

**John Theophilus Desaguliers:
A Newtonian between patronage and market relations**

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Abstract

The dissemination of the mechanical and Newtonian experimental philosophy in 18th-century England arose fascination in relation to the possible application of this new knowledge to the needs of productive life and the general welfare of the population. The activity of many independent and/or itinerant lecturers proved to be fundamental to spread the Newtonian philosophy and allow for the emergence of an ideal of applied science. In the present paper I discuss the intellectual trajectory of John Theophilus Desaguliers (1683-1744), who was the curator, or 'official experimenter', of the Royal Society of London and became a pioneer in the spreading of Newtonianism, as well as one of the most important and most respected independent lecturers on mechanical and experimental philosophy in the first half of the 18th century.

Keywords

Newtonian experimental philosophy; Dissemination of knowledge; England; 18th century;
J.T. Desaguliers

**John Teophilus Deaguliers:
Um Newtoniano entre o mecenato e as relações de mercado**

Resumo

A disseminação da filosofia mecânica e experimental newtoniana na Inglaterra do século XVIII despertou fascínio em relação à possível aplicação deste novo conhecimento às necessidades da vida produtiva e ao bem estar geral da população. A atividade de muitos palestrantes independentes e/ou itinerantes foi fundamental para a divulgação da filosofia newtoniana, permitindo a emergência de um ideal de ciência aplicada. No presente artigo o autor analisa a trajetória intelectual de John Theophilus Desaguliers (1683-1744), curador ou 'experimentador oficial' da *Royal Society* de Londres e pioneiro na disseminação do Newtonianismo, assim como um dos palestrantes independentes mais importantes e respeitados sobre filosofia mecânica e experimental na primeira metade do século XVIII.

Palavras-chave

Filosofia experimental newtoniana; Divulgação do conhecimento; Inglaterra; Século XVIII;
J.T. Desaguliers

Introduction

The dissemination of the mechanical and Newtonian experimental philosophy in 18th-century England arose fascination in relation to the possible application of this new knowledge to the needs of productive life and the general welfare of the population. The activity of many independent and/or itinerant lecturers proved to be fundamental to spread the Newtonian philosophy and allow for the emergence of an ideal of applied science. These lecturers travelled all around England giving courses of 10 to 16 'sessions' or classes. The courses, involving both teaching and experimental activities, were taught to a very diversified and growing clientele, which also included a more specialized audience of industrialists and civil and mechanical engineers, as well as dilettante ladies and gentlemen, whose sole objective was to learn the new teachings based on Isaac Newton's (1643-1727) *Principia* and *Optica* as interpreted by these independent lecturers. In the present paper I discuss the intellectual trajectory of John Theophilus Desaguliers (1683-1744), who was the curator, or 'official experimenter', of the Royal Society of London and became a pioneer in the spread of Newtonianism, as well as one of the most important and most respected independent lecturers on mechanical and experimental philosophy in the first half of the 18th century.

Desaguliers' life

Desaguliers was born as Jean-Théophile on 13 March 1683 in La Rochelle, France, into a family of Huguenots (French calvinists). La Rochelle itself had been a huguenot redoubt since the initial arrival of Reformist ideas in France. However, in 1685, aged only two, Desaguliers was compelled to leave his native city in France due to the revocation of the Edict of Nantes by Louis XIV. In consequence, Huguenots were forbidden to worship and ministers were obliged to leave the country within 15 days, being expressly forbidden to remove their children from France, as they ought to be educated in accordance with the Catholic principles.¹

Despite this prohibition, Desaguliers' father, the Reverend Jean-Théophile Desaguliers, left France taking his son to Guernsey hidden in a barrel, according to some reports. The Desaguliers did not live in Guernsey for more than nine years. Father and son moved to England in 1694. Upon reaching London, Rev. Desaguliers was ordained in the Anglican Church and served as minister in the French Chapel on Swallow Street.² The younger Desaguliers was educated by his father until he was 16, when he went to Sutton Coldfield School in Warwickshire and then to Christ Church College in Oxford, where he earned the degree of Bachelor of Arts. On 4 June 1710 Desaguliers was ordained deacon of the

¹ The Edict of Nantes was issued in 1598 by Henri IV. It allowed Huguenots freedom of worship and the same civil rights as Roman Catholics; see Wilfred R. Hurst, *An Outline of the Career of John Theophilus Desaguliers, M.A., LL.D., F.R.S.* (London: Edson (Printers), Limited, 1928), 2; and Pierre Boutin, *Jean-Théophile Desaguliers: Un Huguenot, Philosophe et Juriste, en Politique* (Paris: Honoré Champion Éditeur, 1999), 9-10.

² Hurst, 2; Boutin, 10.

Anglican Church and that same year entered Hart Hall College in Oxford as lecturer of natural and experimental philosophy, replacing Dr. John Keill (1671-1721). In May 1712 Desaguliers received his Master of Arts degree and on 14 October he married Joanna Pudsey (from the Oxford outskirts) in Shadwell Church.³

Desaguliers lectured in Hart Hall College until 1713, when he decided to live in the metropolitan area and moved with his wife to Channel-Row House in Westminster. He lived in this house until shortly after her death, when he was obliged to leave due to the beginning of the construction of the new bridge over River Thames at Westminster. Thus Desaguliers moved to the Bedford Coffee-House in Covent Garden, where he died on 29 February 1744.⁴

Since Desaguliers had large experience as lecturer of natural and experimental philosophy in Hart Hall College, where he mainly taught the fundamentals of Newtonian physics, his entrance to the Royal Society of London, presided by Newton himself, was not difficult. On 29 July 1714 he was elected Fellow of the Royal Society, being exempted from the payment of admission fees in recognition for the work he had performed in Oxford. A short while later, replacing Francis Hauksbee (who had died in April), Desaguliers was named curator of the Royal Society, which in practice corresponded to a kind of 'official experimenter'. Although he did not have a fixed salary, Desaguliers received a regular payment that varied in accordance to the complexity of the experiments he carried out and the communications presented to the Society. Although he diversified his activities quite a lot, exercising his religious profession and teaching some public classes in natural and experimental philosophy, Desaguliers kept the post of curator of the Royal Society until 1743, one year before his death.⁵

According to Pierre Boutin, Desaguliers' admission to the Royal Society and his nomination to the position of curator or 'official experimenter' was due to an articulation headed by Newton (the Society's perpetual president) and the institution's will to affirm the Newtonian hegemony. The underlying reason was that these events coincided with George I of Hanover's ascension to the English throne and rumors that the German philosopher Gottfried W. Leibniz (1646-1716), Newton's main intellectual rival, was coming to England with the new king's retinue. As a fact, Desaguliers' candidacy as Fellow of the Royal Society had been presented by Sir Hans Sloane (1660-1753) in July 1713, shortly after Hauksbee's death, being recommended by Dr. John Keill for his capacity and competence as 'experimental philosopher'. In addition, on the occasion of his candidacy, Desaguliers presented the members of the Royal Society various experiments of the type that Newton would later incorporate into the fourth edition of his *Opticks* as the result of the work of his collaborator. Nevertheless, the rumors about the possible arrival of Leibniz and the need to reaffirm Newtonianism within the Royal Society were that which led to Desaguliers' election being rushed and his nomination as the institution's curator. His main task as such was to legitimate and propagate the theories of the Society's perpetual president, whereby he developed a solid relationship of friendship and trust with him.⁶

³ Hurst, 2-3; Boutin, 10.

