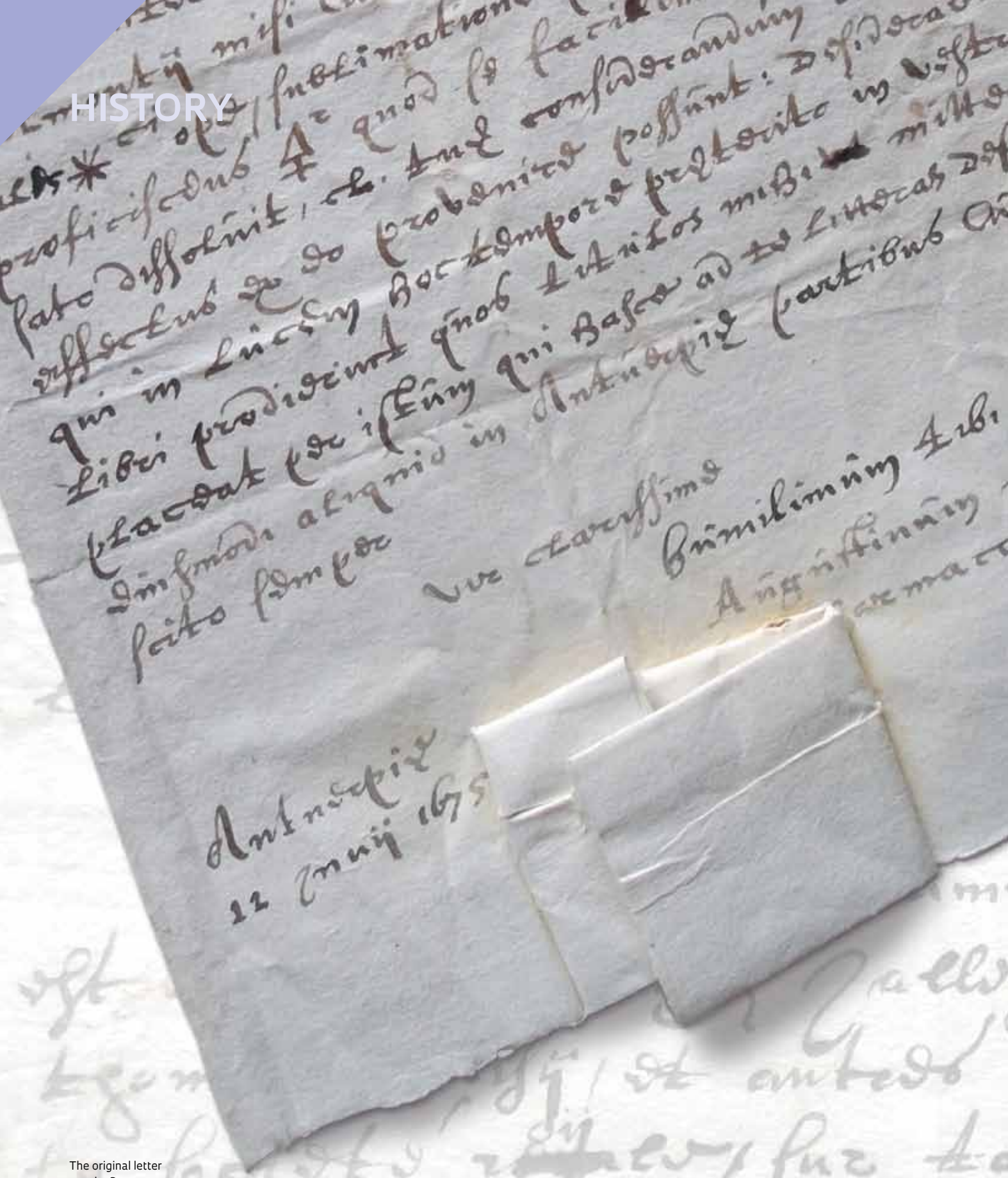
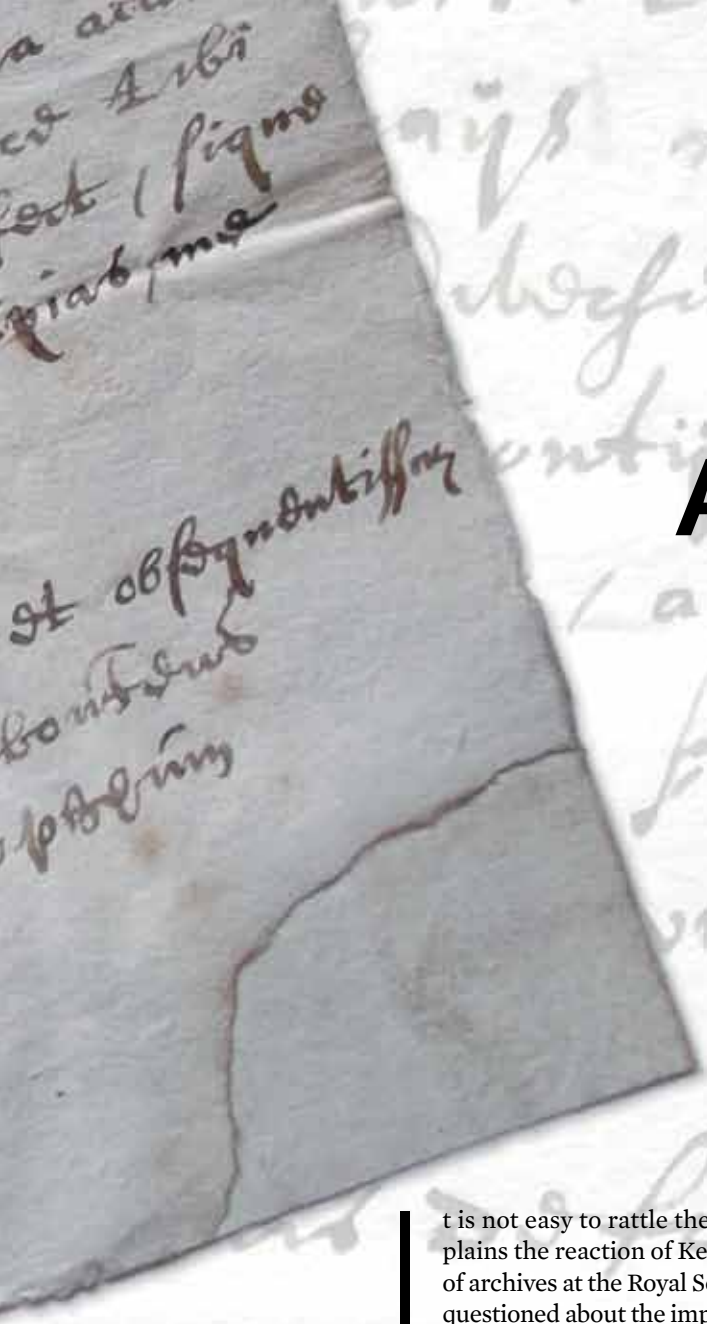


