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Magic and Mathematics at the Court of Rudolph II

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Charles B. Thomas was born near London in 1938, and received his university education in Cambridge and Heidelberg. He has held positions in various universities in Europe and the USA. At present he is Cayley Lecturer in the Department of Mathematics at the University of Cambridge. His mathematical interests include cohomological methods in finite group theory and the interplay between algebraic topology and differential geometry. His interest in history is long-standing; he claims at times to envy the professional historian! One of his greatest moments of satisfaction was overhearing one of his children being asked for his nationality in California and replying "European".

The government I cast upon my brother,
And to my state grew stranger, being transported
And rapt in secret studies.
The Tempest, I.2.74–76.

Die Geistesgeschichte verbindet mit Recht den Beginn der modernen Naturwissenschaft an der Wende zum 17. Jahrhundert mit den Namen von Kepler und Galilei. Neben dem (angeblichen) Ausspruch Galileis "Eppur si muove!" bilden die drei Keplerschen Gesetze der Planetenbewegung dafür ein bekanntes und gern zitiertes Beweisstück. Die herausragende Leistung Keplers verdankt ihr Zustandekommen einer einzigartigen Konstellation von günstigen Umständen am Hofe Rudolf II in Prag. Diese lassen sich allerdings erst richtig würdigen, wenn man sie fächerübergreifend betrachtet. Charles Thomas versucht in seinem Beitrag den dafür notwendigen weiten Bogen zu spannen: Nicht nur von Astronomie, Physik und Mathematik ist hier die Rede, sondern auch von Shakespeare's *Der Sturm*, vom *Corpus Hermeticum* und von den Anfängen der wissenschaftlichen Medizin. Klar wird auch, dass nicht allein die wissenschaftliche Neugier, die Harmonie der Welt zu ergründen, die epochemachenden Erkenntnisse über die Planetenbewegung ermöglicht haben. Am Hofe Rudolf II spielten auch handfeste praktische Gründe eine Rolle. Dazu gehörte insbesondere der Wunsch, genauere Mondtabellen zu erarbeiten, um der eigenen, d.h. spanischen Flotte einen Navigationsvorteil zu verschaffen. — Vielleicht kann dieser sehr weit gespannte Beitrag von C.B. Thomas Anstoss sein, das Thema in der Schule fächerübergreifend darzustellen. Geschichte, Chemie, Physik, Mathematik, Geographie, Latein und Englisch hätten alle etwas Wesentliches zum Verständnis der Zusammenhänge beizutragen. *ust*

The evidence suggests that Shakespeare's last play, from which the lines above are taken, was first performed in 1611. At least some among the audience on that occasion must have noticed the parallel between the fictional events in Milan and the very real events which had recently taken place in central Europe. Here the Emperor Rudolph II had been deprived of the Kingdom of Bohemia by his brother Matthias, retaining little more than his imperial title, and was struggling to retain even this when he died in January 1612. Indeed when *The Tempest* was revived in 1613 on the occasion of the marriage of Elizabeth Stuart to Friedrich V of the Kurpfalz, the "politically aware" could not have helped but recall Rudolph's swing towards the Protestant Union in the last months of his life, identifying Rudolph with the magician Prospero and Elizabeth with his daughter Miranda. Who was this strange Emperor-Magus, who conceivably was being celebrated by Shakespeare in this way, and why did he make such an impact on his contemporaries?

Rudolph was a great nephew of the Emperor Charles V, who had succeeded to the imperial title in 1576, and more importantly to the direct rule of the "lands of the Bohemian crown". He established his capital in Prague, a cosmopolitan city of 50,000 inhabitants of widely varying religious beliefs. The politics of his reign do not concern us directly, except to note that he shared his great uncle's "universalist" conception of the imperial office. This is illustrated by the attempts early in his reign to mediate in the Netherlands conflict, before the battle and confessional lines hardened with the renunciation of Philip II's sovereignty by the United Provinces in 1581. What does concern us however is the Emperor's patronage of late sixteenth century science — a heady mixture of sympathetic magic, search for religious concord and genuine technological innovation. A systematic foundation for these studies was provided by the *Corpus Hermeticum*, a collection of manuscripts from hellenised Egypt, compiled between 100 and 300 AD, but purporting to contain a system of ancient wisdom associated with Hermes Trismegistos, imagined to be a contemporary and perhaps teacher of Moses.