⁴ Hurst, 4; Boutin, 10.

⁵ Hurst, 4; Boutin, 10.

⁶ Boutin, 10-1.

Months after his nomination, in his first trip to France in February 1715, Desaguliers met Pierre Coste (1668-1747), who was considered as the main advocate of John Locke's (1632-1704) work in the Continent, and asked him to translate *Opticks* into French. This involved giving a greater dimension to the Newtonian ideas, especially the ones that were a part of the *Opticks*, considered to be Newton's most accessible work; the French translation was expected to contribute to the greater acceptance of Newtonianism among the French and other continental philosophical circles. Coste's translation reached the public only five years after his meeting with Desaguliers in Amsterdam in 1720, thereby contributing to make Newtonianism become better known by many French-speaking European intellectuals.⁷

The move to Channel-Row House opened new possibilities of work to Desaguliers, who began to teach courses in natural and experimental philosophy, including astronomy, to a varied clientele, as in the metropolitan area, composed of the adjoining cities of London and Westminster, "the Newtonian Philosophy [was] so generally received among Persons of all Ranks and Professions, and even the Ladies"⁸. As a fact, Desaguliers was the first to teach classes and give public courses on natural and experimental philosophy to a diversified audience in the metropolitan area (and actually anywhere in England). Through these courses and with the help of experiments he sought, in a simple language, to make the mechanical, pneumatic, hydrostatic and hydrodynamic principles of the Newtonian philosophy more widely known, as the historian Margaret C. Jacob has argued.⁹ In this way he introduced a new type of professional action to students of natural and experimental philosophy as independent lecturer, i.e., not affiliated with any official teaching institution, especially the universities of Oxford and Cambridge. Desaguliers saw some of his students and friends become independent lecturers, which during the 18th century allowed many men all over England obtain a means of living by teaching courses in their own houses or continually travelling to various cities in the country.¹⁰ Desaguliers said that between 1710 and 1720 there were "eleven or twelve Persons, who performed *Experimental Courses* at this time in England, and others Parts of the World", of whom "I have had the Honour of having Eight of them for my Scholars; whose further Discoveries become an Advantage to my self".¹¹

Desaguliers' admission to the Royal Society not only allowed him become closer to Newton, but also to a number of powerful aristocrats. Through these contacts and relationships, on 3 November 1716 Desaguliers was appointed chaplain of James Brydges, then Earl of Carnarvon and later the first Duke of Chandos, who became one of the main patrons of the Newtonian philosophy. On 8 December 1717, Desaguliers was ordained priest of the Anglican Church by the Bishop of Ely, after which he was granted a *living* in Bridgeham, Norfolk, with an annual income of 70 pounds, by the Lord Chancellor, Thomas

⁷ Boutin, 11.

⁸ John Theophilus Desaguliers, *A Course of Experimental Philosophy*, (London: John Senex, W. Innys & Richard Manby, John Osborn & Thomas Longman, 1734), I: n.p. (preface).

⁹ Margaret C. Jacob, *Scientific Culture and the Making of the Industrial West* (Oxford: Oxford University Press, 1997), 94-5; 110.

¹⁰ Hurst, 4.

¹¹ Desaguliers, *A Course of Experimental Philosophy* (1734), I: n.p. (preface).

Parker (1666-1732). Although he was already recognized as an eminent natural and experimental philosopher, on 16 March 1718 Desaguliers received the degree of Doctor of Laws from University of Oxford, which evidently increased even more his prestige with the aristocracy and the circles of power.¹²

As a result of this increase in prestige, on 28 August 1719 Desaguliers was named rector of Saint Lawrence's Church, known as Whitchurch or Little Stanmore, in Edgworth (later called Edgware), in Middlesex), which was on the boundary of the property of his patron, James Brydges, whose influence was of great importance for this nomination. The Newtonian philosopher and Anglican priest kept this position almost until he died, though from 1731 onwards he was less often present due to travels and other activities. Between 1719 and 1721 Desaguliers also worked alongside George Frederick Handel (1685-1759), who was the organist at James Brydges' private chapel, Canons Park Chapel, and also worked at Whitchurch. The Newtonian philosopher was certainly one of the spectators of the first presentations of the celebrated *Chandos Anthems*, composed by Handel as a tribute to their common patron.¹³

Strategically, Desaguliers sought to establish godparent relationships with aristocrats and other people of prestige who could reinforce the ties of trust with his patrons. The godparents of his third son, Jean Isaac, were the Marquis of Carnavon, son of the Duke of Chandos, and Newton himself, whom his son was named after. The godparents and protectors of his fourth son, Thomas, were Thomas Parker, Earl of Macclesfield and Lord Chancellor of England, Archibald Campbell (Earl of Islay) and the Countess of Clifton.¹⁴

In parallel to his various professional activities, Desaguliers was admitted as a member to the Freemasonry in the metropolitan area, becoming very respected in the Masonic circles and holding several positions. According to Wilfred R. Hurst, "His natural love of mechanics and the prominent part that science plays in operative masonry no doubt induced him first to become Member of the Society". His Masonic activities, which continued to his death, were fundamental to strengthen his ties with the powerful men of his time, since many aristocrats, rich merchants and members of Parliament were also Masons. In addition, many members of the Royal Society entered Masonry through Desaguliers, convinced of the importance of such an affiliation by his charisma and persuasive action, which points to the recognition of his prestige among the philosophical, scientific and aristocratic circles. His first important post was the one of Third Grand Master of the Lodge in the Goose and Gridiron Ale-House, to which he was elected on 24 June 1719, two months before being named Whitchurch rector. On 24 June 1723 he was elected Deputy Grand Master of the same lodge and on 27 December 1725 he was named by the Grand Master, Lord Paisley, Deputy Grand Master of the recently created Premier Grand Lodge of England, which became the most important in the country.¹⁵

¹² Hurst, 6-7; Boutin, 11.

¹³ Hurst, 7-10. Handel served James Brydges from 1718 to 1721.

¹⁴ *Ibid.*, 3.

¹⁵ *Ibid.*, 7-10; 13-4; 18. For Desaguliers' role in Masonry, see Paul Elliott, & Stephen Daniels, "The 'School of True, Useful and Universal Science'? Freemasonry, Natural Philosophy and Scientific Culture in Eighteenth-century England," *British Journal of History of Science*, 39, no. 2 (2006): 207-29.