The original letter sent by Boutens to Oldenburg, showing the small closed envelope



An inconvenient pinch of magic

Brazilian researchers discover alchemical powder in an archive at the Royal Society, the seat of the scientific revolution

Carlos Haag, from Londres

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It is not easy to rattle the British, which explains the reaction of Keith Moore, director of archives at the Royal Society, when he was questioned about the importance of the findings of researchers Ana Maria Goldfarb and Márcia Ferraz, from the Simão Mathias Center of the Pontifical Catholic University of São Paulo (Cesima PUC-SP). Raising his eyebrows, Moore cautiously replied, "It was right under our noses, but nobody found it for 350 years."

He was referring to a pinch of yellowish powder with a pungent odor, wrapped in a small envelope attached to a letter from 1675 that was addressed to the first secretary of the Royal Society, Henri Oldenburg (1515-1677), who came from Antwerp. The letter had been sent by an apothecary and alchemist named Augustin Boutens. Although it attracted no attention, it is a valuable and concrete sample of alkahest, the famous universal solvent that was the target of searches by generations of alchemists and natural philosophers, such as Robert Boyle and Isaac Newton.

In 2010, the duo revealed the only complete recipe for alkahest, from 1661, in a thematic project that was supported by FAPESP ("The secret agenda of chemistry," Pesquisa FAPESP *184*). They have now found what they say is "the first real sample of the compound *Ludus*, an alkahest, which we have been hearing about since the seventeenth century." What is this powder?

