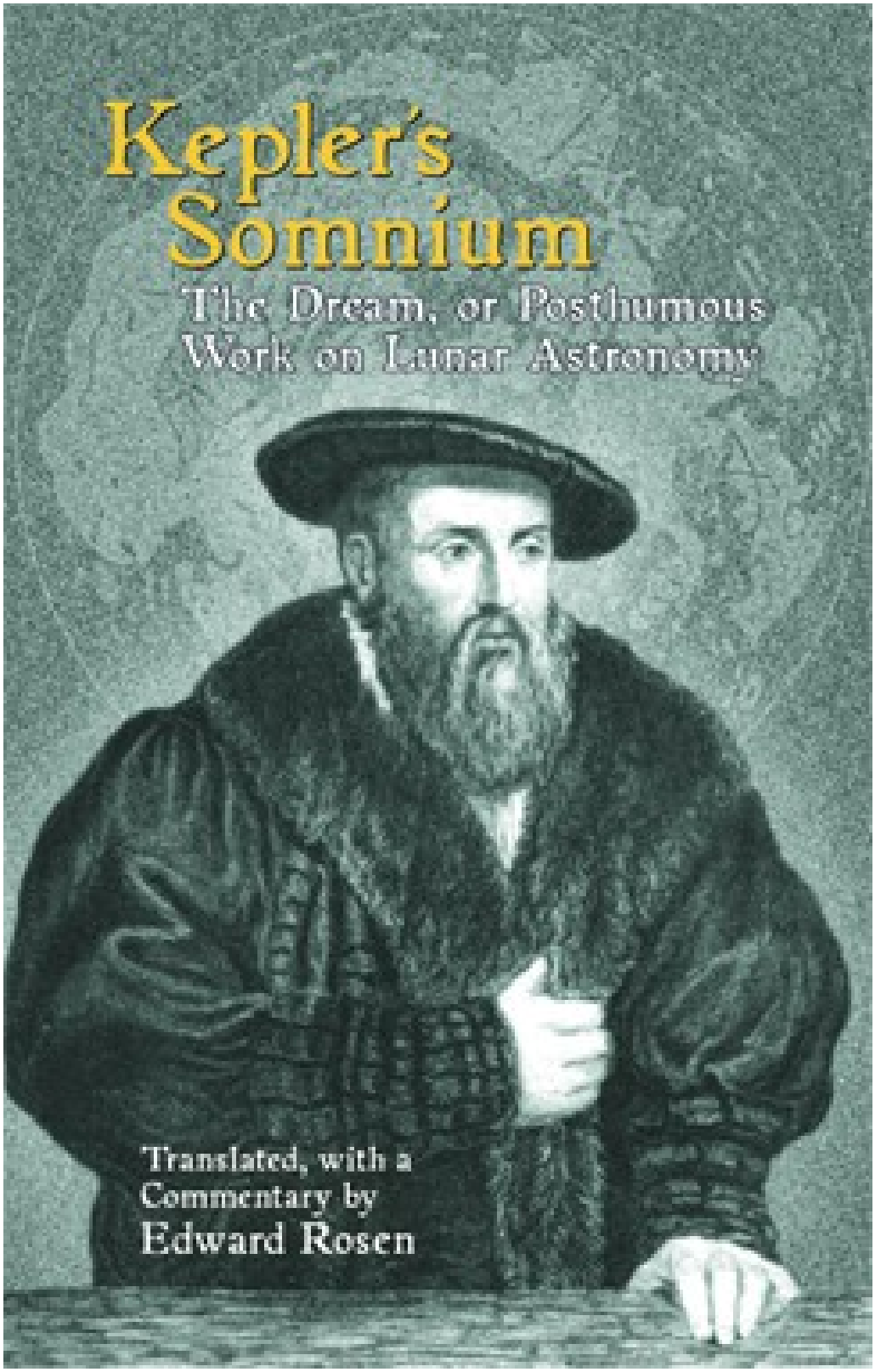
Kepler's Somnium

The Dream, or Posthumous Work on Lunar Astronomy



Translated, with a Commentary by

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Somnium (Latin for *The Dream*) is a fantasy written between 1620 and 1630 by Johannes Kepler in which a student of Tycho Brahe is transported to the Moon by occult forces. It is considered the first serious scientific treatise on lunar astronomy.

Somnium began as a student dissertation in which Kepler defended the Copernican doctrine of the motion of the Earth, suggesting that an observer on the Moon would find the planet's movements as clearly visible as the Moon's activity is to the Earth's inhabitants. Nearly 20 years later, Kepler added the dream framework, and after another decade, he drafted a series of explanatory notes reflecting upon his turbulent career and the stages of his intellectual development. The book was edited by his heirs, including Jacob Bartsch, after Kepler's death in 1630, and was published posthumously in 1634.

Kepler's *Somnium*: Science Fiction and the Renaissance Scientist

In 1634, four years after his death, the most provocative and innovative of Johannes Kepler's works was published by his son Ludwig Kepler, then a candidate for the doctorate in medicine. In one form or another, the manuscript had been the elder Kepler's constant companion since his student days at Tübingen University where his introduction to the heliocentric system, revived from the ancient Greeks by the Polish astronomer Nicholas Copernicus, had prompted Kepler to devote one of his required dissertations to the question: "How would the phenomena occurring in the heavens appear to an observer stationed on the moon?" The theses propounded by Kepler at Tübingen in 1593 contained, in the words of his German biographer Max Caspar, "the first germ of a work which we shall come to know as the last of the books he published," the *Somnium* or *Dream*.[1]

It had been Kepler's intent to personally supervise the publication of his manuscript and, at the time of his sudden death in 1630, six pages of the document were in type. Jacob Bartsch, Kepler's son-in-law, undertook the task of completing publication but he, too, died suddenly before it was finished. The project might well have been abandoned at this point had not Kepler left his widow in dire financial straits. In an attempt to assist his mother during this economic crisis, son Ludwig brought the thin volume to press in 1634. In accordance with the medieval-classical tradition—broken only by Kepler's contemporary Galileo, who occasionally published in the vernacular—the original edition was in Latin. Over two centuries passed before a second Latin edition was published in 1870 in volume eight of the *Opera Omnia*, a collection of Kepler's works edited by Christian Frisch. This was followed in 1898 by a rather poor and quite obscure German paraphrase under the title Kepler's *Traum Von Mond* by Ludwig Gunther. Except for these two limited editions and a few surviving copies of the original printing, a seminal work in science fiction remained a literary curiosity for over three centuries, read only by those few authors with a strong interest in the new genre and possessed of the classical background required to read the work in its original Latin.

It is difficult to appreciate to any degree this last work of a great theoretician and scientist without knowing something of the circumstances surrounding its authorship, a task which spanned some thirty-seven years. For the time in which he lived Kepler's lunar exploration is a truly remarkable and revolutionary work, and in the view of historian Lewis Mumford must be appreciated for "the audacity of the concept" as well as for its intrinsic merit as a pioneering work of science fiction.[2]

There is little, if anything, in the background and early childhood of Johannes Kepler to suggest that this son of a ne'er-do-well mercenary of the Duke of Alba and an innkeeper's daughter, who was nearly burned at the stake as a witch, would become a central figure in the seventeenth-century scientific revolution in astronomy. Kepler was born and spent his childhood in Weil-der-Stadt, a small Swabian village located in southwestern Germany. He lived in the crowded cottage home of his paternal grandfather, Sebaldus Kepler, along with aunts, uncles and numerous brothers and sisters—the latter of whom biographer Arthur Koestler collectively refers to as "this misshapen progeny."[3]

Through some favorable natural phenomena, not yet completely understood by modern science, Johannes was endowed at birth with the gift of genius while the rest of his brothers and sisters suffered from severe mental and physical handicaps. Kepler, himself, was not entirely immune to the family curse of physical infirmity, for he was bow-legged, frequently covered with large boils, and suffered from congenital myopia and multiple vision. The latter affliction must have been particularly distressing to one whose love of the heavens defined his career. Johannes' special intellectual endowment was apparent from an early age however, and fortunately those responsible for his education wanted the gift to be as fully developed as possible. Consequently, Kepler was enrolled at Tübingen University, and it was there that the first seeds of the *Somnium*, published some forty years later, were sown.