There is some evidence that Desaguliers circulated in various metropolitan Masonic Lodges in the 1720s, without, however, becoming an effective member of any of them, especially the ones in the Duke of Chandos' Arms in Edgworth and in the Horn Tavern in Westminster. At the end of the 1730s, obliged to make frequent visits to Bath due to his gout, Desaguliers also participated (without becoming an effective member) in the activities of the lodge in the Bear Inn, even acting as Master on some occasions. In 1731, on one of his trips to Holland, Desaguliers acted as Master in a lodge in the Hague, and in 1737 he acted as Master of the 'Occasional' or 'Emerging' Lodge that was created in Kew Palace, when Frederick, Prince of Wales (son of George II and heir to the English and British throne), began his Masonic learning, guided by Desaguliers.¹⁶

The prestige acquired by Desaguliers as curator of the Royal Society, the success of his public natural and experimental philosophy courses and his close ties with powerful patrons allowed him to become close to the royal family, initially through private classes taught to Frederick, Prince of Wales. In 1737 Desaguliers was nominated Chaplain to the Prince of Wales, leaving the service of Duke of Chandos, while in 1738 he was nominated Chaplain of Bowles' Regiment of Dragoons, one of the most famous cavalry regiments in England.¹⁷

In the 1730s, taking advantage of his prestige and respectability as a great 'experimental philosopher' and one of the best known advocates of Newtonianism, Desaguliers gave a number of public courses on natural and experimental philosophy abroad. Between 1730 and 1732 he went to Holland, the lecturers at University of Leyden and the intellectual circles in the large Batavian cities being great admirers of Newton, while in 1736 he lectured in Paris, at a crucial moment for the establishment of Newtonianism in France, the adepts and followers of which included Voltaire (1694-1778). Three times, in 1734, 1736 and 1741, Desaguliers was awarded the Royal Society maximum distinction, i.e., the Copley Medal. The 1734 medal coincided with the publication of the first volume of his masterwork, *A Course of Experimental Philosophy*, while the one awarded in 1736 acknowledged his trajectory as 'experimental philosopher'. The 1741 medal was in recognition for his "discovery of the properties of electricity", announced in his memoir funded by the Bordeaux Academy in 1742.¹⁸

After great sufferings caused by gout and its consequences, Desaguliers died at the age of 61 on 29 February 1744 in his room at the Bedford Coffee-House in Covent Garden,

See also Margareth C. Jacob, *Living the Enlightenment: Freemasonry and Politics in Eighteenth-century Europe* (Oxford: Oxford University Press, 1991), 65; 90.

¹⁶ Hurst, 14-5; 17-8. The Hague Lodge, created in 1731, was the first Masonic Lodge officially founded outside Great Britain, Desaguliers playing an important role in its emergence, according to Jacob, *Living the Enlightenment*, 90.

¹⁷ Hurst, 6. The prestige of Bowles' Regiment of Dragoons was a result of the role played by the cavalry regiment commanded by Brigadier-General Phineas Bowles in suppressing the 1715 Jacobite Rebellion in Scotland.

¹⁸ Hurst, 10-1. The Copley Medal, awarded to people distinguished in the various scientific fields or in natural and experimental philosophy, was created by the Royal Society as a tribute to Sir Godfrey Copley, a wealthy landowner from South Yorkshire, and a Society fellow, who in 1709 donated 100 pounds to fund the performance of experiments.

and was buried (on 6 March) not far from there in Savoy Chapel. His friends and admirers gave him great praise, lamenting his death and the *General Evening Post* registered his death on 1 March as follows: “Yesterday died at his lodgings in the Bedford Coffee-House in Covent Garden, Dr. Desaguliers, a gentleman universally known and steem’d”¹⁹.

Courses taught by Desaguliers and his publications

Desaguliers was perhaps the best known and most respected independent lecturer on mechanical and experimental philosophy in the first half of the 18th century. Unlike other contemporary independent lecturers on these topics, who circulated across towns in the interior of England, thus being authentic itinerant or travelling lecturers, Desaguliers had a busy and agitated life and concentrated all his chores in London and Westminster, or at the very most in nearby towns, such as Edgeworth. His travels were of a different kind, unrelated to his more immediate survival, such as his trips to European countries to teach courses and contact local scientific and philosophical circles (Holland and France) or the ones to Bath to treat his health.

With a wide range of personal and professional-religious relations, Desaguliers capitalized his prestige work as an independent lecturer of natural and experimental philosophy or mechanical and experimental philosophy as a complement. Desaguliers’ fame and respectability attracted a large clientele, which through the payment of fees of two or three guineas attended the courses given at his home (in Channel Row, Westminster) or in coffee houses in London and Westminster, such as the Bedford Coffee-House, Covent Garden, which was also a redoubt of Whig politicians and intellectuals. According to Desaguliers himself, in the preface to the first edition of his most important work, *A Course of Experimental Philosophy*, between his early time in Oxford and 1734, he taught 121 courses on natural and experimental philosophy. Since he continued working as an independent lecturer until a short while before his death, the number of the courses he taught was certainly much higher.²⁰

According to Desaguliers, his courses followed the same teaching methodology as established by John Keill in the classes he taught at Hart-Hall College between 1704 and 1710, since he had been “the first who publickly taught *Natural Philosophy* by *Experiments* in a mathematical Manner”. For this reason,

“(...) he laid down very simple *Propositions*, which he prov’d by *Experiments*, and from those he deduc’d others more compound, which he still confirm’d by *Experiments*; till he had instructed his Auditors in the *Laws of Motion*, the *Principles of Hydrostaticks* and *Opticks*, and some of the chief *Propositions* of Sir Isaac Newton concerning *Light* and *Colours*”.²¹

¹⁹ *General Evening Post*, 1/3/1744 (No. 1.630) apud Hurst, 18-9.

²⁰ Desaguliers, *A Course of Experimental Philosophy* (1734), I: n.p. (preface).

²¹ *Ibid.*

Keill, thus, not only introduced “the Love of the *Newtoninan Philosophy*” into the academic environment, but also sought to differentiate his courses from the activities carried out in London at the same time by Hauksbee (then curator of the Royal Society), who, also according to Desaguliers, taught “Courses of Experiments” and not “Courses of Experimental Philosophy,”²² as Keill did in Oxford. Actually, the courses taught by Hauksbee consisted of a series of “*electrical, hydrostatical, and pneumatical*” experiments for the curiosity of the public, without any major consequences for the development of natural and experimental philosophy. In relation to this Desaguliers added:

“But as they were only shewn and explain’d as so many curious *Phaenomena*, and not made Use of as *Mediuns* to prove a Series of philosophical Propositions in a mathematical Order, they laid no such Foundation for true Philosophy as *Dr. Keill’s Experiments*; tho’ perhaps perform’d more dexterously and with a finer *Apparatus*”.²³

On the other hand, even following this methodological advice in his successive courses for large publics, Desaguliers did not exclude novelties and the numerous advances in natural and experimental philosophy, including in the program of his classes “the *Mechanicks* (strictly so call’d, that is, the Explanation of mechanical Organs, and the Reason of their Effects) and several *Optical Propositions*”. Moreover, he always sought to improve the courses he taught “by the Addition of new *Propositions* and *Experiments*, and by altering and changing [his] *Machines*”, with the aim of making the content “more intelligible to such of [his] Auditors as were not acquainted with *Mathematicks*, or more satisfactory to such as were; especially in what regards the Causes of the Motions of the heavenly Bodies, and the *Phaenomena* of our *System*”.²⁴

Desaguliers also found another way to obtaining resources from his clientele through the sale of syllabuses, which in truth were catalogues of the courses or programs of classes taught (which also served as a way of publicizing his teaching activities) and textbooks that summarized the content of these classes and the experiments taught.