The Royal Society wants the sample to be analyzed by one of its fellows, such as Martyn Poliakoff (*see interview on page 25*), vice-president of the institution. "Despite our personal curiosity, as researchers of science history, we have no intention of going to a laboratory to try to find out what this powder is in today's terms," says Márcia. "What's important is the discovery of further strong evidence that a substantial portion of the ancient sciences, such as alchemy, persisted after the appearance of a new view of science (and even played a part in the formation of it), remaining on the agenda of the figures who promoted the scientific revolution from which modern chemistry originated. There's a little-known story that says that this passage was gentler and more coherent and only ended in the nineteenth century," says Ana.

PHOTOS JOANNA HOPKINS/ROYAL SOCIETY

The paradox of the slow evolution

Various waves competed during the rise of modern science, the result of a slow passage that only ended in the nineteenth century

Lavoisier
Seen as the apex of new science, he was the result of a long process and many visions, which resulted in the modern standard laboratory

EIGHTEENTH CENTURY

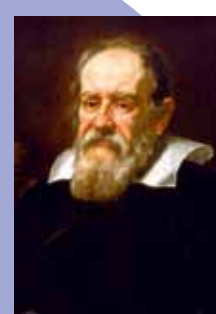
Isaac Newton
As an exponent of reason, he was a natural philosopher who brought together rationality and hermetic beliefs in a way that few others did

SIXTEENTH AND SEVENTEENTH CENTURIES

Robert Boyle
A hermeticist who converted to being a mechanist, he created greater distance in the division between the two views

Hermeticists
A heterogeneous group of philosophers of nature, along with alchemists and neo-Platonists, whose view of the world included magic and charms

In common
Anti-Aristotelians; experimentation with and observation of nature; science and religion supporting each other; practical knowledge



Mechanists
Division between the inanimate world and live matter

Aristotelianism

ANTIQUITY

Above all, the story confirms the researchers' belief that investigating the history of science means rolling up one's sleeves and facing the dust of centuries that has accumulated on original documents in an attempt to breathe life into them. To Moore's surprise, the document passed through the hands of historian Marie Boas, who was responsible in the 1960s for cataloguing the correspondence of Oldenburg, for fifteen years the "the jack of all trades" of the Royal Society. When she came across the small envelope, Marie merely noted "a sample of what appears to be pyrite, attached to the text."

"Marie's work is impeccable, but thinking like many did at the time, she ignored the possible alchemical interests of the 'new scientists,' and so she ended up not investigating the hermetic character of Oldenburg's letters, which sometimes included 'cleaning up' the past and unrecommended interventions," Ana explains. "This finding expands the view that chemical philosophy did not die with the triumph of the mechanical and corpuscular view. Knowing that they were still after materials like Ludus and alkahest proves this and adds further important names to the list of those who undertook these searches, even some who thought they had been converted to rationalism and, even more, to the mechanicality of the seventeenth century," explains Pyio Rattansi, professor emeritus at University College London. He revealed the importance of hermeticism and the Bible in the scientific works of Newton, who had previously been seen as the 'patron saint' of modern science. "Besides him, other 'men of reason' had 'hidden agendas' that discreetly included alchemical processes," says Ana.

This revision of the history of science only came to light when, despite the "siren song" of technology, researchers saw the limitations of digital catalogues and began delving directly into the "closed bottoms" of the archive, much to the initial incredulity of the British. "It was clear to us that it was necessary to understand the thinking of the men of science of that time. There was a type of duality toward any new facts. On one hand, there was the need to keep them secret because many were veritable state secrets, especially when dealing with laboratory materials or processes. On the

PHOTO REPRODUCTION

other hand, there was a maxim (which is, incidentally, still upheld) of new science that advocated knowledge [being] prepared by many and within the grasp of everybody," says Ana. "Many people have itchy palms and want to get their hands on this knowledge, and who knows what they will do to have it published," wrote Newton to Oldenburg in 1676. The "intricate adventures" required of researchers to find the recipe for alkahest were the result of this view.