Kepler was an excellent student in all fields of study including theology, but he worked most diligently and happily on astronomical questions. It was his good fortune to matriculate while Michael Maestlin, one of the most learned and esteemed astronomers of the time, was a member of the Tübingen faculty. In deference to the teachings of Martin Luther and Phillip Melanchton, Luther's advisor on scientific matters, Maestlin, at least in his public lectures, advocated the geocentric system of planetary motion as described by the second century Greek astronomer Claudius Ptolemy in his influential treatise the *Almagest*.[4] Copernican theory, even when taught on the speculative basis permitted by the Roman Catholic Church until Galileo's trial in 1633, was strictly prohibited at the outset by the Lutherans; and among his theological colleagues Maestlin was the only advocate of the new astronomy. Privately, however, Maestlin did discuss the heliocentric universe, and apparently his early recognition of Kepler's genius persuaded Maestlin to admit his student to that small circle of intimates who shared his views. "In the youthful enthusiastic head of his pupil the spark ignited. Maestlin's considerations and repressions were alien to the young and unencumbered Kepler who, open and dauntless, entered into disputation in favor of the new astronomical theory."[5]

Kepler also learned a good deal of practical astronomy from Maestlin, including the ancient Greek technique of estimating elevations on the moon's surface by measuring the shadows cast by these protuberances. And he began to grapple with the question put at the beginning of this paper of how the heavens would appear to an observer standing on the moon. Kepler knew from studying Copernicus that the earth is moving very rapidly. Yet those who inhabit the planet are unaware of this rapid movement because they are not able to detect it through the use of their senses. Kepler quite logically reasoned that a man standing on the moon

would share an identical experience; he could see the earth change position because he would not be a participant in its rotation just as a moonwatcher on earth observes lunar motion in which he does not participate. This realization and the complex issues it raised became the basic theme of Kepler's dissertation of 1593 and, quite inadvertently, the generative force underlying the first work of modern science fiction.

Had the Tübingen faculty been more tolerant of the new astronomy, the theses presented in Kepler's dissertation would have been publicly debated and probably long forgotten. However when the proposal was presented to the authorities for their approval, they vetoed the debate. One of Kepler's closest friends and a fellow student, Christoph Besold, who later became a noted professor of law at Tübingen, appealed to his professor and advisor, Vitus Müller, to permit him, rather than Kepler, to uphold the theses in a disputation; but after considering the matter, Müller refused. The fact that Besold requested to debate Kepler's theses suggusts that the authorities might have known of the close Kepler-Maestlin relationship, and that Kepler and his friend considered it more likely that Müller and his colleagues would reach a favorable verdict if Besold, a law student, led the debate.

Kepler was no doubt disappointed and perhaps even somewhat bitter about the decision; yet he was also realistic enough to know that to further protest his fate, when even his highly respected professor of astronomy was condemned to public silence on matters Copernican, would be foolhardy and perhaps damaging to his career. Still, there was sufficient grit to produce a pearl. Kepler wisely decided to keep his manuscript until the time when a more favorable climate of opinion might prevail. He also wanted to do more research, particularly on the Greek classics, and to discover any possible precedents in them that would make his work more palatable to the Aristotelians.

The student dissertation of 1593 was left untouched by its author for the next sixteen years. Meanwhile, Kepler's career as a mathematician-astronomer flourished. He was graduated from the Faculty of Arts at Tübingen at the age of twenty and enrolled at the Theological Faculty of the University to continue preparing for his chosen vocation—that of a Lutheran clergyman. His reputation as an excellent mathematician followed him however; and the Tübingen Senate offered Kepler the position of teacher of mathematics and astronomy in Gratz, the sleepy capital of the Austrian province of Styria. Fearing himself unworthy of such a post, Kepler reluctantly accepted the offer only after considerable coaxing: his plans for a career in theology were permanently abandoned. The choice proved a good one; the young mathematician became a respected teacher and he apparently enjoyed his new surroundings, for Kepler remained in Gratz until January of 1600. The rather obscure town provided few distractions from scholarly pursuits, and, since his classes were small, Kepler had considerable free time to devote to mathematics and astronomy.

At the age of twenty-five he published his first book, the *Mysterium Cosmographicum*, which is a brilliant if highly mystical and error-prone amalgam of Aristotelian and Copernican cosmology.[6] The work attracted the attention of the great Danish astronomer, Tycho Brahe, who was deeply impressed by Kepler's synthesis of the old and new astronomy.[7] This favorable impression ultimately led Brahe to offer Kepler a position as his assistant after the Dane was appointed Imperial Mathematician by the Holy Roman Emperor, Rudolph II.

Kepler worked with Brahe from early 1600 until the latter's death in November 1601, after which Kepler succeeded to the post of his teacher. Equally important is the fact that after a squabble with Tycho's heirs, Kepler inherited the astronomer's observational data,

unparalleled for its accuracy, on the oppositions of Mars between 1580 and 1600. It was through the mathematical analysis of Brahe's observations that Kepler arrived at his famous law of ellipses in 1605. The conclusions derived from this law provided the basis for his most important scientific work, *Astronomia Nova*, published in 1609, the same year in which his interest in the forgotten dissertation of his student days was rekindled.

In his capacity as Imperial Mathematician Kepler resided in Prague, then the capital of the Holy Roman Empire. During the summer of 1609, he became involved in a series of long conversations with his friend and ecclesiastical advisor to Emperor Rudolph, Wackher von Wackenfels. Rudolph had asked Kepler his views regarding the patterns of light and shadows appearing on the lunar surface: the emperor had personally concluded that they are formed by the reflection off the moon of major land masses located on the earth. In effect, Rudolph was advocating a somewhat modified version of the Aristotelian position and he wanted to know if Kepler agreed with him.

Kepler, of course, did not agree with his patron because as far back as his student days he had known that the shadows on the moon were caused by mountains or other natural outcroppings. It was a conclusion reinforced by years of additional study and observation both on his own and under Tycho's tutelage. While not an expert on the matter himself, Wackher was interested in Kepler's views and encouraged his friend to publish them. Kepler's lifelong intrigue with lunar geography combined with Wackher's interest resulted in the composition of the *Somnium*, a greatly modified version of his student dissertation.[8]

There can be little, if any, doubt that Kepler selected the framework of the *Dream* to satisfy two major demands: first, fewer objections could be raised among the ranks of those still within the Aristotelian orbit by passing off this Copernican treatise as a figment of an idle slumberer's uncontrollable imagination; and secondly, it enabled Kepler to introduce a mythical agent or power capable of transporting humans to the lunar surface. In fact to the cursory reader, Kepler must have appeared more mythographer than speculative scientist, and this is the very impression the author intended.[9]

The *Somnium* begins like a classical legend and relates the author's "dream" about the adventures of a young man, Duracotus, a native of an island called "Thule" by the ancients, Iceland by seventeenth-century Europeans. Duracotus' father, a fisherman by trade, died at the extremely advanced age of 150, but the child was still too young to have any recollection of him. Fiolxhilde, the mother, is a "wise woman," who supports both her son and herself by gathering herbs which are then cooked, stuffed in little bags of goatskin, and sold at a nearby port to sailors. The bags supposedly harbor mysterious lucky charms and the healing powers required by seamen on the long and always dangerous voyages across the north Atlantic. One day, out of curiosity," Duracotus cut open one of the bags his mother intended to sell to a ship's captain, scattering its contents on the ground. In a fit of anger Fiolxhilde's temper got the best of her and she sold her son to the captain in place of the lost herbs.