Some pamphlets with class programs and notes survived and allow us a good understanding of the content and aims of Desaguliers’ courses. One of these pamphlets, in an English and French edition, had 14 pages and was entitled *A Course of Mechanical and Experimental Philosophy (Cours de philosophie mécanique & experimentale)*, having been published in London, perhaps by the author himself, around 1720, and afterwards

²² Francis Hauksbee published a book reporting his experiments entitled *Physico-mechanical experiments on various subjects containing an account of several surprising phaenomena touching light and electricity, producible on the attrition of bodies, etc.* (London: [s.n.e.], 1709). The second edition of this book is entitled *Physico-mechanical experiments on various subjects containing an account of several surprising phaenomena touching light and electricity, producible on the attrition of bodies, etc. To which is added a supplement, containing several new experiments* (London: J, Senex & W. Taylor, 1719).

²³ Desaguliers, *A Course of Experimental Philosophy* (1734), I: n.p. (preface).

²⁴ *Ibid.*

republished in 1725 with 8 pages.²⁵ In the internal subtitle Desaguliers indicated who the target public was and the general aims of the course:

“Whereby any one, altho’ unskill’d in Mathematical Sciences, may be able to understand all those Phaenomena of Nature, which have been discovered by Geometrical Principles, or accounted for by Experiments; and Mathematicians may be diverted in seeing those Machines us’d, and Physical Operations perform’d concerning which they have read”.²⁶

In a type of explanatory note he presented the general methodology used in his classes, reinforcing the central role of his mathematical and experimental method:

“The Method of this Course is wholly Mathematical, *viz.* a Chain of Propositions proving each at her; but instead of *Definitions, Axioms,* and *Postulata*, purely Geometrical, the Experiments made at the First Lecture, prove the *Precepts* given at the Second, and so on: Things which at herwise would be merely Speculative, being by this means render’d Objects of this Senses, and better understand in a Month or Six Weeks, than in Year’s close Application to Books only”.²⁷

In relation to the structure of the course itself and the content of the 12 classes to be taught, he emphasized:

“This Course consists of Four Parts. In the First are laid down the Principles of *Mechanics*, and Laws of Motion, and the several Operations of Engines shewn.

In the Second, the Nature of *Fluids* is explain’d, the Laws of Hydrostatics are rationally demonstrated and its Paradoxes or most surprising *Phaenomena*, shewn, and experimentally accounted for.

The Third Part takes in the Properties of *Air*, and all the *Phaenomena* which depend upon its Pressure and Electricity; its Condensation and Rarefaction by Engines; the manner how it is vitiated, and how purified; with great variety of Experiments upon the *Air-Pump*.

The Fourth Part treats of *Optics*; considering 1stly, Direct Vision or Perspective, the Nature and Affections of Light; 2ndly, Catoptrics, or reflex Vision; 3rdly, Dioptrics, or refracted Vision, in which the Nake of the Eye is consider’d; with Faults of and Helps for bad Eyes. Lastly, Sir Isaac Newton’s Theory of Light and Colours, prov’d by his Experiments, and confirm’d by some new Ones, which may be done even by Candle-light”.²⁸

A second (eight-page) pamphlet entitled *An Experimental Course of Astronomy* concerns an astronomy course with 16 classes (taught in Chanel-Row), which probably was

²⁵ Desaguliers, *A Course of Mechanical and Experimental Philosophy* (London: [s.n.e.], c.1720) 2nd ed. (London: [s.n.e.], 1725).

²⁶ Desaguliers, *A Course of Mechanical and Experimental Philosophy* (c. 1719), 3.

²⁷ *Ibid.*, 4.

²⁸ *Ibid.*, 3-4.

published by Desaguliers in 1725. To a certain extent he repeated the same procedures as in the previous pamphlet, detailing the general aims of the course and its experimental nature, methods, plan of the class, etc. For this course, Desaguliers used a 'planetarium', to wit, an instrument to determine the position and distances of 'heavenly bodies' in the 'universe', designed by Desaguliers himself. In the internal subtitle of the pamphlet, Desaguliers not indicated the target public, but also the general objective, i.e., the interpretation of the 'System of the World' according to the Newtonian approach. He expressed the aim of his astronomy course as follows:

“Whereby such a competent Knowledge of that whole Science may be attain’d to, by only attending sixteen Lectures; that Persons, whose Business, or other Avocations, will not permit them to apply to that Study, may, in a Month’s time (by Help of several new Machines and Experiments purposely contriv’d) make them selves better acquainted with the *System of the World*, the Reasons and physical Causes of the *Appearances* and *Motions* of the *Heavenly Bodies*, the Nature of *Eclipses*, and the Use of *Globes* and *Maps*, than by a Year’s Application to Books and common Globes”.²⁹

Nevertheless, it is the books written by Desaguliers (some with the help of his closest collaborators) that most clearly show the content of the classes taught and the experiments made to demonstrate the notions addressed in these classes. The first book attributed to Desaguliers, 80 pages long, was published in 1717 with his approval; it consists of a summary of the content and experiments presented in his classes, based on notes made by Richard Bridger and William Vream, his collaborators.³⁰ Its title was *Physico-mechanical lectures or, an account of what is explain’d and demonstrated in the course of mechanical and experimental philosophy, given by J. T. Desaguliers, M.A., F.R.S.* Desaguliers’ distinctions and titles were described on the title page to ensure the credibility of the work and attract the public in general, since he sought to reach a larger number of persons than the ones who attended his classes. The *Physico-mechanical Lectures* were divided in three parts – ‘Mechanics’, ‘Hydrostatics’ and ‘Opticks’ –, and had the following subtitle on the title page: “Wherein the Principles of Mechanics, Hydrostatics and Optics, are demonstrated and explain’d by a great number of experiments. Design’d for the use of all such as have seen, or may see courses of Experimental Philosophy”³¹.

In a sort of warning to his readers, Desaguliers gives a justification for the synthetic character of the book, to which he referred as “minutes”, while promising to publish his “Lectures in full” when he had “more Leisure” to do so. He expressed himself as follows:

²⁹ Desaguliers, *An Experimental Course of Astronomy* (London: [s.n.e.], 1725), 3.

