Isaac Newton's papers up for sale

By Ann Talbot
26 September 2000

A collection of Sir Isaac Newton's papers has been put up for sale, in what is probably the most important auction of scientific manuscripts for 70 years. The papers date from 1669, the most productive period in Newton's life, when he was developing his calculus and his theories of gravity and optics.

The Earl of Macclesfield, who is selling the papers, has offered Cambridge University the opportunity to buy them rather than putting them up for auction at Sotheby's. Newton studied at Cambridge from 1661 and he occupied the Lucasian chair of mathematics from 1669 to 1701. The university already owns the bulk of Newton's papers, while another collection is kept in the Bodleian Library at Oxford University.

This new collection will enable researchers to throw fresh light on a crucial period in the intellectual development of a man who shaped modern scientific thinking. The plan is to put the papers on public display and to digitise them so that they can be made available on the Internet.

The Macclesfield family stand to make £6.37m out of the sale. The UK Heritage Lottery Fund have promised to fund up to 75 percent of any purchase by Cambridge, with the University itself raising a further £1.6m in the largest public appeal it has ever launched. Dr Patrick Zutshi, the keeper of manuscripts and archives at Cambridge University Library, said that the University was prepared to go into debt to secure the papers; so important did it consider them to be.

The spectacle of lottery funds again going to line the pockets of the wealthy, as they did in the case of the purchase of papers belonging to wartime Prime Minister Winston Churchill, among the first purchases to be made with money from the Heritage Lottery Fund, is an invidious one. This fund has become a subsidy for the selfishness of already wealthy collectors who lack sufficient sense of public spirit to donate what they and their ancestors have hoarded to universities and galleries, so they can be enjoyed and studied by both specialists and the general population.

Lord and Lady Macclesfield have insisted, as a condition for allowing the University to stump up this record sum, that the papers will be known as the Macclesfield collection—preserving a name that is not otherwise noted for its contribution to science. In their private collection, the papers were treated with little regard for either their scientific value or their future preservation. Some of them were stuck into an album with sellotape.

The price tag being put on these papers is an attempt to express their exceptional value in terms of money. In reality they are a priceless resource that cannot be adequately valued by the market. They represent the culmination of a long series of scientific discoveries and protracted philosophical struggles that found their most developed expression in the person of Isaac Newton.

Newton's major achievement was to uncover the natural laws that governed the motion of the planets and the motion of bodies on the surface of the earth. Despite the great transformation that has taken place in physics since the work of Einstein, Newton's equations are still used to determine the trajectory of spacecraft today.

Newton was undoubtedly a genius. What is more remarkable is that he stands out as a genius in a period that was populated with great scientific figures. He was born in the year that Galileo died. He was the contemporary of Boyle (the Irish chemist who worked on gases), Leibniz (German mathematician and philosopher who also worked on calculus), Locke (the English philosopher), Descartes (the French philosopher and mathematician), Gassendi (the Italian physicist), Hobbes (English political philosopher) and Huygens (the Dutch mathematical physicist and astronomer).

He said of himself that he stood on the shoulders of giants. This was indeed the case. His immediate predecessors had made revolutionary developments in science that opened the way for his own achievements. In the generation before Newton, scientists had begun to reject an exclusive reliance on ancient authors such as Aristotle, whose works had been seen as the only authoritative source of knowledge. Instead they began to actively investigate natural phenomena with the help of mathematics and an array of new scientific instruments such as the telescope, the barometer, the air pump, the microscope and the thermometer.

Scientists began to study craft skills, recognising that they needed them to conduct their experiments and that craft workers had derived considerable knowledge of nature through centuries of practical activities. The spread of this new knowledge was facilitated by the printing press, and a new tradition of technical illustration drawn from actual specimens.

The new science transformed the way in which Europeans understood themselves, the world they lived in and its place in the universe. No longer could the earth be seen as the unique centre of the universe. It became one planet among many. Observers looked eagerly at the moon, hoping to see signs of life if only their telescopes could be made powerful enough. The laws of mechanics were discovered and systematised. The human body itself came to be understood almost like a machine, in which the blood was circulated by a pump.

This scientific revolution was intimately connected to the expansion of trade and explorations that took place from the 15th century onwards. The implications of these geographical discoveries were still being absorbed in Newton's day. His library contained a large collection of travel books that described the new continents and the peoples who inhabited them. He himself edited a book dealing with the new geography.

If Newton was the heir to a revolutionary tradition in science, this was also true in a social and political sense. He grew up during the revolutionary struggle against feudal privilege that is known as the English civil war.

Cambridge, where Oliver Cromwell had studied, became a centre of radical and scientific thought. Isaac Barrow the mathematician, who later retired from the Lucasian chair so that Newton could have it, was part of a group of scientists and natural philosophers whose interests reflected the growing challenge to the old scholastic curriculum based on Aristotle.