The following day, the captain set sail for Norway but he stopped in Denmark to deliver a letter from a bishop in Iceland to the astronomer Tycho Brahe, who then resided on the island of Hveen in the Sund between Copenhagen and Elsinore Castle. Duracotus became quite ill during the voyage (apparently he carried no bag of his mother's charms), and he was put ashore when Tycho's letter was delivered. The astronomer questioned the boy at some length, considered him to be quite intelligent, and undertook to train him in the science of astronomy. Duracotus' response is enthusiastic: "I was delighted beyond measure by the astronomical

activities, for Brahe and his students watched the moon and the stars all night with marvelous instruments."[10]

After spending five years in Tycho's company Duracotus took his master's leave and sailed for home. He found Fiolxhilde much as she was when he left, except that the old woman had suffered terribly as a result of her impetuosity and was overjoyed to see her son alive and well. A number of long discussions ensued during which Fiolxhilde expressed happiness over Duracotus' acquaintance with the new science of the stars. She confesses to her own special knowledge of the heavens and the fact that her teacher is none other than the "Daemon of Lavania"—the spirit of the moon. "Most of the things which you saw with your own eyes or learned by hearsay or absorbed from books, he related to me as you did." The mother then reveals her ultimate secret: it is possible, with the assistance of the Daemon, to travel to Lavania and, quite predictably, she asks her son to accompany her on just such a lunar voyage. Duracotus consents and "as soon as the sun set below the horizon, and was in conjunction with the planet Saturn in the sign of the Bull, Fiolxhilde summoned the Daemon and seated herself next to her son who covered their heads with a blanket. Within a few moments the journey of "fifty thousand German miles" had begun, up through the ethereal regions to the moon.

Up to this point there is little which separates the Somnium from a long literary tradition rooted in the imagination of the ancient Greeks. After his rebuff at the hands of the Tübingen faculty Kepler had purchased a copy of Lucian's satirical work on lunar exploration facetiously titled, *A True Story*. From a scientific point of view the work made no sense: Lucian's voyage to the moon begins in a whirlwind and concludes by poking fun at the society of his day through a chronicle of "hilarious discussions on the moon." The flight of Duracotus and Fiolxhilde is also the result of supernatural forces that are no less mystical than the whirlwind conjured up by Lucian.

A second, and more important source of inspiration for Kepler's moon voyage was Plutarch's *The Face on the Moon*, which Kepler read in 1595. It is a symposium of Greek scientific thought that includes the views of Hipparchus, Aristotle, and Aristarchus of Samos. Extensive speculation on the lunar environment as a possible home for life is presented; and Plutarch even relates the story of a mythical traveler—a Greek Duracotus—who sails to an island whose residents have knowledge of the passage to the moon.[12] Kepler now had the classical precedent he lacked during his student days: he even hoped to publish translations both of Lucian's and Plutarch's work with the *Somnium* to show his debt to these classical writers, and hopefully blunt potential criticism of his own moon voyage.[13] It was a task he did not complete.

While Kepler's method of flight to the moon is not markedly different from that outlined by Lucian, and although much of his inspiration for lunar exploration is undeniably Plutarchian, the Somnium represents a sharp break with classical tradition; the first intimation of which occurs during the voyage itself. We are informed that the flight of four hours is "most difficult and fraught with the greatest danger to life." Only those who are slender of body are acceptable, thus ruling out most German males whose general corpulence was apparently distasteful to the slender Kepler. In jest Kepler carried the matter further by pointing out the Daemon's preference for "dried-up old women, experienced from an early age in riding he-goats at night or forked sticks or threadbare cloaks." It was to prove a most costly joke for, as we shall see, it later backfired on its author whose own mother was accused of practicing witchcraft by superstitious neighbors and nearly burned at the stake by the authorities.

The take-off for the moon hits the traveler as a severe shock, "for he is hurled just as though he had been shot aloft by gunpowder to sail over mountains and seas." In order to counteract what Isaac Newton would later define as the force of gravity, the moon voyagers are put to sleep with the aid of opiates and their limbs are arranged in such a way that their bodies will not be torn apart by the force of acceleration.[14] Since breathing is inhibited by the swift passage of extremely cold air through the nostrils, damp sponges are applied to the face. Within a short time the speed of flight becomes so great that the body involuntarily rolls itself up into a ball like an endangered spider and "we are carried along almost entirely by our will alone, so that finally the bodily mass proceeds toward its destination of its own accord:" Kepler had introduced the concept of "inertia" to the physical sciences and had extended its operation into the heavens.

Kepler anticipates another major obstacle to the moon voyager when he observes that we agreed not to begin "until the moon begins to be eclipsed on its eastern side. Should it regain its full light while we are still in transit, our departure becomes futile." In other words, Kepler knew that once outside the protective blanket provided by the earth's atmosphere, humans could not survive the resulting solar bombardment: the flight must begin at the critical moment when the sun is behind the earth or at a point directly opposite the point of take-off. During a lunar eclipse the earth's shadow would provide the tunnel of darkness required to protect the vulnerable moon voyager; and it is not by accident that the maximum duration of such an eclipse is four and one-half hours, just one-half hour more than the duration of the voyage itself.[15] A further indication of Kepler's mastery of Copernican astronomy is his understanding that since the earth and the moon are both in motion, the shortest route to the latter would not be the straight line advocated by such ancient writers of mythology as Lucian, but a trajectory from earth to a point in space where the moon and the lunar voyagers would arrive simultaneously.[16]

Kepler also relates that many additional difficulties arise during the lunar voyage which are too tedious to enumerate. We are already aware, however, that Kepler possessed a keen grasp of the most serious obstacles to lunar flight and that even though those obstacles were beyond solution in terms of the technological equipment of his age, he believed it was at least theoretically possible—from a scientific point of view—for men to reach the moon. It is this attitude that sets Kepler apart from all the others who considered the possibility of lunar flight before him.

Upon reaching the surface of Lavania the voyagers are weary, but soon recover sufficiently to walk about. The Daemon immediately guides his charges to a cave in order to protect them from the penetrating rays of the rising sun. There they meet other daemons and have the opportunity to recuperate from the effects of their arduous journey before beginning a reconnaissance of the moon's geography, flora, and fauna. They are informed by their spiritual hosts that Lavania consists of two hemispheres: Subvolva and Privolva. Subvolva always has its Volva (Earth) above which corresponds to the earth's satellite, the moon, while Privolva is forever deprived of the sight of Volva.[17] Taken together, a night and a day on Lavania are equivalent to one month on earth providing alternating two-week periods of intense, scorching heat followed by a cold unimaginable on this planet. The extremes of temperature in the Subvolvan hemisphere are mitigated to some extent because of Volva's presence which has a moderating influence on the climate. Geographically, the surface of the moon possesses everything that is on earth, but on a grossly exaggerated scale: the mountains reach unbelievable heights while the fissures, valleys, and craters plunge to precipitous depths unknown in the terrestrial realm.

