

# Measurer of All Things: John Greaves (1602-1652), the Great Pyramid, and Early Modern Metrology

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Writing from Istanbul to Peter Turner, one of his colleagues at Merton College, Oxford, John Greaves was deeply worried:

Onley I wonder that in so long time since I left England I should neither have received my brasse quadrant which I left to be finished for my journey thither, nor any notice of it [...]. I agreed with mr. Allen upon price and the time that he should finish it, if he hath failed me he hath done me the greatest injury that can be.<sup>1</sup>

A great injury indeed, because Greaves's journey to Italy and the Levant was all about measuring—luckily the instrument did reach him at some later stage. The thirty-six-year-old Professor of Geometry at Gresham College was taking the measurements of countless monuments and objects in the locations he visited. In Rome he measured, among many other ancient structures, Cestius' Pyramid and St. Peter's basilica. In Lucca, deeply impressed, he counted his paces around the beautiful city walls. In Siena he observed together with a "Mathematical Professor" one of the *Sidera Medicea* using "a glass." In Egypt he even hurt his eyes gazing at the sun, looking for sunspots and measuring its diameter.<sup>2</sup> His measuring mission, however, culminated in the fixing of the

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<sup>1</sup> BL Ms. Add. 34727, f. 63 (March-June, 1638).

<sup>2</sup> "Observations from his travels, extracted from his mss. notes in the Savilian Library," in T. Birch (ed.), *Miscellaneous Works of Mr. John Greaves* (2 vols.; London, 1737), II, 486, 491-93

latitudes of Istanbul, Rhodes, and Alexandria. As Bishop Juxton wrote before the trip to Greaves's employers at Gresham College (apparently using Greaves's own promotional language):

This worke I find by the best astronomers, especially by Ticho Brache [*sic*] and Kepler, hath beene much desired as tending to the advancement of that science, and I hope it wil be an honour to that nation and prove ours if we first observe it.<sup>3</sup>

A mathematician-Orientalist, commanding the ancient and modern astronomical and geographical literature of Latin, Greek, Hebrew, Arabic, and Persian authors, Greaves was arguably the best qualified European at the period to perform the task. That he miscalculated the latitude of Rhodes is of less consequence for his present-day readers.<sup>4</sup> However, one of the most obscure and therefore telling of his measurement activities was the survey of the Pyramids of Giza, which resulted in the *Pyramidographia* (1646).<sup>5</sup> This remarkable learned treatise and travel account hybrid, which is at the focus of the present study, gives us a glimpse into the rich and complex world of scientific antiquarians.

Greaves is most conveniently remembered today as an Orientalist. While we must be thankful to Edward Said for broadening the meaning of Orientalism—from an academic discipline, accumulating objective knowledge of the East, into a much wider cultural discourse, his emphasis on the nineteenth and twentieth centuries and on the European colonial mindset is less useful for making historical sense of what early modern Orientalists were doing—physically and culturally. We can understand Greaves's "Oriental" enterprise in its

(Rome); 478 (Lucca); 480 (Siena); 508 (Egypt). In Greaves's list of acquaintances, jotted down during his travels on the inside cover of a printed astrological almanac for 1637, the professor is identified as Benedetto Giovanelli Orlandi (Bodley Ms. Savile 49 [1], 1').

<sup>3</sup> Quoted by Nicholas Tyacke, "Science and Religion at Oxford before the Civil War," in *Puritans and Revolutionaries: Essays in Seventeenth-Century History Presented to Christopher Hill*, eds. D. H. Pennington and K. V. Thomas (Oxford, 1978), 84, from PRO T. 56/13, fol. 2'.

<sup>4</sup> This project, together with the plan simultaneously to observe a lunar eclipse in several locations, was conceived by John Bainbridge, Greaves's mentor and predecessor as Savilian Prof. of Astronomy (letter from Constantinople to Turner, 2 Aug. 1638, published in *Miscellaneous Works*, II, 437); and see G. J. Toomer, *Eastern Wisdom and Learning: The Study of Arabic in Seventeenth-Century England* (Oxford, 1996), 72-75; and Raymond Mercier, "English Orientalists and Mathematical Astronomy," in *The "Arabick" Interest of the Natural Philosophers in Seventeenth Century England*, ed. G. A. Russell (Leiden, 1994), 158-214, here 170.