By the time Newton arrived, conditions were very different at Cambridge. The restoration of the monarchy in 1660 brought about the ejection of all the progressive thinkers that had established themselves there during Cromwell's Commonwealth. Only Barrow remained, and neither science nor mathematics was taught.

Certain historians who want to isolate Newton from the earlier revolutionary tradition emphasise that there is no positive evidence that

Newton and Barrow ever met. But even if Barrow did not introduce Newton to mathematics, which he probably did, the scientific ideas nurtured during the revolution had become too widely disseminated for an intelligent and inquiring mind to ignore. Many of the displaced academics went to London where they continued their scientific activities in the Royal Society. Newton and his contemporaries pursued their scientific interests separately from their official university studies.

Detailed study of Newton's papers has revealed the extent to which he retained ideas associated with the revolution. He espoused an extreme form of Protestantism, which, had it become generally known, would have got him expelled from the university and barred from holding public office. He devoted years of his mathematical ingenuity to deciphering the prophecies that he believed were contained in the Bible. Just like the revolutionaries of the 1640s, he looked forward to the coming of the millennium—the kingdom of God on earth—which he confidently predicted on the basis of his calculations could be expected in the late 19th century.

Newton was the heir to a revolutionary tradition, but he lived his life in a period of reaction when absolutist monarchies were tightening their grip on the Continent. The English ruling class needed conditions of political and social stability if it was to achieve the economic development necessary to consolidate its power at home and establish its position in a world that was characterised by intense competition between rival mercantile powers. From 1660 to 1688 they sought to reach a political compromise that would at once secure them the gains of the revolution while establishing a stable form of government.

Newton played an active part in this process of political consolidation, standing as a Member of Parliament for the University and serving as Warden of the Mint. The English ruling class had men of high calibre to call upon. Newton, Locke and Petty (the English economist) all applied their minds to the economic and political problems of this period. Newton brought the same intellectual rigour that he had employed in scientific problems to reorganising the Mint and establishing the sound coinage that was necessary for his country's economic success.

Despite the constraints of the historical period in which he worked, Newton is impossible to understand without seeing him in the context of the earlier revolutionary events—not least because that revolution had made it possible for scientists in Britain to think and publish much more freely than ever before. Newton still had to be cautious about expressing his heterodox religious ideas openly, but he did not, like Descartes, live in fear of sharing Galileo's fate. The threat of religious persecution impeded Descartes' work and prevented him from ever publishing a clear exposition of his scientific ideas.

The connection between Newton and the revolution of the 1640s goes even deeper than this. He was considerably influenced by group of scientists known as the Hartlib circle, who were drawn to the English revolution because they saw it as an opportunity to develop a new society in which science would be used to eradicate poverty and disease. They proposed that a body should be set up to which reports of all scientific discoveries should be sent so that the knowledge could be made freely available. They took advantage of the lifting of censorship to publish works that were previously only circulated privately in manuscript form, and advocated the reform of education. As the Commonwealth government could not finance their plans, the Hartlib circle set about literally making their own gold by means of alchemy. Needless to say the attempt was not successful.

It was from members of the Hartlib circle that Newton derived his knowledge of alchemy. Newton was familiar with the principles of chemistry. He was fostered by an apothecary while he was at Grantham grammar school and spent his boyhood experimenting with chemicals. But from the 1670s he devoted himself specifically to alchemy, under the influence of surviving members of the Hartlib circle, who included Robert Boyle. Newton corresponded with Boyle until Boyle's death in 1691 and may well have acquired his collection of alchemical texts from other members of the group. Newton continued his researches for two decades and at one point even believed that he had succeeded in producing gold. This passion for alchemy, which has proved such an embarrassment to later historians, shows Newton's connection to the revolutionary tradition of the 1640s.

It took another revolution for historians of science to begin to appreciate how much the bourgeois revolution had contributed to Newton's achievements. A now little known Soviet physicist and historian of science, Boris Hessen, who died a victim of Stalin's purges in 1938, was responsible for giving a new direction to the history of science and the study of Newton. In 1931 he gave a paper at the Second International Congress of the History of Science and Technology in London that set out for the first time an historical-materialist analysis of Newton's life and work [1]. Hessen showed that Newton's scientific work had a material basis in the technological developments and economic imperatives of the time. He established what he called the “earthy core” of Newton's *Principia* that underlay its abstract mathematical form.

His lecture was a seminal influence on many of the historians and scientists present, inspiring them to set the history of science in its wider social context rather than considering its development as though it had taken place in a vacuum. For others, Hessen's paper, whether acknowledged or not, became the target of their attempts to deny that Newton had any connection with economics or technology.