Of equal interest to the student of science fiction is Kepler's detailed analysis of the life forms that inhabit Lavania. His powers of scientific deduction were matched by a fertile and realistic imagination when postulating biological conditions on the moon. Although he was trained as an astronomer and mathematician, Kepler was too good a scientist not to understand that the dual effects of the lunar climate and the irregular, hostile terrain would produce plants and animals far different from those that inhabit the earth. He rejected the temptation, which others had not, of simply recreating a terrestrial civilization on the moon; for in Kepler's Lavania there are no men and women, no civilization as he knew it. Thus nearly two centuries before Buffon, Lyell, and Darwin, Kepler had grasped the close interrelationship between life forms and their natural environment.

Whatever is born on the moon attains a monstrous size: growth is extremely rapid, dictating a very short life span by terrestrial standards. Since there are no towns the "Privolvans have no fixed abode, no established domicile." They are nomadic creatures who roam in crowds over their entire hemisphere:

> Some use their legs, which far surpass those of our camels; some resort to wings; and some follow the receding water in boats; or if a delay of several more days is necessary, then they crawl into caves. Most of them are divers; all of them draw their breath very slowly; hence under water they stay down on the bottom.

Kepler considered the natural protection of large bodies of water and of caves as indispensable to an environment whose temperatures far exceed those of the hottest regions on earth. And although he does not elaborate on the subject, he suggests that the lunar inhabitants are not the dumb animals they might at first appear to be. Their ability to construct boats to escape the far-reaching effects of the sun provides evidence of this.

Feeding is a nocturnal function which, if prolonged until after sunrise, often leads to death. The skin of the moon-dwellers, the majority of whom resemble massive serpents, is spongy and porous and, if exposed to the full force of the sun, becomes scorched and brittle. Food consists primarily of plants whose surface "is like rind" and of the carcasses of the large number of creatures who die each day. Such is the gigantic race of short-lived creatures that the historian of literature Marjorie Hope Nicolson likened to those of the antediluvian age on earth: lunar pterodactyls or ichthyosauri that bask for a brief moment in the rising or setting sun, then creep forever into the impenetrable Lavanian darkness.[18]

At this point the Somnium comes to a rather abrupt and premature conclusion. Kepler informs us that, "A wind arose with the rattle of rain. I returned to find myself and found my head really covered with the pillow and my body with the blankets," an allusion, no doubt, to the beginning of the moon voyage when Duracotus and Fiolxhilde covered their heads prior to the take-off.

The actual text of the Somnium, exclusive of the lengthy footnotes which were completed several years later and represent the third and final stage of composition, comprises only about twenty type-written pages. Had the work been published at this point it would have been a slender volume indeed; but Kepler clung to his plan to publish it in conjunction with translations of Plutarch and Lucian, and then only after it had been circulated among his most trusted colleagues in manuscript form. As was noted above, Kepler's primary concern was with the opposition he might provoke among the Aristotelians; he wanted some idea of the type of reception he could expect.

In 1610, a few months after the text of the *Somnium* was completed, Kepler received some welcome and exciting news from Italy. His fellow scientist, Galileo Galilei, had constructed a number of telescopes and had used them to observe celestial phenomena not visible to the naked eye. The astounding results were published in Galileo's revolutionary little work, *The Starry Messenger*, in which the Italian astronomer announced the discovery of sunspots, Jupiter's four moons, countless "new" stars, and most importantly—from Kepler's point of view—the mountains and craters of the moon. Here was visual confirmation of much of what Kepler had theorized in the *Somnium*, and it marked the beginning of the end of Aristotelian cosmology. Yet Kepler, unlike the overly euphoric Galileo, was realistic enough to know that the new discoveries, no matter how revolutionary and enlightening, would not bring about an immediate and universal acceptance of Copernicanism, but at least the Aristotelians were clearly on the defensive. At this point the future of the new astronomy and of the *Somnium* looked almost as bright as the new stars seen for the first time through Galileo's telescope.

The lunar geography was probably read privately in manuscript form for the last time in 1610. Through a rather complicated and unfortunate series of events, Kepler lost control of a copy in 1611 and a number of individuals—many of them unknown to Kepler personally—gained access to it, including some that the author would not have approved of. The *Somnium* was written for scientists and was little understood, except on the most superficial level, by those lacking a scientific background. Kepler suggests that it became the subject of gossip in the tonstrinae, the forerunner to the modern coffeehouse.[19] Some of those who knew Kepler and his family, or at least thought they did, discovered sufficient autobiographical material in the manuscript to feed the fires of ignorance and superstition then engulfing Germany. They equated Johannes with Duracotus and made particular note of the similarities between Katherine Kepler, the astronomer's mother, and Fiolxhilde, the fictional peddler of magic charms and herbs. Especially damning was the description of Fiolxhilde as a "wise woman" in league with celestial spirits, nor did Kepler's joke about the Daemon's preference for old witches as traveling companions help. To make matters worse, Katherine Kepler was well known for her vile temper and generally cantankerous disposition, not to mention the fact that the aunt who had cared for her as a child was burned at the stake as a witch. The stage was set, charges were leveled, and in 1615 Katherine Kepler was arrested on suspicion of practicing witchcraft. In his attempt to evade the scorn of the Aristotelians by concealing his pro-Copernican work in the guise of classical mythology, Kepler had inadvertently set a trap for himself and his mother, for they had become the unwitting victims of the seventeenth-century European witch-craze.

Johannes Kepler's reputation as a noted mathematician-astronomer by no means served as a guarantee that Katherine Kepler would escape the fate of thousands of others who had already died at the stake for their alleged complicity in what authorities envisioned as a mass satanic conspiracy. Kepler was well aware of the seriousness of the charges and he put all else aside to work for Katherine's exoneration. A long, tedious, and taxing legal battle resulted: only after five years, part of which his mother spent in prison, was the old woman released; but the damage had been done. Katherine Kepler died in April of 1622 from causes directly attributable to the rigors of her imprisonment; her son had been able to do little significant work while trying to obtain his mother's release; and the publication of the *Somnium*, at least for the present, was out of the question. Historical circumstances, as during his student days at Tübingen in 1593, had again deprived Kepler of the opportunity to publicly air his views. Under these conditions, could it have truly mattered to Kepler whether or not his desire to speak out had been thwarted by a narrow-minded faculty senate impervious to all scientific

inquiry deemed anti-Aristotelian, or a group of superstitious and half-crazed witch-hunters who had mistaken fantasy for reality?