³⁰ In addition to helping Desaguliers in his experiments, William Vream was a manufacturer of scientific instruments in London, having previously worked with Hauksbee. In 1717 Vream published a booklet entitled *A Description of the Air-pump, According to the Late Mr. Hauksbee’s Best and Last Improvements: with the manner of making fifty of the most curious experiments upon it, etc.* (London, published by the author, 1717).

³¹ Desaguliers, *Physico-mechanical Lectures or, an account of what is explain’d and demonstrated in the course of mechanical and experimental philosophy, given by J. T. Desaguliers, M.A., F.R.S.* (London: Richard Bridger & William Vream, 1717).

“The following papers being only minutes of my lectures, for the use of such gentlemen as have been my Auditors, were printed at their Desire; to save the trouble of writing them over for every Person. Therefore I beg all such Readers, as have not seen my Course of Experiments, to pardon my want of Method and short Hints; and desire them no to expect a full Account of all the Experiments made in the Course, and mention’d in the Catalogues: For I have only taken Notice of so many as prove every Proposition; that this little Book may serve as a *Memorandum*”.³²

However, in 1719 Desaguliers and his collaborators were surprised by the publication of a larger book, 201 pages long, attributed to him, but which actually consisted of a collection of experiments carried by Desaguliers, but organized and edited by a certain Paul Dawson. The latter was a protégée of Sir Richard Steele, who had raised him since childhood and sent him to Desaguliers to attend his classes on natural and experimental philosophy. The title of the book published by Dawson was *A system of experimental philosophy, prov’d by mechanicks*, with a long subtitle on its title page, similar to the one used by Desaguliers in his book two years earlier:

“Wherein the Principles and Laws of Physicks, Mechanicks, Hydrostaticks, and Opticks, are demonstrated and explained at large, by a great Number of curious Experiments: With a full Description of the Air-Pump, and the several Experiments thereon: As also of the different Species of Barometers, Thermometers, and Hydrometers; as shewn at the publick Lectures in a Course of Mechanical and Experimental Philosophy. As performed by J. T. Desaguliers, M.A., F.R.S.”.³³

Dawson took care to include Desaguliers’ titles to increase the credibility of the work, sold for 5 shillings, and to attract the attention of the public; for this purpose he also added details on the title page on illustrations, appendices and descriptions of machinery and equipment:

“Illustrated with several Copper Plates. To which is added, *Sir Isaac Newton’s Colours*: The Description of the condensing Engine, with its Apparatus: and *Rowley’s Horary*; a Machine representing the Motion of the *Moon* about the *Earth*; *Venus* and *Mercury* about the *Sun*, according to the Copernican System”.³⁴

In the preface, dedicated to Sir Richard Steele and full of praise to his patron, Dawson explicitly admitted that that the books had not been prepared by Desaguliers, but that he had given authorization for publication: “I therefore humbly present to you the following *Treatise* containing the several Philosophical Experiments shewn by Mr.

³² Desaguliers, *Physico-mechanical Lectures*, A-2.

³³ Paul Dawson, *A System of Experimental Philosophy, prov’d by mechanicks* (London: B. Creake & J. Sackfield, 1719). Although Desaguliers’ name appears on the title page, I do not consider it to be book written by him, but rather a work published or organized by Dawson.

³⁴ *Ibid.*

Desaguliers in his public Lectures, which I have carefully collected, and that *Gentleman* approved of".³⁵

When *Desaguliers* heard through booksellers in London that a book attributed him was being sold, his first reaction was to "[look] over the whole book, and corrected every Error therein", annexing an errata, because he "was unwilling that those who buy it should find it any wise imperfect". Probably with the help of the already mentioned collaborators, *Desaguliers* hurriedly rewrote the book and gave a different title to – *Lectures of Experimental Philosophy*, considering it a second edition of the book as corrected by him. The book also had the following subtitle on the title page: "Wherein the Principles of Mechanics, Hydrostatics and Optics, are demonstrated and explain'd by a great number of experiments. Design'd for the use of all such as have seen, or may see courses of Experimental Philosophy".³⁶

In the preface, or "Advertisement to the Reader", to *Lectures of Experimental Philosophy*, *Desaguliers* clearly deauthorized Dawson's version. In this regard he stated:

"Mr. Dawson (a young Man whom Sir Richard Steele had put under my Care) took a Copy of the Lectures above-mentioned, that they might be of Service to him when he went thro' my Courses, and they were afterwards sold and published without my knowledge".³⁷

Desaguliers also stated he was "obliged to give an Account of the following Lectures, to serve as Apology for their appearing before [he] designed to publish them"³⁸. A short while later he engaged in the translation of a book by Willem s'Gravesande's (1688-1742) from Latin to English, which was published in two volumes, in 1721 and 1722 respectively, with the title *Mathematical elements of natural philosophy confirmed by experiments, or an introduction to Sir Isaac Newton's philosophy*.³⁹

Due to his many religious and Masonic activities, as well as to the various courses he taught among other intellectual tasks, *Desaguliers* had little time to prepare a more detailed work, which would have afforded his students, and the public in general, a more detailed explanation of mechanical, hydrostatic and optical principles, as well as of the 'System of the World' in the light of the Newtonian theories, with experiments that could demonstrate the indented 'veracity' of such theories. However, he did have time to write a poem entitled *The Newtonian system of the world, the best model of government: an allegorical poem* in 1727, shortly after the death Newton, which was published the following year, being dedicated to another aristocrat and the godfather of one of his children, Archibald Campbell, "the Right

³⁵ *Ibid.*; original emphasis.

³⁶ John T. *Desaguliers*, *Lectures of Experimental Philosophy. Wherein the Principles of Mechanicks, Hydrostaticks and Opticks, are demonstrated and explain'd by a great number of experiments*. 2nd ed. (London: W. Mears, etc., 1719), A-5.

³⁷ *Ibid.*

³⁸ *Ibid.*

³⁹ Willem J.S. 's Gravesande, *Mathematical Elements of Natural Philosophy Confirmed by Experiments, or an introduction to Sir Isaac Newton's philosophy*, transl. Jean-Theophile *Desaguliers* (London: J. Senex & W. Taylor, 1720-1721).