Henri Oldenburg: secretary of the Royal Society, centralized all information for the institution and was one of the pioneers of scientific standards

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'After the initial document discoveries, we considered everything relating to alkahest in the Royal Society clear and visible," says Márcia. This was true until they found the mysterious letter from Boutens to Oldenburg. "Years have gone by since I sent a good quantity of *Ludus helmontiano* to you, from which I produced the sulfurous material I enclose below. I trust in your wisdom to understand what effects it produces." The reference to the clay-like mineral attracted the attention of Ana and Márcia. After all, *Ludus* was the basis of a recipe for *liquour alkahest* produced by the Belgian doctor Van Helmont (1579-1644), who dedicated his life to studying the obscure works of Paracelsus to produce what would be the "remedy for all diseases." Capable of dissolving any substance without leaving a residue (because the substance would be reduced to its primary constituents), *alkahest* could be the source of powerful remedies, especially against the "ills of the stone," renal lithiasis (i.e., kidney stones), the incurable cause of many deaths until the nineteenth century.

"According to Van Helmont, it was possible, for example, to create medicine to fight urinary calculus by dissolving *Ludus* in alkahest, not so much because of the mineral but because of the capacity of alkahest to transform it into the source of a cure. Everything was the result of millenary thinking: the solvent was a gift from God when the world was approaching its end," explains historian Paulo Porto, a professor from the Institute of Chemistry at the University of São Paulo (USP). *Ludus* functioned like the plastic capsule that today forms the shell of a pill, allowing for the gradual diffusion of medication into the organism. The dilemma for alchemists was to guarantee that alkahest dissolved gradually and did not kill patients in the attempt to cure them. "Since the 1640s, the main objective of English science had been to prolong the life of people, and alkahest prepared with *Ludus helmontiano* was the medicine indicated for this," says Paulo. For many of his contemporaries, King Charles II created the Royal Society to bring together the greatest minds of the age to produce "the great remedy."

The researchers felt the digital catalogues had some limitations and delved into the secret archives, despite the initial incredulity of the English

Because of this goal, the letter aroused the suspicion of the researchers. "How to understand, regarding this 'great remedy,' which had been sought for years, that there were no records in the minutes of the Royal Society about the arrival of a sample of one of its components? Everything indicated that we were looking at a 'secret' that was valuable to the fellows of the institution," says Márcia. It was necessary to understand the relationship between Oldenburg and Boutens. The first clue was a letter from September 1667 written by Boyle immediately after the secretary had left prison, where he had been jailed because of his "excessive" contact with people abroad. It was soon discovered that intense correspondence was part of his work. Oldenburg exchanged correspondence with anyone who might have known, or who knew someone who had known, some

1 Brazilian researchers sitting in a research room at the Royal Society

2 Interior of the institution's archives

3 Decree establishing the Royal Society, with an effigy of King Charles II

secret about the "Art." The various spies he spread throughout Europe informed him of any experiments.

The first thing he did after leaving prison was to write the letter to Boyle. "You mention a box that I believe was addressed to me. It's *Ludus* from Antwerp. Feel free to open it and, after, send it to me with your opinion as to whether it is genuine *Ludus*." Several subsequent letters, with the same tone of humble supplication, were not sufficient for Boyle to honor his request, and Oldenburg never laid hands on the precious box. The archives gradually revealed the links between the secretary and Boutens, the alchemist from Antwerp. In November 1667, Oldenburg wrote to the alchemist, "I learned from a friend in Paris [certainly one of his spies] about your great predisposition to curiosity and your special inclination towards the solid philosophy that is based on the observation and experiments we are trying to establish here in the Royal Society. I was also informed of your untiring attempts to discover the secrets of nature by the good path of chemistry."

The epistolary seduction goes further. "I'd like you to know that the English admire chemical operations carried out by men of good sense who are free from the common prejudices imposed worldwide by the some people who intend to talk dogmatically without any preliminary critical experimentation, as the excellent Mr. Boyle found it necessary to do in his *Sceptical chymist* (1661)," he continues. "We know that there is *Ludus helmontiano* in abundance in your region: I would earnestly ask you to send it to us in London by sea." In December, the reply arrived from Boutens: "I'm going to send more than 70 kg of *Ludus* with a description of the method I use to make the remedy." The payment from the impoverished Royal Society was made in books that were much sought after by alchemists. The letter was enthusiastically received by the members of the Royal Society, as was another letter written by Boutens some months later, describing the places Ludus could be found. This correspondence, however, was not continued, and only in June 1675 did another letter from Boutens appear: the one attached to the sample of the "extremely secret powder."