The tragedy of Katherine Kepler's long and painful ordeal weighed heavily upon her son for the remainder of his life. He felt a deep sense of personal responsibility for the old woman's demise even though any reasonably objective observer could find no grounds for culpability on his part. There was little left for Kepler but his work, and he set out to complete a number of projects postponed by his mother's arrest and imprisonment. Of primary concern was a handbook of Copernican astronomy without which fellow scientists would not know how to correlate the laws Kepler derived from Tycho's observations with the work of Copernicus to arrive at an operable model of the heliocentric system.[20] Another project of importance was the planetary position predictions that would confirm the validity of Kepler's theory of elliptical orbits as set forth in the law of 1605. Only after overcoming several major obstacles, which biographer Arthur Koestler likens to the Ten Plagues of Egypt, were the *Rudolphine Tables*, named in honor of Kepler's deceased patron, brought to press.[21]

Meanwhile, Kepler returned to the manuscript of the ill-fated *Somnium* which had been neglected since 1610. During the last decade of his life, from 1620 to 1630, Kepler wrote the 223 footnotes to the Dream which are much longer than the text itself. It is within these footnotes that the true scientist stands forth, for they contain the scientific core of the lunar geography. This, the third and last stage of composition, was undertaken as a result of Kepler's dissatisfaction with his scant attention to scientific detail in the earlier version of the manuscript. The point is made by Kepler himself in a letter written to his friend, Matthias Bernegger, dated December 4, 1623:

> Two years ago, immediately after my return to Linz I have started to work again on the astronomy of the moon, or rather to elucidate it by remarks.... There are just as many problems as lines in my writing, which can only be solved astronomically, physically, or historically. But what can one do about this? The people wish that this kind of fun, as they say, would throw itself around their neck, with cozy arms; in playing they do not wish to wrinkle their foreheads. Therefore, I decided to solve the problem myself, in notes ordered and numbered.[22]

Perhaps because of his mother's ordeal, coupled with the rising popularity of the new astronomy, Kepler no longer feared or even cared about the possible consequences of publishing a work founded on Copernican principles. The insecurity that had resulted from Kepler's lifelong fear of Aristotelian sanctions against his work had finally been overcome. He had paid a price that few men of his or any other generation are willing to pay, and then, just before the manuscript could be published, death unexpectedly deprived him of the satisfaction of seeing his long labor in print.

In his analysis of the *Somnium* Kepler's biographer Max Caspar muses over the question: What would the Dream have been like had Kepler written about a "moon state" the way his contemporary, Campanella, composed a "sun state "?[23] The question arose at Kepler's own suggestion in the same letter to Bernegger in which he had outlined his reasons for adding footnotes to the *Somnium*. Kepler asks:

> Campanella wrote a *City of the Sun*. What about my writing a "City of the Moon"? Would it not be excellent to describe the cyclopic mores of our time in vivid colors, but in doing so—to be on the safe side—to leave this earth and go to the moon? More in his *Utopia* and Erasmus in his *Praise of Folly* ran into trouble and had to defend themselves. Therefore let us leave the vicissitudes of politics alone and let us remain in the pleasant, fresh green fields of philosophy.[24]

Caspar considers it unfortunate that Kepler did not carry out his plan; but it is a view this writer does not share.[25] No one, of course, can know the type of lunar society Kepler might have created had he not wanted to stay out of the sticky realm of social and political speculation: he was a genius and of all human qualities none is more unpredictable. Still, it is difficult to believe that any work of social criticism he might have authored could have matched Kepler's contribution either to scientific theory or the new literary genre, science fiction. There is little in the historical record to show that he possessed the political insight of either a Sir Thomas More or an Erasmus, but everything to show that he was a scientific genius with few peers. To have turned the *Somnium* into a polemic for social and political reform would have almost certainly detracted from its real value as a unique contribution to science fiction and might have negated its value in the field of scientific theory as well.

Kepler's other major biographer, Arthur Koestler, paints the picture of a man astride the crest of a great "watershed" in Western intellectual history: on the one side is the medieval world where science is dominated by religion and the teachings of the ancient Greeks; on the other side is the modern world in which science finally becomes a discipline unto itself. Kepler leans one way, then the other; but he can never quite extricate himself from the medieval mentality of the times and cross over onto the plain of modern thought. In many ways it is a fair characterization, but one that fails to take sufficient account of the one work that preoccupied Kepler off and on for some thirty-seven years and reflects the various stages in his intellectual maturation as a scientist.

The *Somnium* is itself a watershed, for it marks both the end of an old era and the beginning of a new one. After his introductory tribute to the classicists, the modern scientist takes command. The Daemon of Lavania is nothing less than Kepler's own subtly masked voice speaking with confidence and authority about the unlimited possibilities that he, believes science holds for mankind. Gone is the fantasy-utopian world of Lucian and Campanella; in its place is an imaginative modern work anchored in fact and rich in rational scientific theory. If Kepler's little fictional work was to be overlooked by historians of science for over three and one-half centuries, later writers of cosmic voyages in the seventeenth, eighteenth, and nineteenth centuries did not make the same mistake. The *Somnium* was known to Jules Verne, H.G. Wells and, I believe, at least indirectly, to such contemporary writers of science fiction as Arthur C. Clarke. Kepler opened the way for a new vision of the universe as the home of a plurality of worlds.[26] Seen from the perspective of the twentieth century, there is no reason to dispute the assertion that Kepler's Dream is the *fons et origo* of modern science fiction.[27] Fortunately, even after the passage of three hundred and fifty years, history has a way of correcting injustice and apportioning credit where it is due. It has not been until the last few years that Kepler's many works have finally been given the attention merited by their major contributions to later scientific and technological developments, not the least of which are twentieth-century man's lunar voyages.

NOTES

1. Max Caspar, *Kepler*, trans. and ed. C. Doris Hellman (London and New York 1959), pp. 47-48. The full title of Kepler's work is *Somnium seu Astronomia Lunari (Dream or Astronomy of the Moon).*

2. Lewis Mumford, *The Myth of the Machine: The Pentagon of Power* (New York 1970), p. 46.

3. Arthur Koestler, *The Sleepwalkers* (London and New York 1959), p. 228.

4. Caspar, *Kepler*, p. 46.

5. ibid., p. 46.

6. For an excellent analysis of the *Mysterium* see Koestler, *The Sleepwalkers*, pp. 247-267.

7. Tycho could not quite bring himself to a full embrace of the Copernican system. He accepted the concept of heliocentrism but retained part of the Aristotelian-Ptolemaic system by theorizing that the planets circle the earth which in turn circles the sun.

8. Caspar, *Kepler*, p. 351. One of the new twentieth-century scholars of the *Somnium*, Marjorie Hope Nicolson, shares the view that much of the work was written in the summer of 1609. However, Professor Nicolson writes, "there are details which could not possibly have been known to Kepler before the spring of 1610." She is referring to Galileo's publication of *The Starry Messenger* which made known detailed observations of the lunar surface with the telescope. It is a point worth keeping in mind, but one which does not significantly alter the historical account. See her article "Kepler, the *Somnium*, and John Donne," in *Roots of Scientific Thought*, ed. by Philip P. Wiener and Aaron Noland (New York 1957), p. 310.

9. Translation of the *Somnium* into English was first undertaken by Joseph Keith Lane, a candidate for the Master of Arts degree at Columbia University in 1947. The thesis has not been published. The first complete published translation in English appeared in 1965: *Kepler's Dream* trans. by Patricia Frueh Kirkwood with an interpretation by John Lear (Berkeley and Los Angeles). A subsequent translation appeared in 1967: *Kepler's Somnium*, trans. with a commentary by Edward Rosen (Madison and London). Unless otherwise noted, I have employed the Rosen translation when quoting from the *Somnium*.

10. The reader may have already surmised that there is a substantial amount of autobiographical material in the *Somnium*. For example, Kepler's father disappeared before his son formed any permanent impression of him; his mother was a collector of herbs; and Kepler was Brahe's pupil, although not at Tycho's Uraniburg observatory on Hveen, but in Prague.

11. Lear and Kirkwood, *Kepler's Dream*, pp. 42_43.

12. Ibid., p. 45.

13. See Nicolson, "Kepler, the *Somnium* and John Donne," pp. 322_323.

14. Kepler anticipated the universal law of gravitation later formulated by Sir Isaac Newton, but he lacked both the mathematical proof and the objectivity necessary to advance beyond the realm of speculation. See Koestler, *The Watershed*, pp. 336_340 and Rosen, *Kepler's Somnium*, pp. 218_221.