<sup>5</sup> John Greaves, *Pyramidographia: Or a Description of the Pyramids in Agypt. By Iohn Greaves, Professor of Astronomy in the University of Oxford* (London, 1646). After the first edition there were a shortened French translation in Thevenot's *Relations de divers voyages*, 1696, a 1706 English edition, a 1737 edition in the *Miscellaneous Works*, corrected by Birch according to Greaves's own annotated copy (Bodley Savile I 7), and a 1744 reprint in Churchill and Churchill's *Collection of Voyages and Travels*.

depth and variety only within long established European traditions of scholarship and keeping the intellectual concerns of his time in mind.<sup>6</sup>

But beyond articulating for us the nature of early Orientalism, the *Pyramidographia*, as well as Greaves's entire scientific career, situated in their wider European context, provide a fine entry point into a foreign world of learned practices and methods. It teaches us how well into the seventeenth century astronomy and philology, observation and bookishness, could coalesce in one figure, in one enterprise.<sup>7</sup> We still lack a modern biography of Greaves, a complex protagonist of a complex period, and even a full evaluation of his intellectual work. While this paper surely cannot compensate for that, I do attempt here a brief exposition of Greaves's *Pyramidographia*.<sup>8</sup>

Modern historians of archaeology and Egyptology, preoccupied mostly with the disciplines' progress and development of scientific standards, have noted the *Pyramidographia* in passing and praised its precise language and rigorous research. Greaves, indeed, provided the first full scholarly treatment of the Giza complex, meticulously surveying both the works of previous authors, ancient and modern, Eastern and Western, and the monuments in situ.<sup>9</sup> Using up-to-date antiquarian methods he had imported from Rome, Greaves identified the pyramids' builders, established the chronology and history of their construction and use, and described their physical attributes. In modern terms Greaves made a genuine, balanced archaeological study, based on a wide sample of written sources and material evidence.<sup>10</sup> However, because our aim is to reconstruct Greaves's own vocabulary rather than to establish a genealogy for ours, it is more than plausible to assume that he would have located his chief success elsewhere. The following analysis is devoted then to a contextual read-

<sup>6</sup> See Peter Burke, "The Philosopher as Traveller: Bernier's Orient," in *Voyages and Visions: Towards a Cultural History of Travel*, eds. J. Elsner and J.-P. Rubiés (London, 1999), 124-37; Daniel Goffman, *Britons in the Ottoman Empire: 1642-1660* (Seattle, 1998). Cf. the forum "Orientalism Twenty Years On," *American Historical Review*, 105 (2000), 1204-49.

<sup>7</sup> See Ann Blair, *The Theater of Nature: Jean Bodin and Renaissance Science* (Princeton, 1997).

<sup>8</sup> See Birch's biographical account in Greaves, *Miscellaneous Works* (based mostly on A. Wood's *Athenae Oxonienses*, and on T. Smith's *Vitae quorundam eruditissimorum et illustrium virorum*). Birch's manuscript working notes for this edition are kept as BLAdd. 4243. See Toomer, 127-42, 167-79, and see Mercier.

<sup>9</sup> See for example, John Wortham, *The Genesis of British Egyptology, 1549-1906* (Norman, 1971), 19-23; and Leslie Greener, *The Discovery of Egypt* (London, 1966), 54; cf. Helen Whitehouse, "Towards a Kind of Egyptology: The Graphic Documentation of Ancient Egypt, 1587-1666," in *Documentary Culture: Florence and Rome from Grand-Duke Ferdinand I to Pope Alexander VII*, ed. Elizabeth Cropper et al. (Bologna, 1992), 63-79.

<sup>10</sup> Cf. Graham Parry, *The Trophies of Time: English Antiquarians in the Seventeenth Century* (Oxford, 1995), 291, where John Aubrey's *Monumenta Britannica* is described as the first recognizable archaeological study written in Britain, although Aubrey was aware of Greaves's *Pyramidographia*: "Of Mausolea," in *Monumenta Britannica: Or, a Miscellany of British Antiquities*, ed. John Fowles (Sherborne, 1980), 672-73.

ing of the *Pyramidographia*, one that is concerned with the intellectual currents in which Greaves moved as he crawled through the dark pathways of the Great Pyramid.