Oldenburg, however, did not reply to the letter. Initially, the researchers attributed this atypical attitude of the secretary to excessive work. However, they discovered another reason. Francis Mercurius, son of Van Helmont, was in England during the same period and clearly had knowledge of his father's many secrets; he even brought samples of his materials with him. Junior, as he was known, quickly grew close to the great English academics. Through Henri More, he became the mentor of Lady Anne Conway, a victim of terrible migraines that Harvey was unable to cure. In addition to More and Ralph Cudworth, Anne's circle included leaders of the Platonists from Cambridge and an experienced laboratory man, Ezekiel Foxtrot, a friend and collaborator of Newton. "What united them was a concern about the radical skepticism of the period, which they tried to combat with 'rational' acceptance of Biblical prophecies mixed with millenary views. To justify the new skeptical scientific universe, they assumed the ideal that they lived in times like those described in the books of Daniel and Revelation,"

For Rattansi, the findings mean that the intellectual origins of sixteenth- and seventeenth-century science must be revised

observes Rattansi. Daniel believed that knowledge would increase as mankind approached its end. This was the daily reality of the seventeenth century and is present in the dialogue of Junior and Lady Conway. The two ultimately converted to the Quaker sect; Quakers were notorious millenarians and supporters of these ideas.

Junior took to England samples of his father's secret materials, among which were pieces of the precious Ludus. One of these pieces was given to Foxtrot, who passed it on to Newton, who gave it to the naturalist John Woodward. "Newton gave me a piece of material brought from Germany by the young Helmont as being the true Ludus from his father, which in my view is in no way different from what is found here in England," the disbeliever noted. Newton's interest in alkahest and other alkahest-like materials was profound, and this interest is now apparent. What of the box sent to Oldenburg years before? "Boyle took it and handed it to Locke, one of his favorite men in the laboratory, for him to analyze," says Ana.

"Such revelations expand the spectrum of the complex link of the English circle with nascent science and the debates that were going on, such as those between the empiricists and rationalists, begin to lose sense," affirms Rattansi. According to the professor, the findings oblige us to revise the intellectual origins of the sixteenth and seventeenth centuries. "Aristotelian science was discredited as being sterile. There was then a split between 'mechanistic philosophy,' based on Galileo and Descartes, and heterogeneous groups of 'nature philosophers,' especially the neo-Platonists and hermeticists. The differences between the groups was not very strong: they were anti-Aristotelian; they advocated observation, experimentation and experience, to the detriment of abstract thinking; they preached that science and religion supported each other; both dreamed about improving and spreading knowl-

1 Façade of the Royal Society in London

2 Second-floor hall, with the door to the library

3 The institution's seal, with its motto *Nullius in verba*: one cannot trust words alone but experiments

edge about nature for practical purposes," the professor noted.

However, although one group believed that behind all of the changes in nature was the mechanism of matter in movement, others saw these changes as a game of secret sympathies and antipathies acting at a distance. "For the mechanists, there was a division between the inanimate world of matter and that of the soul and intelligence. The hermeticists, on the other hand, believed that everything had life and understanding. In short, the beliefs were divided between those who had a magical and enchanted cosmic view, which was full of prodigious happenings, and the mechanists, who chose to view the world as being sober and disenchanted, being mainly concerned with the daily course of nature," explains Rattansi.

Shortly before the Glorious Revolution, hermetic science took over in England because it contained the ideal of a new natural philosophy as part of a great reformist project. This explains the initial harmony between the powerful currents of revolution and the hermeticists; the Puritans were partly responsible for disseminating this enchanted and reforming view. In times of war, famine and poverty, any current that preached the realization of ways to improve daily life, agriculture, education and health for all had great popular appeal. Therefore, some groups began to preach extensive reform, such as Samuel Hartlib and his Invisible College, supported by the maxims of a Czech, Jan Comenius. Comenius was invited to England, where he wrote extensively about education, employing ideas that combined alchemy and natural philosophy. Among his proposals was the creation of universities in every city. Even Boyle and others who founded the Royal Society and who sympathized with the cause of Comenius began to fear for order and stability in this climate of sectarianism.

England began to be invaded, this time by the new and "sober" doctrines of Descartes and de Gassendi. This invasion included a notable number of conversions to mechanistic science, which began to be appreciated as the most appropriate type of science, a synthesis between theology and natural philosophy. If the Universe was like a machine, this doctrine pointed to its creator. "In seventeenth-century England, it was usual for the study of natural philosophy to harmonize with the mystic and theological view of the world; hence, the worship of Newton. But not just of him, as we now know, but of prisca sapientia, knowledge of the classics that he and others believed to be truths revealed by God to the first inhabitants of the Earth," says Rattansi.