This was no easy task. Newton had spent his boyhood constructing models such as kites, lanterns, dolls house furniture and a perfect working model of a windmill that he had seen built near his home. So closely was Newton's mind attuned to technology that his first response to reading of Descartes' theory that the universe was filled with vortices of atoms was to devise mills that could be worked by these hypothetical sources of power. He became so skilled a craftsman that he invented and built his own reflecting telescope, with tools that he made himself, casting the tube and grinding the mirror to a degree of accuracy that could not be matched by anyone else.

Not only did historians downplay Newton's involvement with technology, but also they glossed over his religious ideas and interest in alchemy. As more of his papers became available for study it became increasingly difficult to square the Newton who was an icon of British empiricism with the Newton that emerged from the documents.

Hessen's approach was different. He attempted to understand the whole man and put the religious and mystical side of Newton's work in its social context. For Hessen this was part of a life and death political struggle with the Stalinist hacks who were attempting to turn Marxism into a mechanical theory from which dialectics was banished.

The new relativity physics and quantum mechanics came under severe attack from Stalin's supporters, who pointed out that Einstein was a follower of Mach, whom Lenin had polemicised against in his *Materialism and Empirio-criticism*. Hessen was publicly condemned as a supporter of relativity and quantum mechanics at a state philosophy conference in 1930. He was compared to the “wreckers” who were then being tried for alleged attacks on Soviet industry and was sent to the London conference so that he would incriminate himself by a defence of the new theories.

Instead, he defended both physics and Marxism from Stalinist perversion by delivering a paper in which he stressed that the Newton who had discovered one of the fundamental laws of motion of the material universe was also a deeply religious man steeped in the mystical traditions of alchemy, who had hoped that his *Principia* would prove the existence of God beyond all doubt. Hessen was able to point to the material forces that lay behind the peculiar amalgam of science and religion that characterised Newton. While he could not openly defend Einstein's theories, he was able to show that it was possible to disentangle the materialistic essence of his scientific work from the ideological influences that he had absorbed from Machism.

Hessen was fighting both for Soviet physics, which was in danger of falling behind the West because of the dogmatic rejection of relativity and quantum mechanics, and for his own life. He and six other members of the eight-man Soviet delegation, including Bukharin who led it, died at the hands of the Stalinist bureaucracy. That Soviet science made great strides in the ensuing period under Stalin's regime is a testimony to the dedication of the generation, which, like Hessen were educated before Stalinism emerged, and who were inspired by the high ideal of creating a socialist society. They recognised that socialism demands the highest development of science and the productive forces. Their conception of science was a lineal descendant of that which had inspired modern science from its inception in the Renaissance. Early scientists envisaged science as a means to change the world, harness natural forces for the benefit of mankind and improve the human condition by the application of reason.

Today there is widespread alienation from science. Treating Newton's papers as a base commodity is an indication of the disdain in which science is held. The claim that science is a force to improve the human condition is often regarded with cynicism. This is in part due to the connection of science with big business and government, who, in their drive for profit, have used it to build weapons of mass destruction and caused serious ecological harm. More profoundly it is due to the damage that Stalinism has done to socialist consciousness. For the present generation there is no obvious connection between science and progressive social ideas, as there was for the generation that came to consciousness at the time of the Russian revolution.

The more thoroughly Newton's papers have been studied, however, the more apparent does this connection between progressive social ideas and science become in his own work and achievements.

The project of creating gold was utopian, as was the plan to eradicate poverty and disease based on the level of scientific knowledge and technological ability that existed in the mid-17th century. At that point, science and the transformation of society were necessarily seen in utopian terms. Today the situation is very different.

Much that could only be dreamt of in Newton's day and still remained unrealisable with the limited resources of a backward and isolated country like the Soviet Union, is now a practical possibility. Modern science is capable of overcoming the scourges of poverty and disease, while the global integration of the economy has mobilised the resources of the entire world. Currently this potential is obscured because the immense capacity of science and the global economy are used to make profits for the giant transnational corporations and to enrich a tiny number of people who control this system. It requires a revival of socialist consciousness for the possibilities to be realised.

Making this collection of Newton's papers available on the Internet and displaying them in an exhibition will refocus interest on Newton and the history of science. It will encourage a rediscovery of the connection between science and progressive social ideas, in a period when there is growing dissatisfaction with the present social order. Lord Macclesfield's attempt to make a few (more) million out of a family heirloom and Cambridge University's bid to preserve the memory of one of its famous alumni may turn out to have a deeper significance than anyone expected.

Note:

1. Science at the Crossroads, Papers from the 2nd International Congress of the History of Science and Technology, 1931. N.I.Bukharin et al., Frank Cass and co. Ltd., London, 1971.