If the *Pyramidographia* is hard to classify either as an Orientalist or archaeological work, what about Egyptology? The cultural history of early modern Egyptology has yet to be fully explored. In particular there are only cursory treatments of the pyramids and pyramidology in early modern culture. We are lucky though to have a few excellent starting points, which jointly allow us to appreciate the unique and the ordinary aspects of Greaves's work.<sup>11</sup> Broadly speaking, Greaves's meticulously researched scholarly monograph on the Giza complex stands out over the background of the period's "Egyptology"—dominated by Neoplatonic fascination with Egyptian hieroglyphs, description of preternatural wonders, appetite for mummies, and conventional, romanticizing travel accounts.<sup>12</sup>

This is not to deny that Greaves himself was deeply interested in those aspects of Egyptian history and culture, particularly in mummies and hieroglyphs. In the last paragraph of the *Pyramidographia* he alluded to a future work on mummies and hieroglyphs, based on his observations, transcriptions, and purchases, many of which, he gloomily reported, had perished "amidst the sad distraction of the time" (120, wrongly numbered 142).<sup>13</sup> What made ancient Egypt so unique in Greaves's and many other Europeans' eyes was that it could somehow withstand time's destructive effects. Mummies had therefore attracted Greaves's close attention: in his travel notes he devoted a lengthy description to the one he examined in Alexandria.<sup>14</sup> In the *Pyramidographia* itself he discussed Egyptian embalming methods in order to explain the purpose for which the pyramids were built and their subsequent form (43-60).

Hieroglyphs on mummy cases, gems, and monuments gave him cause for many speculations, and his manuscript travel notes are full of occasionally elegant hieroglyph sketches.<sup>15</sup> In the *Pyramidographia* he ambitiously an-

<sup>11</sup> Karl H. Dannenfeldt, "Egypt and Egyptian Antiquities in the Renaissance," *Studies in the Renaissance*, 6 (1959), 7-27; Frances Yates, *Giordano Bruno and the Hermetic Tradition* (London, 1964); Erik Iversen, *The Myth of Egypt and Its Hieroglyphs in European Tradition* (Princeton, 1993<sup>2</sup>); James S. Curl, *Egyptomania: the Egyptian Revival, a Recurring Theme in the History of Taste* (Manchester, 1994); Sydney Aufrère, *La momie et la tempête: Nicholas-Claude Fabri de Peiresc et la curiosité égyptienne en Provence au début du XVII<sup>e</sup> siècle* (Avignon, 1990); Brian Curran, "Ancient Egypt and Egyptian Antiquities in Italian Renaissance Art and Culture" (Ph.D. diss., Princeton University, 1997). On pyramids see John Paoletti, "Renaissance," in *Pyramidal Influence in Art* (Dayton, Ohio, 1980), 27-35; Harry Bober, "The Eclipse of the Pyramids in the Middle Ages," *ibid.*, 5-18; Jeannine Guérin Dalle Mese, *Égypte: la mémoire et le rêve, itinéraires d'un voyage, 1320-1601* (Florence, 1991), 524-49.

<sup>12</sup> Early modern Europeans, such as François I<sup>er</sup>, eagerly consumed the oil skimmed off boiled mummy flesh, known for its curative effect. Dannenfeldt, 17-21.

<sup>13</sup> Page numbers within the text refer to the *Pyramidographia*.

<sup>14</sup> *Miscellaneous Works*, II, 516-21.

<sup>15</sup> Bodley Ms. Savile 49 (3), f. 11<sup>v</sup>, passim.

nounced how he might have deciphered the “civill” Egyptian script, had the inscriptions on the first and third pyramids (the translations of which he had in Diodorus and Herodotus) not been defaced. He agreed with Athanasius Kircher that the sacred Egyptian script, representing animals or familiar objects, expressed abstract notions. Yet he sharply refuted Kircher (“though an able man”), who argued that the Coptic script had originated in the hieroglyphic, and rightly claimed it to be a corruption of the Greek (113-14).<sup>16</sup>

Like many travelers before and after him, Greaves arrived in Egypt eager to encounter the supernatural, basically Herodotean landscape. At a Frenchman’s store in Cairo he learned about curious medicines, saw a two-headed calf, and a four-legged dancing serpent, which preferred (in the summer) bagpipe music.<sup>17</sup> Though unnamed by Greaves, the Frenchman is easily identified as Louis Bertier, a Lyon merchant who stayed in Cairo for twenty-two years and was running there a famous cabinet of curiosities.<sup>18</sup> He stayed at the residence of the Venetian Santo Seghezzi, the French consul in Cairo, another focal point for Europeans in town. He heard there stories about local witches who could make cats speak, and about real encounters (which he reconfirmed later) with the devil “in the form of a Blackamoor.” Thus even if he had the impression that “the Arabians and moors use much witchcraft at Cairo,” it was basically in European circles there, perhaps geared to satisfy marvel-hungry Europeans, that he obtained his dose of memorabilia.<sup>19</sup>