Honourable The Earl of Ilay".⁴⁰ Although Desaguliers' main aim was to celebrate the coronation of the new monarch, George II, the home to his friend and godfather of one of his children was explicit in the title and body of the poem. Desaguliers sought to celebrate the ascension of George II by exalting the beauty and harmony of the Newtonian system of the world, which needed to be extended to the political world and society at large, in other words "an explicit application of [Newtonian] physics to politics", according to the historian Roy Porter.⁴¹ In the views of another historian, Pierre Boutin, "the Newtonian epistemological model, in relation to gravitation and optics, achieved such success that it gave rise to the spread of Newtonianism throughout the human sciences"⁴². This intention became much clearer in the explanatory introduction to the poem, which reveals both the natural and experimental philosopher and the mason, in which Desaguliers considers "*Government as a Phaenomenon*" in terms very similar to the "Natural Government of our System, according to the Laws settled [by] the *All-wise* and *Almighty Architect* of the Universe"⁴³. He also added:

"The *limited Monarchy*, whereby our Liberties, Rights, and Privileges are so well secured to us, as to make us happier than all the Nations round about us, seems to be a lively Image of our System; and the Happiness that we enjoy under *His* present MAJESTY'S Government, makes us sensible, that *ATTRACTION* is now as universal in the Political, as the Philosophical".⁴⁴

It appears that only in the beginning of the 1730s, when he reduced his religious and Masonic activities, did Desaguliers have the time to devote himself to preparing the magnum opus he had promised and which his friends and admirers were anxiously awaiting. His initial plan, following his practice as independent lecturer, was to publish two large volumes with the content of the 12 classes of his course in mechanical and experimental philosophy, containing a detailed description of the experiments carried out, drawings of equipment and machinery, with their description, as well various necessary appendices. In 1734, after many delays, Desaguliers published the first volume of his intended magnum opus, entitled *A course of experimental philosophy* (473 pages and 32 illustrations on copper-plates), containing the first 'five classes' of his course, with the description of the experiments related to such classes. He warned his readers against the unauthorized book Dawson had published in his name in 1719: "I must no omit mentioning, that [...] some Persons published a Book of *Experimental Philosophy* in my Name, without my Knowledge, which they endeavor'd to pass upon the World of my *Lectures*"⁴⁵.

The title page of *A course of experimental philosophy* also informed that the it was "Adorn'd with thirty-two copper plates", that Desaguliers had a doctorate ('LL.D'), was a Fellow of the Royal Society ('F.R.S.') and held the position of "Chaplain to his Grace the

⁴⁰ John T. Desaguliers, *The Newtonian System of the World, the Best Model of Government: An Allegorical Poem* (Westminster: A. Campbell & J. Roberts, 1728).

⁴¹ Roy Porter, *Enlightenment: Britain and the Creation of the Modern World* (London: Penguin Books Press, 2000), 137.

⁴² Boutin, 185.

⁴³ Desaguliers, *The Newtonian System of the World*, iii-iv.

⁴⁴ *Ibid.*, v.

⁴⁵ John T. Desaguliers, *A Course of Experimental Philosophy* (1734), I: [n.p.] (preface).

Duke of Chandos". In the beginning of the volume there is a very long list of "The Names of such Persons, as have encouraged this Work by their Subscriptions", which included aristocrats, professionals, merchants, pharmacists, landholders (esquires) and well-known politicians. At the top of the list (obviously) came the names of "His late Majesty King George the first, His Present Majesty, [and] Her Present Majesty" (George II and Caroline). The work demanded by the publication of the book was complex, and due to its magnitude involved a consortium of the best-known London publishers of books on science or natural philosophy, including John Senex, W. Innys, Richard Manby, John Osborn and Thomas Longman.⁴⁶ The book was dedicated "To His Royal Highness Frederick, Prince of Wales", with the following words, which must have helped to his future appointment as Chaplain to the more restricted circle of the Prince of Wales:

"To contemplate the Works of GOD to discover Causes from their Effects, and make Art and Nature subservient to the Necessities of life, by a Skill in joining proper Causes to produce the most useful Effects, is the Business of a Science, the Grounds and Principles of which, I have the honour to lay at Your Royal Highness's feet".⁴⁷

As in previous publications, in the preface Desaguliers emphasized that the book was for those "little vers'd in Mathematical Sciences" and presented the methods used in his classes, also followed in the preparation of the book:

"As the greatest Part of my Auditors, at whose Desire I have printed this *Course*, are but little vers'd in Mathematical Sciences; the *Lectures* are free from difficult *geometrical Demonstrations* and *algebraical Calculations*; and the same thing is often prov'd by several Experiments; that where one does not immediately strike with a clear Conviction, another may. I only require Attention and common Sense, with a very little *Arithmetick*, in my Readers, to qualify them for understanding these *Lectures*; provided they begin the first *Lecture*, and go on regularly, that they may advance from the easiest Truths to those more complex ones, which are deduc'd from them; for otherwise many things may seem difficult to a Person, who should open the Book at random; especially great Part of the last *Lecture* of this *Volume*, which yet may be clearly understood by all, who have made themselves Master of what goes before".⁴⁸

Desaguliers also argued that although in "Newtonian Philosophy" the truth was supported by Mathematics, the corresponding "physical discoveries" could be communicated to the public without having recourse to it. Moreover, a series of "machines" had been developed "to explain and prove experimentally what Sir *Isaac Newton* has demonstrated mathematically". In addition "several of his own Experiments are shewn in publick *Courses*", which allowed "a great many Persons [to] get a considerable Knowledge of *Natural Philosophy* by Way of Amusement", being thus led to a more thorough study of mathematics and becoming "eminent Philosophers". The main example mentioned by

⁴⁶ *Ibid.*, [n.p.].

⁴⁷ *Ibid.*, A-2 and A-2r.

⁴⁸ *Ibid.*, [n.p.] (preface).

Desaguliers is Locke, who had become a Newtonian without having deep understanding of mathematics.⁴⁹

On the other hand, the importance of ‘Facts’, their recognition through ‘Observation’ and ‘Experimentation’ and mathematical foundations were fully reaffirmed and supplied the real meaning of the knowledge on natural philosophy:

“All the Knowledge we have of Nature depends upon Facts; for without Observation and Experiments, our natural Philosophy would only be a Science of Terms and an unintelligible Jargon. But then we must call in Geometry and Arithmetick to our Assistance, unless we are willing to content our selves with natural History and conjectural Philosophy. For, as many Causes concur in the Production of compound Effects, we are liable to mistake the predominant Cause, unless we can measure the Quantity of the Effects produc’d, compare them with, and distinguish them from each other, to find out the adequate Cause of each single Effect, and what must be the Result of their joint Action”.⁵⁰

After this reflection, Desaguliers could not help but return to one of his (and all Newtonians’) preferred intellectual exercises, which was to perform strong criticism of René Descartes’ (1596-1650) theories, pejoratively called a ‘philosophical Romance’. According to Desaguliers, Cartesian theories helped overcome the hegemony of “Aristotelian Physicks”, but were incapable of offering a new consistent and convincing interpretation of the natural phenomena. In this regard Desaguliers stated:

“When *Mons. Des Cartes’s* philosophical Romance, by the elegance of its Style and the plausible Accounts of natural *Phaenomena*, had overthrown the *Aristotelian Physicks*, the World receiv’d but little Advantage by the Change: For instead of a few Pedants, who most of them, being conscious of their Ignorance, conceal’d it with hard Words and pompous Terms; a new Set of Philosophers started up. Whose lazy disposition easily fell in with a Philosophy, that required no Mathematicks to understand it; and who taking a few Principles for granted, without examining their Reality or consistence with each other, fancied they could solve all Appearances mechanically by Matter and Motion; and, in their smattering Way; pretended to demonstrate such things, as perhaps *Cartesius* himself never believ’d; his Philosophy (if he had been in earnest) being unable to stand the Test of the Geometry which he was Master of”.⁵¹

For Desaguliers only the Newtonian mechanical and experimental philosophy could provide the answers to human questions about natural phenomena and lists the principles ‘discovered’ by Newton in natural philosophy, which included “the universal Laws of attraction”, “the true Figure of the Earth” and “the true Nature of Light and Colours”, which were subjects explored more thoroughly in his classes together with the necessary experimental demonstrations. Desaguliers did not deal with “*Sir Isaac Newton* noble

⁴⁹ Ibid., [n.p.] (preface).