15. Lear and Kirkwood, *Kepler's Dream*, p. 57.

16. Kepler's ft. 62.

17. See Kepler's ft. 89 and 90.

18. Marjorie Hope Nicolson, *Voyages to the Moon* (New York 1948), p. 47.

19. ibid., p. 44.

20. The work is titled the *Epitome Astronomiae Copernicane*, a somewhat misleading rubric for the Epitome is a textbook of the Keplerian system rather than the Copernican system. Koestler, *The Sleepwalkers*, p. 406.

21. For an account of the difficulties encountered by Kepler see Koestler, pp. 406-411.

22. Carola Baumgardt. *Johannes Kepler: Life and Letters* with an introduction by Albert Einstein (New York 1951), p. 155.

23. Caspar, *Kepler*, p. 351.

24. Baumgardt, Johannes *Kepler: Life and Letters*, pp. 155-156.

25. Caspar, *Kepler*, p. 351.

26. It might be argued that this distinction belongs to the Italian philosopher Giordano Bruno (1548-1600) whose pantheistic teaching encompassed a plurality of worlds distributed throughout an infinite universe. Bruno, however, was a religious mystic who soared into the metaphysical realm unencumbered by the ballast of scientific thinking which was Kepler's constant companion.

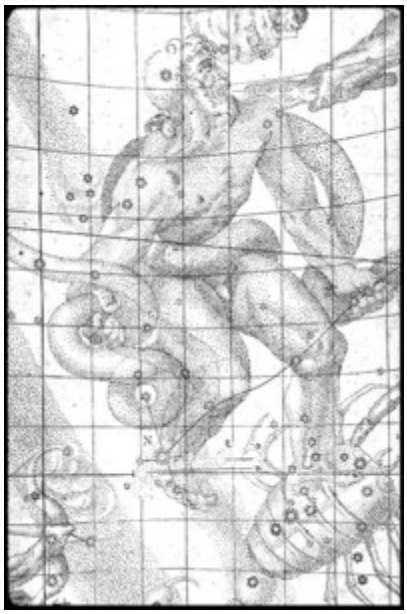
27. Nicolson, *Voyages to the Moon*, p. 41.

ABSTRACT

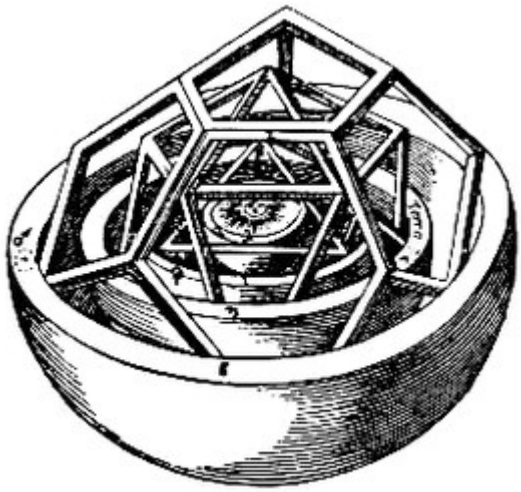
Following an account of the painful family circumstances and risks attending the posthumous publication of *Somnium* in 1634, this essay contends that the work marks the beginning of a new era. After an initial tribute to the classicists, the modern scientist takes over. The Daemon of Lavania is nothing less than Kepler's own subtly masked voice, speaking with authority about the unlimited possibilities of science. Gone is the fantasy-utopian world of Lucian and Campanella; in its place is an imaginative modern work anchored in fact and rich in rational scientific theory. And if Kepler's small-scaled fictional work was overlooked by historians of science for over 350 years, writers of cosmic voyages during the seventeenth, eighteenth, and nineteenth centuries did not make the same mistake. The *Somnium* was known to Jules Verne, H. G. Wells, and, I believe, to such contemporary writers as Arthur C. Clarke. Kepler opened the way for a new vision of the universe as a home to a plurality of worlds; indeed, Kepler's *Dream* may be seen as the *fons et origo* of modern science fiction. Only in the last few years have Kepler's writings finally been given the attention merited by their historical importance and their contribution to later scientific and technological developments, including twentieth-century man's lunar voyages.

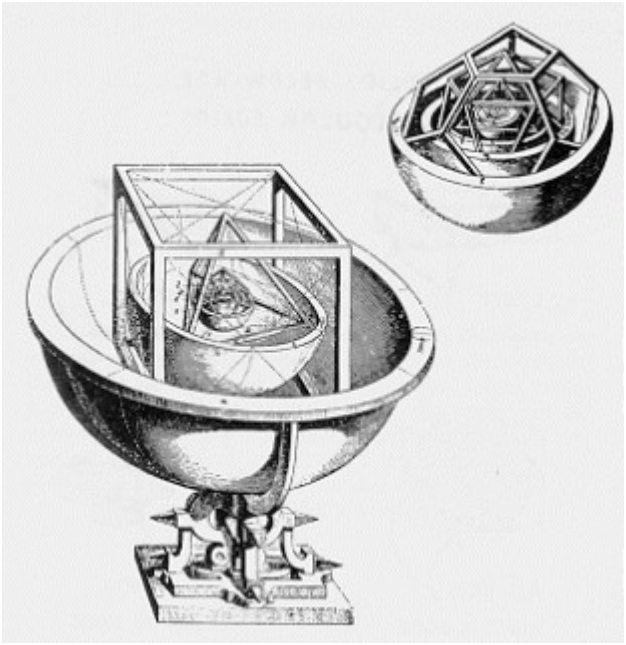
One of the most important books in the history of science, Kepler's long-overlooked Somnium made a significant contribution to the study of astronomy. Its unique twofold nature, combining a serious scientific treatise on lunar astronomy with a fictional narrative about a trip to the moon puzzled seventeenth-century readers as well as succeeding generations, and the work lapsed into obscurity.

The Somnium begins like a classical legend and relates the author's 'dream' about the adventures of a young man, Duracotus, a native of an island called Thule by the ancients, Iceland by seventeenth-century Europeans. Duracotus' father, a fisherman by trade, died at the extremely advanced age of 150, but the child was still too young to have any recollection of him. Fiolxhilde, the mother, is a 'wise woman,' who supports both her son and herself by gathering herbs which are then cooked, stuffed in little bags of goatskin, and sold at a nearby port to sailors. The bags supposedly harbor mysterious lucky charms and the healing powers required by seamen on the long and always dangerous voyages across the north Atlantic. One day, out of curiosity Duracotus cut open one of the bags his mother intended to sell to a ship's captain, scattering its contents on the ground. In a fit of anger Fiolxhilde's temper got the best of her and she sold her son to the captain in place of the lost herbs.

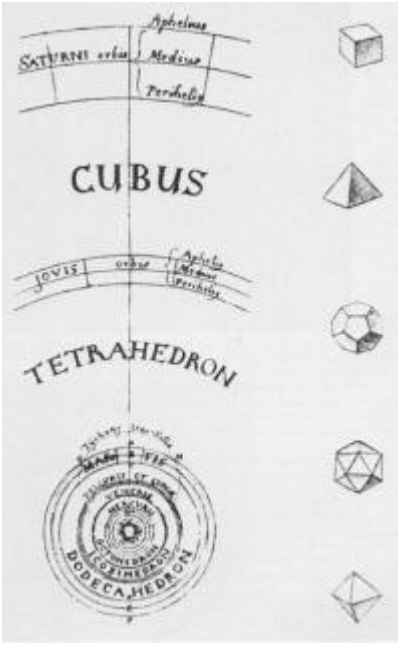


The following day, the captain set sail for Norway but he stopped in Denmark to deliver a letter from a bishop in Iceland to the astronomer Tycho Brahe, who then resided on the island of Hveen in the Sund between Copenhagen and Elsinore Castle. Duracotus became quite ill during the voyage, apparently he carried no bag of his mother's charms, and he was put ashore when Tycho's letter was delivered. The astronomer questioned the boy at some length, considered him to be quite intelligent, and undertook to train him in the science of astronomy. Duracotus' response is enthusiastic: "I was delighted beyond measure by the astronomical activities, for Brahe and his students watched the moon and the stars all night with marvelous instruments.