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The archives of the Royal Society are a salutary reminder of the many currents that brought about the scientific revolution of the seventeenth century

Thus, the professor suggests, the researchers' findings reinforce this revisionist perspective of the scientific revolution because even after the acceptance of mechanistic explanations, the problems that attracted the attention of rationalist figures such as Newton and Boyle were the same ones that concerned the hermeticists: transmutation and the alkahest; the action of the powder of sympathy; the influence of constellations on men; and the use of magisterial formulas for medicinal purposes. "What we find in the archives of the Royal Society are salutary reminders of the many currents that competed in the scientific revolution of the seventeenth century. These are reminders about the extent to which the creators of modern science, like Newton, still used the hermetic tradition along with natural philosophy," observes Rattansi.

"Medical problems have always driven interests, and the doctors were always an extensive community. The people who looked at a wider context, such as Isaac Newton, always existed in smaller numbers, even in the seventeenth, eighteenth and nineteenth centuries. For example, in 1820, there were just 100 people on that island to carry out research. Science was not seen as something that could solve the problems of technology or medicine because there was no investment in human capital for working in these areas," remembers historian Frank James, the chairman of the Royal Institution.

In James' analysis, "It's clear that Newton's work on the force of gravity is associated with his experiences with alchemy, precisely because these concepts were not considered in the philosophic thinking of that period. This is why other authors have a problem with Newton's ideas, given that they do not necessarily acknowledge that the origins of his postulates are legitimate. Only Newton knew of the validity of his studies because much was based on his work as an alchemist." Rattansi agrees: "Newton only made his discoveries when he made use of all manner of knowledge, which allowed him to see what the 'rational' thinkers were unable to see."

Historian Michael Hunter, from Birkbeck College, London, sees "exaggeration and inconsistency in these statements. Some individual members may even have dabbled in alchemy or in a search for miraculous cures, but they left this aside when they joined the Royal Society, which outlawed looking for magic to the detriment of the study of natural philosophy, of which the institution was the biggest propagator, publicly," says Hunter. "One must keep in mind that the Royal Society functioned as a corporate entity and played a fundamental role in establishing the boundaries of what was or was not science," he observes. According to Hunter, in the *Philosophical Transactions*' articles, when alchemy was talked about at all, it was addressed tangentially. This was a point of honor for their editor, Henri Oldenburg, who rejected "magic." "We rarely find laboratory investigations linked to alchemy, particularly because the intellectual audience of the time rejected supernatural things, and entering this field would mean tarnishing the reputation of anyone who did it" says Hunter. It is worth remembering, however, that the researchers found a document, written by Oldenburg, listing "the experiments carried out at the Royal Society during the stewardship of Sir Murray," among which was alkahest.

Nevertheless, the most important point in this story, which today might go unnoticed, is the standardization of ways of thinking and operating in the laboratory. "In a world in which alchemy worked with secret theories and prescriptions, each group of academics had different ways of thinking and working with the subject. The work of the Royal Society and Oldenburg, therefore, can be seen as a way of bringing together these disparate groups and establishing standards of work in the laboratory that could be repeated, as modern science preaches," says Ana.

This issue is present in the correspondence of the secretary with the Venetian hermeticist doctor, Francesco Travagino. Oldenburg discovered that his Italian friend had changed common mercury into pure silver, and he wanted the recipe. When Travagino sent it, he bemoaned that he had been incapable of repeating the deed. Oldenburg's reply reveals just how anxious people of the time were to find a modern path for laboratory science. For Oldenburg, one of the greatest difficulties in any procedure was knowing the origin of the material, which was one of the rare parameters. "Just like Boyle, Oldenburg thought about clearly defined standards so that the experiment could be reproduced and universally accepted," observes Márcia. The letters reveal that the first secretary of the Royal Society perhaps had been more than an "intelligencer," exchanging ideas with great figures such as Boyle. As an immigrant who was always viewed with mistrust and aware of his position as secretary, Oldenburg preferred to share his ideas and laboratory experiences with other members of the society. In doing so, he obtained an official position and a better salary.

We move on, then, to a new mystery about the possible swallowing of hermetic preparations by notable figures of the time, with dramatic outcomes. The researchers are investigating history to tell it with documents. ■