⁵⁰ Ibid., [n.p.] (preface).

⁵¹ Ibid., [n.p.] (preface).

Invention in pure Mathematicks, justly admired at home and abroad; because, tho' they have been of great use in the discovery of the Causes of natural *Phaenomena*, they are foreign to my present Subject, which is *Physics* (...).⁵²

The five classes in the first volume of *A course of experimental philosophy* included the following subjects: Class 1 – General notions about the subject (force, movement, attraction, retraction, etc.); Class 2 – The movement of bodies and amount of motion in bodies, “The *Momentum* or *Quantity of Motion* in Bodies (sometimes call'd simply *Motion*) is that force with which Bodies change their Place”; Class 3 – “Simple Machines” or “Organs”, “call'd by some *Mechanical Faculties*, or *Mechanical Powers*”, which were seven: “the *Balance*, the *Leavers*, the *Pulley*, the *Axis in Peritrochis* (or Axle in the Wheel), the *Inclin'd Plane*, the *Wedge*, and the *Screw*”; Class 4 – “Concerning the Friction in Mechanical Engines”; Class 5 – “Concerning Sir Isaac Newton's three *Laws of Motion*” and “several Corollaries or Consequences from them”, illustrated “by Experiments”. At the end of the volume, there is a supplementary text entitled “Description of the Planetarium”, concerning an instrument created by Desaguliers “to shew the Motion of the heavenly Bodies”.⁵³

The second volume of *A course of experimental philosophy* (568 pages and 46 additional illustrations) was published only in 1744, the same year as the death of the author, and contained the remaining “seven classes”, as well as detailed descriptions of the experiments carried out and drawings of equipment and machinery, with their description. Among the publishers were W. Innys, M. Senex and Thomas Longman, who had a tradition of publishing scientific or natural philosophy books. Once again the title page states the book was “Adorn'd with forty-six copper plates” and that Desaguliers had a doctorate (*LL.D.*), was a Fellow of the Royal Society (*F.R.S.*), “Chaplain to His Royal Highness Frederick, Prince of Wales” and a former lecturer at “*Hart-Hall (now Hertford College) in Oxford*”. In the beginning of the volume a list of subscribers is presented, with the same format as the one in volume I, including individuals in the same social and professional categories preceded by “His Late Majesty King George the First, His Present Majesty, Her Late Majesty” (George II and Caroline, who had already died). Among the subscribers (probably the one with lower purchase power) were people who had paid 18 shillings for printing, and others who had acquired it for one guinea, with the right to binding and a hard cover. Desaguliers dedicated the second volume also to the Prince of Wales, now his main patron, declaring himself to be his “most oblig'd, most Humble, and most Devoted Servant, Chaplain, and Experimental Philosopher”.⁵⁴

According to Desaguliers, the second volume had “more need of an Apology than a Preface, upon many Accounts”. The first was related to the great delay in the publication of the second volume, 10 years after the first one. Although the health problems that Desaguliers suffered in the second half of the 1730s and beginning of the 1740s were well known, he did not blame them for the delay, but rather not having immediately kept the “Promise I made in my First Book to decide the Question about the *Force of Bodies in Motion*,

⁵² *Ibid.*, [n.p.] (preface).

⁵³ *Ibid.*, 43, 88, 284, 430.

⁵⁴ John T. Desaguliers, *A Course of Experimental Philosophy, Adorn'd with forty-six copper plates*, volume 2 (London: W. Innys, M. Senex and T. Longman, 1744), [n.p.], vii.

which has now been a subject of Dispute about 59 Years". This 'Question' tormented Newtonians in various European countries, with the Force of Bodies being understood in Germany, Italy and Holland as "the Product of the Mass into the Square of the Velocity of the Body", while in England and France it was conceived of as the "the Product of the Mass into the simple Velocity".⁵⁵

After reading a recent republication of s'Gravesande's book,⁵⁶ which had been recommended to him by his friend Pieter van Musschenbroek (1672-1761), Desaguliers finally made a decision without taking either side, but indicated a third alternative, by stating that both sides were correct in regard to the centrality of their arguments, but mistaken in their criticism of the opposing arguments. For him that was a "Dispute about Words", since the two sides gave distinct meanings to the word 'Force'. His explanation is as follows:

"I could not quit my Conviction in favour of the old Opinion, as it was supported by Demonstration; but yet could not find any want of Accuracy in several of the Experiments I examin'd, which were made to prove the new Opinion: neither could I find any Fallacy in the reasoning from those Experiments; tho' I thought it must be want of Penetration in me that I could not perceive it, supposing that both Opinions could not be true. At last, as I was often blam'd for not publishing my second Volume, I resolv'd to satisfy my Subscribers, and to mention the principal Arguments and Experiments alledg'd for both Opinions; but my Friend Professor *P. V. Muschenbroek* sending me word, that he begg'd I would postpone publishing my second Volume till I had read Dr. *sGravesande's* last Edition of his Philosophy; I complied with his Desire, and examining every thing again with Care, found that the Philosophers on both Sides were right in the main; but only so far wrong, as they attributed to their Adversaries Opinions, which they had not: and that the whole was only a Dispute about Words; the contending Parties meaning different Things by the Word *Force*. If I have succeeded in reconciling this Matter, the Professor *Muschenbroek* deserves the Praise of it, by whose Love of Impartiality I was prevail'd upon to examine all the Arguments anew".⁵⁷

Desaguliers was raising a problem of definition in physics which would still take some time before it was solved and seemed to have found a more satisfactory alternative to the problem by calling it a "Dispute of Words", since among the natural and physical

⁵⁵ *Ibid.*, v.

⁵⁶ Desaguliers refers to s'Gravesande's book the first edition of which he had translated into English (published in 1720-1721) and then published a number of times in English with the title *Mathematical Elements of Natural Philosophy Confirmed by Experiments, or an introduction to Sir Isaac Newton's philosophy*. Probably the Latin version, mentioned by Musschenbroek and consulted by Desaguliers, was the sixth edition (revised and modified), the English translation of which was published in 1747 in London. Musschenbroek was also the author of an explanatory compendium of Newtonian philosophy, originally published in Latin in 1726 and translated into English in 1744, entitled *The Elements of Natural Philosophy. Chiefly intended for the use of students in universities*, transl. John Colson (London: J. Nourse, 1744).

