 (Bologna: CIS, University of Bologna, 2001); PICCOLINO and BRESADOLA, *Rane, Torpedini e Scintille* (cit. note 15).

37 On the controversy over lightning rods: TRENT A. MITCHELL, "The politics of experiments in the eighteenth century: the politics of audience and the manipulation of consensus in the debate over lightning rods", *Eighteenth-century studies*, 1998, *31*, 307-331; for the Italian context: FERDINANDO ABBRI, "La 'spranga elettrica': Frisi e l'elettricità", in *Ideologia e scienza nell'opera di Paolo Frisi (1728-1784)*, edited by Gennaro Barbarisi (Milano: Franco Angeli, 1987), vol. 1, pp. 161-199; STEFANO CASATI, "Storie di folgori: il dibattito italiano sui conduttori elettrici nel Settecento", *Nuncius*, 1998, *13*: 493-512. ANTONIO PACE, *Benjamin Franklin and Italy* (Philadelphia: The American Philosophical Society, 1958), chapter 2.

duction to electricity offered directions on how to perform the "finest of all electrical experiments" and Fontana had a few of them in the Museum.[38]

The collection of electrical instruments was particularly representative of the links between spectacle and usefulness that the Museum embodied. In 1780, returning to Florence after his five-year journey abroad, Fontana obtained from the Grand Duke that more space should be given to the electrical instruments.[39] But the links between spectacular display and public utility, as we have seen, was by no means limited to this particular collection. In all its parts, but more effectively as a whole, the Physics Cabinet of the Royal Museum testified to Fontana's attempts to create an institution where tradition and innovation, research and display, spectacle and usefulness would be fruitfully combined.

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[38] JAMES FERGUSON, *An introduction to electricity* (London, printed for W. Strahan and T. Cadell, 1770), p. 64.

[39] ASF, *Segreteria di Finanze, Affari prima del 1788, 480:* Lettera a Fontana del 6 marzo 1780.