As much as it shared in the general culture of Egyptian lore and curiosity of late-Renaissance Europe, Greaves’s Egyptology, as expressed in the *Pyramidographia*, was nonetheless different. Disenchanted perhaps by Isaac Casaubon’s famous (though not first) debunking of the myth of Hermes Trismegistus, Greaves was not after Egyptian esoteric wisdom.<sup>20</sup> His findings had for him, as a seventeenth-century natural philosopher, that urgency and relevance which were possible only in the fenceless terrain of early modern knowledge, where scholarship and science could easily converse with one another. His description of the pyramids was but a section of a larger, practical

<sup>16</sup> Kircher’s theories were first published in his *Prodromus coptus* (1636). Birch refers to a meeting between the two (*Miscellaneous Works*, I, vi). Though I could not find reference to it in Greaves’s travel notes, such a meeting is more than likely to have happened; we know that Kircher later used the notes of Tito Livio Burattini (1617-81), “an ingenious young man (86)” who was Greaves’s companion in the Pyramid: Whitehouse, 68.

<sup>17</sup> *Miscellaneous Works*, II, 523-24.

<sup>18</sup> See Henry Blount, *Voyage into the Levant* (London, 1636), 45, and Jean Coppin, *Le Bouclier de l’Europe* (Puy, 1686), 179-82. See also Aufrère, 100-104.

<sup>19</sup> *Miscellaneous Works*, II, 521-22. On Santo Seghezzi see Aufrère, 89-98.

<sup>20</sup> On Casaubon’s *Exercitationes* see Yates, 398ff; Frederick Purnell, Jr., “Francesco Patrizi and the Critics of Hermes Trismegistus,” *Journal of Medieval and Renaissance Studies*, 6 (1976), 155-78; and Anthony Grafton, “Protestant Versus Prophet: Isaac Casaubon on Hermes Trismegistus,” in *Defenders of the Text: The Traditions of Scholarship in an Age of Science, 1450-1800* (Cambridge, Mass., 1991), 145-61. Greaves referred to the *Exercitationes* in the context of weights and measures in *A Discourse of the Romane Foot* (London, 1647), 58.

and sober project of standardizing and synchronizing the weights and measures of all ancient and modern nations. It is metrology which fueled Greaves's fascination with ancient monuments, and with the Great Pyramid above all.

Published some seven years after Greaves's return, when he was already the Savilian Professor of Astronomy in Oxford (since 1643), *The Pyramidographia* is unsurprisingly a scholarly work, with only few travel narrative elements. In his preface Greaves presented his project as an attempt to compensate for the lost *Sacred Commentaries* of the Egyptians, upon which Diodorus Siculus based his account of Egypt. Therefore, he writes, "it will be no superfluous labour to imitate the examples of the ancients, and to supply the loss of them, by giving a distinct narration of the several respective dimensions, and proportions of these pyramids" (A6<sup>r</sup>, A7<sup>v</sup>). Most of the work, however, could have well been written in Oxford: it is an extremely erudite and rationalistic discussion of chronology and history, based on classical, modern, and Eastern sources, a combination that even in the age of polymaths was unique.

After establishing the identity of the pyramid builders, Greaves attempted to date their construction. Using precise mathematical language<sup>21</sup> and advancing slowly from one secure date to another, Greaves finally reached the conclusion that the pyramids were built around 1266 BC. Now we know that, following the misdating of Herodotus, he got his chronology wrong by more than one thousand years, yet his was a remarkably learned error.<sup>22</sup>

Making the various Egyptian chronologies agree with one another was a daunting task. If we follow all the authors on Egyptian chronology, writes Greaves, "we shall finde our selves intangled in a Labyrinth, and Maze of Times." Greaves's way out of his temporal uncertainties, was to "to finde out some common, and received *Epocha*, in which either all, or most agree, that shall be our guide in matters of so great antiquitie" (17). For this solid point in time Greaves chose the miraculous migration of the Israelites from Egypt, which had the same hand to perform it and to record it, namely, the hand of Moses. However, he was well aware that "by the Scripture alone, it is impossible to inferre, what King of Aegypt was coetaneous with Moses," and suggested "Synchronisme," a comparison of sacred and profane authors, as a way to address the shortcomings of Scripture (18). Greaves was employing here perhaps the language of Joseph Mede, who attempted, in his apocalyptic interpretation

<sup>21</sup> E.g. "I shall limit this uncertainty between 420 and 430 years, which is sufficient latitude" (34).