After spending five years in Tycho’s company Duracotus took his master’s leave and sailed for home. He found Fiolxhilde much as she was when he left, except that the old woman had suffered terribly as a result of her impetuosity and was overjoyed to see her son alive and well. A number of long discussions ensued during which Fiolxhilde expressed happiness over Duracotus’ acquaintance with the new science of the stars. She confesses to her own special knowledge of the heavens and the fact that her teacher is none other than the "Daemon of Lavania"—the spirit of the moon. "Most of the things which you saw with your own eyes or learned by hearsay or absorbed from books, he related to me as you did." The mother then reveals her ultimate secret: it is possible, with the assistance of the Daemon, to travel to Lavania and, quite predictably, she asks her son to accompany her on just such a lunar voyage. Duracotus consents and "as soon as the sun set below the horizon, and was in conjunction with the planet Saturn in the sign of the Bull, Fiolxhilde summoned the Daemon and seated herself next to her son who covered their heads with a blanket. Within a few moments the journey of 'fifty thousand German miles' had begun, up through the ethereal regions to the moon.

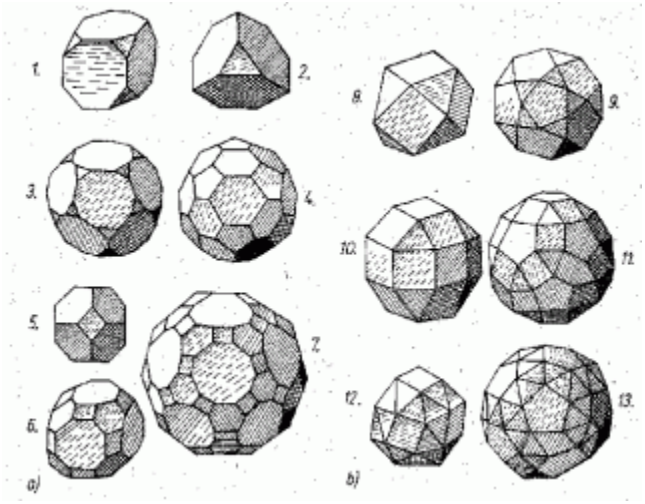


A second, and more important source of inspiration for Kepler's moon voyage was Plutarch's The Face on the Moon, which Kepler read in 1595. It is a symposium of Greek scientific thought that includes the views of Hipparchus, Aristotle, and Aristarchus of Samos. Extensive speculation on the lunar environment as a possible home for life is presented; and Plutarch even relates the story of a mythical traveler—a Greek Duracotus—who sails to an island whose residents have knowledge of the passage to the moon.12 Kepler now had the classical precedent he lacked during his student days: he even hoped to publish translations both of Lucian's and Plutarch's work with the Somnium to show his debt to these classical writers, and hopefully blunt potential criticism of his own moon voyage.13 It was a task he did not complete.

While Kepler's method of flight to the moon is not markedly different from that outlined by Lucian, and although much of his inspiration for lunar exploration is undeniably Plutarchian, the Somnium represents a sharp break with classical tradition; the first intimation of which occurs during the voyage itself. We are informed that the flight of four hours is most difficult and fraught with the greatest danger to life. Only those who are slender of body are acceptable, thus ruling out most German males whose general corpulence was apparently distasteful to the slender Kepler. In jest Kepler carried the matter further by pointing out the Daemon's preference for «dried-up old women, experienced from an early age in riding he-goats at night or forked sticks or threadbare cloaks.» It was to prove a most costly joke for, as we shall see, it later backfired

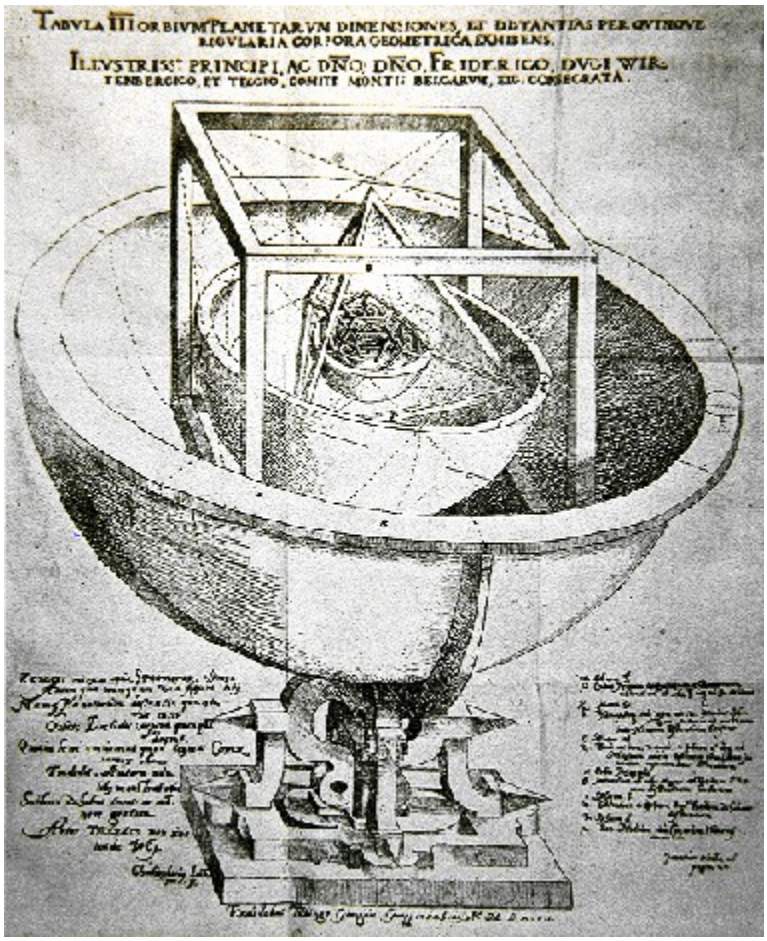
on its author whose own mother was accused of practicing witchcraft by superstitious neighbors and nearly burned at the stake by the authorities.

The take-off for the moon hits the traveler as a severe shock, «for he is hurled just as though he had been shot aloft by gunpowder to sail over mountains and seas.» In order to counteract what Isaac Newton would later define as the force of gravity, the moon voyagers are put to sleep with the aid of opiates and their limbs are arranged in such a way that their bodies will not be torn apart by the force of acceleration.14 Since breathing is inhibited by the swift passage of extremely cold air through the nostrils, damp sponges are applied to the face. Within a short time the speed of flight becomes so great that the body involuntarily rolls itself up into a ball like an endangered spider and we are carried along almost entirely by our will alone, so that finally the bodily mass proceeds toward its destination of its own accord. Kepler had introduced the concept of inertia to the physical sciences and had extended its operation into the heavens.