⁵⁷ Desaguliers, *A Course of Experimental Philosophy* (1744), II: v-vi.

philosophers of his time, especially the two mentioned groups (Germans, Dutch and Italians, on the one hand, and English and French on the other), there was no consensus about the use of the term 'Force', because the definition of this physical quantity was not univocal. There was much confusion between two different physical entities or magnitudes, both of which were called 'Force', but identified as 'Living Force' [mv^2 or Velocity Squared] and 'Quantity of Movement' [mv]. Therefore, there was not one single definition of these two magnitudes or entities, such as the notion of 'Force' itself, allowing for the unification of this conceptual field.⁵⁸

One further apology was linked to another (unfulfilled) 'promise', i.e., that the second volume would have a section on optics. For lack of time or a decision he had made upon the publication of the second volume, Desaguliers decided to "leave no room for the Opticks", excluding it totally. He alleged that "the Treatise of Opticks, I design'd to publish, was only intended to be easy and popular". For this reason he recommended the book on the subject "publish'd by the Reverend and Learned Dr. [Robert] Smith, Master of Trinity College in Cambridge". According to Desaguliers people interested in an easier or less detailed approach could find in Dr. Smith's book "that Part which he [called] *Popular Opticks*", which would "give them full Satisfaction". He also indicated that his newest contributions to optics, as well as his "explicit Descriptions of making several of Sir Isaac Newton's Experiments to make them easy in the Execution", could be found in several issues (348, 360, 361, 374 and 406) of the *Philosophical Transactions*, published by the Royal Society.⁵⁹

The seven classes covered in the second volume of *A Course of Experimental Philosophy* dealt with the following subjects: Class 6 – "Concerning the Congress of Bodies" or "of the Effects arising from the Stroke of Bodies that come against each other in the same, opposite, or oblique directions, and under various Circumstances"; Class 7 – "Hydrostaticks", covering "the Effects of the Gravity, Pression, Resistance, and Motion of fluid Bodies; whether are incompressible, as *Water*, or compressible, as *Air*: as also the Action of Solids on Fluids, and Fluids on Solids"; Classes 8 and 9 – "Hydrostatics", with the description of a large number of experiments about fluids; Class 10 – "Hydrostaticks", which although also covered subjects related to pneumatics also dealt with "A further Consideration of the Nature of the Air; in respect to several of its properties, which we have not yet taken notice of", including experiments related to these proprieties and the description of the machinery and instruments used in them; Class 11 – "Hydrostaticks", with considerations and descriptions "Of the Air-Pump, Condensing Engines, and Wind-Gun"; and Class 12 – "On Engines, especially Hydrostatical and Hydraulick Machines". The second volume also had a

⁵⁸ In the 18th century, among the references of classical mechanics, the notion of the 'quantity of motion' (mv) came to be understood as 'linear momentum', while the notion of 'living force' (mv^2 or velocity squared) came to be conceived, in the first half of the 19th century, as 'kinetic energy'. This footnote and the paragraph to which it refers were prepared based on observations made by Prof. Dr. Carlos Alvarez Maia, Department of History, State University of Rio de Janeiro, who I would like to thank for his valuable clarifications related to physics.

⁵⁹ Desaguliers, *A Course of Experimental Philosophy* (1744), II: vi-vii. Desaguliers alludes to a book by Dr. Robert Smith entitled *A Compleat System of Opticks in Four Books, viz. a popular, a mathematical, a mechanical, and a philosophical treatise* (Cambridge: [s.n.e.] No publisher, 1728).

post-script entitled “Air changed, purified, and conveyed from Place to Place, by the Author”.⁶⁰

By excluding optics from the second volume Desaguliers sought to give more space to more complex and sophisticated machinery in his last two classes. In addition, subjects related to applied mechanics were becoming a major obsession in England in the middle of the 18th century, within a climate of ‘fascination’ for the emerging ‘applied technology’, as highlighted by the historian Paul Langford.⁶¹

In the twelfth and final class, Desaguliers explored in more detail the new world of applied mechanics, which was beginning to open up to the British; he addressed the nature of hydrostatic and hydraulic machinery, which were the most complex of his time, described them meticulously and presented a history of their development. It is worth noting that Section XIV of this class presents a history of the first steam-driven machine or engines, called ‘fire-engines’ in the 18th century, from the initial experiments of Marquis of Worcester (1601-1667) at the beginning of the 1660s, passing through the engines built by Thomas Savery (1650-1715), Thomas Newcomen (1664-1729) and John Cawley (1663-1717), and the more advanced ones built by Joshua Haskins (?) and Richard Newsham (d. 1743), whom he had met before his death.⁶²

Between patronage and the market: conclusion

John Theophilus Desaguliers truly carried out intensive and varied experimental activities on which was based not only his work as independent lecturer of natural philosophy, but also all his intellectual production, materialized in a set of publications that included books, booklets publicizing his courses and articles published in *Philosophical Transactions*. The first volume of *A course of experimental philosophy* was republished in 1745, in a second edition revised and updated by the author himself, while in 1763 the two volumes were republished based on the editions from 1744-45.⁶³ The two volumes of *A course of experimental philosophy* were much sold by English booksellers in the middle of the 18th century and one might say that it became an almost obligatory reference work for the public in general and those interested in the industrial application of the principles elaborated by the Newtonian mechanical and experimental philosophy.

On the other hand, Desaguliers’ proximity to members of the aristocracy and monarchical circles of power, as well as his friendship and godfather relationship with Newton were fundamental for the development of his philosophical-scientific and religious

⁶⁰ Desaguliers, *A Course of Experimental Philosophy* (1744), II: 1-95, 96-143, 144-184, 185-248, 249-374, 375-411, 412-555 and 556-568.

⁶¹ Paul Langford, “The Eighteenth Century (1689-1789)”, in *The Oxford History of Great Britain: Vol. 4 The Eighteenth Century and the Age of Industry*, ed. Paul Langford et al. (Oxford: Oxford University Press, 1992), 1-71 (see especially 44).

⁶² Desaguliers, *A Course of Experimental Philosophy* (1744), II: 465-6.

⁶³ *Ibid.*, *A Course of Experimental Philosophy*, volume 1 (London: W. Innys, 1745) and 2 volumes (London: A. Millar, 1763).

activities, allowing him a very tranquil life from the financial point of view. Furthermore, the support and sponsorship of the Duke of Chandos, the Prince of Wales and other influential aristocrats made the publication of his books possible, especially the two volumes of his most important work, *A course of experimental philosophy*.

Desaguliers' personal trajectory to a certain extent reflects the crossroads of modern science, and of many who devoted themselves to it, who were in the middle of a process of transition from an aristocratic society based on values of nobility and on patronage relations to a new society that produced and consumed material and cultural goods that increasingly assumed the characteristics of merchandise. One of the grounds of this new mercantile-capitalist society was the autonomy or freedom of producers or providers of services, who offered their 'products' to consumers also autonomous, free and willing to buy these products. However, the overcoming of the old social order would still take a while and to consolidate only in the 19th century, with the help of the experimental and applied science advocated by Desaguliers and that was part of the basis of England's transformation into the first industrial world power.