The interests of Rudolph's circle can be seen from the list of contents of the library of the President of the Hofkammer, Ferdinand Hofmann von Grunpichl und Strechau, known to be acquainted with and well-disposed towards Kepler. The library can be assumed to be typical of many, and was preserved intact until recently at Nikolsburg. Rudolph's own library and collections seem to have been largely broken up during the Thirty Years War. It contained a wide theological collection, books on geography, travel and antiquities, medicine and natural science. There were texts in Czech, Hebrew and Arabic, and most significantly an edition of the *Corpus Hermeticum* (published in Cracow) and the *Magna Alchemia* of Leonhard Thurneysser.

As a mathematician one is struck by the fact that the Hermetic texts, or at least their final version, are contemporaneous with the last flowering of Alexandrian mathematics (both pure and applied). For example the Hermetic writers are much concerned with infusing the presence of the Egyptian gods in their statues. Here perhaps we have an echo of the use of steam power, and other mechanical means, to operate temple doors and to make the statue of a god move in such a way as to indicate acceptance of the suppliant's offering.[1] But tricks of this kind apart the writers of the Hermetic texts see the physical world as a reflection of ideas in the divine mind. Since the human mind has something of the divine in it, by understanding the workings of his own mind (essentially by internal reflection) the Magus could understand and even influence the structure of the material world. This teaching, along with much else, had been rediscovered in renaissance Florence, and strongly influenced thinkers throughout Europe up to the beginning of the Thirty Years War. For example it pervades the natural magic of Marsilio Ficino[2], who taught that certain combinations of colours, animals, plants, scents and sounds could influence human behaviour. Later that extraordinary man Giordano Bruno (who spent part of his wandering life in Prague) clearly believed that he could use magic to augment his own undoubted personal charm to influence and even control the action of princes. As in Alexandria these teachings intrigue the creative mathematicians — an early example is Girolamo Cardano, famous for at least contributing to the algorithm for solving cubic equations, but also a highly regarded physician and the author of books with a "hermetic" flavour such as *De Subtilitate Rerum*.

Confident in the Emperor's patronage such "wizards, alchemists, kabbalists and the like" (to quote a hostile report to Matthias and the other Archdukes in 1606) journeyed to Prague, either to visit (like Bruno), or to settle (like the physician Michael Maier, and crucially for the development of science, Johannes Kepler). And here we meet one vital difference between Alexandria and Prague — the artisan is not held at a distance. The magician may start by trying to understand the world by internal reflection, but he is now ready to test his ideas against experiment, and is always looking for better methods for doing this. Thus the Italian Mordante designs an improved compass (much to his compatriot Bruno's scorn!), the Swiss Bürgi[3] constructs improved clocks as an aid to astronomical observation, and as is well-known, Kepler comes to Prague to exploit the planetary data of the Dane Tycho de Brahe. In part this new concern with accuracy, this desire to make the theory fit the facts, grows out of the sixteenth century's navigational needs. We remember Kepler for the three laws of planetary motion; his contemporaries were as interested in the compendium of astronomical information contained in the *Rudolphine Tables*. This mixture of the weirdly theoretical and the down to earth practical is well illustrated by the career of the English magician/scientist John Dee, yet another visitor to Rudolphine Prague (1583–1589)[4]. Dee's interests were so encyclopaedic, that he still needs an adequate biographer; at one extreme he sought to communicate with angels (aided by Edward Kelley, who in his turn claimed to Rudolph to be able to transmute base metals into gold), at the other he wrote an introduction to the first English edition of Euclid's Elements, emphasising the practical applications of geometry. On an earlier journey through central Europe Dee had attended the coronation in Pressburg/Bratislava of Rudolph's father Maximilian II as King of Hungary, and had dedicated a book describing his *Monas Hieroglyphica* (see below) to him. In the Hermetic system this must be regarded as a "universal talisman', and since I hope to show that this notion is central to Kepler's way of thinking, some background is necessary.

Among the various Hermetic texts is the *Picatrix*, a manual of practical magic, which first became known in the West in the form of an Arabic translation from the original Greek. A translation into Spanish was made for King Alfonso the Wise of Castile in the thirteenth century, but this seems to have been lost. But in one version or another this work was known to Marsilio Ficino, who based his own cautious magical system on it. I have already referred to his belief that one can construct "talismans" to influence human