Kepler anticipates another major obstacle to the moon voyager when he observes that we agreed not to begin «until the moon begins to be eclipsed on its eastern side. Should it regain its full light while we are still in transit, our departure becomes futile.» In other words, Kepler knew that once outside the protective blanket provided by the earth’s atmosphere, humans could not survive the resulting solar bombardment: the flight must begin at the critical moment when the sun is behind the earth or at a point directly opposite the point of take-off. During a lunar eclipse the earth’s shadow would provide the tunnel of darkness required to protect the vulnerable moon voyager; and it is not by accident that the maximum duration of such an eclipse is four and one-half hours, just one-half hour more than the duration of the voyage itself.15 A further indication of Kepler’s mastery of Copernican astronomy is his understanding that since the earth and the moon are both in motion, the shortest route to the latter would not be the straight line advocated by such ancient writers of mythology as Lucian, but a trajectory from earth to a point in space where the moon and the lunar voyagers would arrive simultaneously.16

«Campanella wrote a City of the Sun. What about my writing a 'City of the Moon?' Would it not be excellent to describe the cyclopic mores of our time in vivid colors, but in doing so—to be on the safe side—to leave this Earth and go to the Moon?» ~ Johannes Kepler.



Kepler's model to explain the relative distances of the planets from the Sun in the Copernican System.

Following an account of the painful family circumstances and risks attending the posthumous publication of Somnium in 1634, this essay contends that the work marks the beginning of a new era. After an initial tribute to the classicists, the modern scientist takes over. The Daemon of Lavania is nothing less than Kepler’s own subtly masked voice, speaking with authority about the unlimited possibilities of science. Gone is the fantasy-utopian world of Lucian and Campanella; in its place is an imaginative modern work anchored in fact and rich in rational scientific theory.

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sources: depauw.edu, doverpublications.com, depauw.edu

Berättelsernas månresor

Den första historien om att resa till månen

Den första modärna månfärdshistorien som fick någon betydelse skrevs 1865 av fransmannen *Jules Verne*, den hette "De la Terre á la Lune" (Från Jorden till Månen) Fortsättningen, "Autour de la Lune"(Runt Månen) kom 1871.

Verne var inte den enda som satt och plitade på historier om resor i rymden under 1860-talet, men det var Vernes berättelser som direkt inspirerade flera av första generationens rymdfartsteoretiker.

Som litterär genre fanns månresor med långt före Vernes tid, men hur långt före?

jw 28.5 1998, uppdat. 08.12.2005

De allra första mån-historierna kunde inte skrivas förrän myter och gudaberättelser hade fått vika för rationella försök att med iakttagelser och mätningar skapa en världsbild.

För forntidens människa var den jord hon vandrade på en platt skiva med himlavalvet lagd som en snurrande ostkupa över. I Homeros' Iliad beskrivs jorden på - och som - den praktsköld smed-guden Hefaistos gör åt Achilleus. I Odysseen råkar "den mångförslagne Odysseus" ut för alla tänkbara äventyr. En resa till månen är otänkbar, och förekommer inte. Månen nämns inte ens.

Under senantiken lyckades *Aristarchos från Samos* (ca.310 - 230 f.Kr) någång kring 260 före vår tideräknings början, använda egna mätningar och Euklides då helt nya geometri-sammanställning till hjälp för att bestämma de relativa avstånden mellan jorden, månen och solen.

Aristarchos kom till att sträckan solen-månen var över 18 men under 20 gånger sträckan månen-jorden, med ledning av jordskuggans form vidmånförmörkelser, att måndiametern

måste vara drygt 1/3 av jordens. Månavståndet fick han till kring 80 jordradier. Solens diameter fick han till 7 gånger jordens, och solens volym följaktligen 340-faldigt jordens volym.

Den logiska slutsatsen var att jorden omöjligen kunde vara världsalltets centrum. Det var första gången i historien som en *mätning* hade uppdagat något om världsalltets byggnad!

I Alexandria bestämde Museion-förmannen *Eratosthenes* (275 - 195 f.Kr) jordens diameter till ett värde som vi idag anser någorlunda rätt, och då kunde också avståndet till månen beskrivas med landsvägsmått. Måtten visade klart att det mesta av världsalltet måste vara tom rymd, med jorden, solen och månen som mycket små kroppar i den stora tomheten .

Plutarchos från Chaeronea (46 - 120), av oss mest känd som levnadstecknare, skrev även essäer. En av dem handlar om det ansikte man ser i månen. Plutarchos beskriver sin måne som en jord i miniatyr, men bebodd av "daimones", som via de broar sol- och månförmörkelserna upprättar kan besöka Jorden. Sokrates "daimon" var en av dem, och Plutarchos misstänkte att oraklet i Delfi hade med mån-demonerna att skaffa.

Och nu är det dags för de första bevarade månrese-historierna 160 e.Kr.

Lukianos från Samosata (ca.115-200) använde gladeligen, 40 år efter Plutarchos frånfälle, månen som en lokal för några av sina satiriska berättelser. I "*Alethes Historia*" (En sann berättelse) sveper en sjuttionio dygns storm utanför Herakles stoder iväg berättelsens "jag" med skepp, besättning och allt till månen. Det åttionde dygnet klarnar vädret och *"vi fick ett stort land i luften i sikte, likt en skimrande ö."*

Nicolaus Copernicus (1473 - 1543), *Johannes Kepler* (1571-1630) och *Galileo Galilei* (1564 - 1642) tog upp och förnyade Aristarchos' heliocentriska världsmodell. Galilei och Kepler kunde efter 1609 dessutom betrakta månen genom de första teleskopen.

Galileo Galileis brevvän, doctor mathematicus Johannes Kepler, var den, som konstruerade prototypen till det egentliga astronomiska teleskopet - det som Galilei använde var en urtyp för teaterkikare. Kepler var också den förste som översatte Lukianos' "*Alethes Historia*" till latin. Kepler skrev därtill en egen månrese-historia "*Somnium"* (Drömmen) var den första och bästa bland de nya månrese-berättelserna som teleskoptittandet lockade fram.

Kepler plitade på Somnium för sitt höga nöjes skull, av och till, under mer än ett decennium. Somnium trycktes först efter hans död, på latin år 1632 och på tyska 1634.

Kepler visste att jordens atmosfär inte sträcker sig ända till månen. Men då han inte kände till någon fysisk möjlighet att ta sig dit, valde han som vehikel sin fantasi, som han förklädde till en dröm.

"*På den skimrande ön Levania, belägen på femtio tusen tyska mils avstånd i den djupa ethern",* dvs på månen, bor, i enlighet med Plutarchos, andeväsen, demoner, som kan flyga mellan jorden och månen längs den skuggbro som uppstår vid sol- eller månförmörkelser. Man kan tillkalla dessa andar genom att yttra tjugo magiska bokstäver (ASTRONOMIA COPERNICANA), och om de är välvilligt sinnade, kan de låta en astronom följa med på en resa över. Förutsatt då att astronomens tankevärld inte är alltför jordbunden och astronomen själv inte för korpulent. Pekfingret riktas mot *Tycho Brahe* (1546-1601), som visserligen lät Kepler ta del av sitt superba observationsmaterial, men som så länge han levde lät denne betala för varje smula med gyckel och hån.

Mån-demonerna skyr solens ljus i likhet med astronomerna. Kepler minns sin ölkällare i Prag, "*varest man på bästa sätt observerar solens gång över meridianen".*

Kepler konstaterar att strömmande vatten forslar bort lösmark från bergen och breder ut det över lågland. Han tycker sig se tecken på att detta måste ha skett på månen likaväl som på jorden. En idéhistoriskt viktig iakttagelse: Den aristoteliska skillnaden mellan de eviga himlarna och förgängelsens Jord existerar inte.