<sup>22</sup> The currently agreed upon date is c. 2500 BC, in the fourth dynasty: Mark Lehner, *The Complete Pyramids* (London, 1997), 108; and see Mary T. Brück, "Can the Great Pyramid Be Astronomically Dated?" *Journal of the British Astronomical Association*, 105 (1995), 161-64, and Allan B. Lloyd, *Herodotus, Book II: Introduction and Commentary* (3 vols.; Leiden, 1975-88), I, 185-90, III, 60-73.

of *Revelation*, to synchronize its various prophecies with one another, and match them to known human history.<sup>23</sup>

Greaves then takes the reader through a tortuous path along such stations as Biblical prophecies and Olympiads to conclude that the pyramids, on the authority of Diodorus and Herodotus, were built at some point during the 904 years between Moses and the destruction of the Temple. For this period, he admits, only the lists of Manetho as preserved by Africanus and Eusebius are reliable. Within this strip he assigns the massive construction project to the Twentieth Dynasty, the names of whose kings, he conjectures, were effaced from history just for that reason (37-39).

As Paolo Rossi noted, “chronology was a slippery terrain” in the seventeenth century, and Egyptian chronology, challenging the self-sufficiency of the Bible as a history of mankind, was particularly so.<sup>24</sup> Acceptance of non-Biblical sources, especially after La Peyrère’s pre-Adamite theory (published 1655) had heightened the debate, had the potential of presuming pre-deluvian, or even pre-creation Egyptian existence. Greaves, however, does not seem to have had any problem with relying heavily either on the dynasties of Manetho the Egyptian priest, as published in Scaliger’s edition of Eusebius, or on Herodotus and Diodorus. All were in fact used as instrumental sources on an equal standing with the Bible for solving his practical exercise in chronology. Moreover, Greaves was open to Scaliger’s abstract ideas about time, such as the “Julian Period” and the “first Julian Period of proleptic time.” What seems most characteristic of Greaves’s short chronological excursion, however, is the complete absence of any reflection upon the theological implications that his work methods and facts might have. Although Greaves was dealing with the relatively safe post-deluvial period, he still proved himself, again, to be a follower of Scaliger, who had attempted to establish chronology as an independent branch of knowledge.<sup>25</sup> Greaves’s work on chronology and synchronization, which truly deserves a separate study, finds further expression in his notebook, where he noted down on the vernal equinox of 1638 in Constantinople the parallel readings in Arab, Coptic, Hebrew, Greek, and other calendars, as

<sup>23</sup> Joseph Mede, *Clavis apocalyptica* (Cambridge, 1627); tr. Richard More as *Key of the Revelation* (London, 1643). Note schematic chart opp. 26. See Paul Christianson, *Reformers and Babylon: English Apocalyptic Visions from the Reformation to the Eve of the Civil War* (Toronto, 1978), 124-29.

<sup>24</sup> Paolo Rossi, *The Dark Abyss of Time: The History of the Earth & the History of Nations from Hooke to Vico*, tr. Lydia Cochrane (Chicago, 1984), 151.

<sup>25</sup> See William Adler, *Time Immemorial: Archaic History and Its Sources in Christian Chronography from Julius Africanus to George Syncellus* (Washington, D.C., 1989), and Anthony Grafton, “Joseph Scaliger and Historical Chronology: The Rise and Fall of a Discipline,” *History and Theory*, 14 (1975), 156-85; *Joseph Scaliger: A Study in the History of Classical Scholarship* (2 vols.; Oxford, 1983-93), II, also Don Cameron Allen, *The Legend of Noah: Renaissance Rationalism in Art, Science, and Letters* (Urbana, 1949).

well as in his editions of the chronological work of the prince-scientist Ulugh Beg (1394-1449), whom he greatly admired, and of Bainbridge's *Canicularia*.<sup>26</sup>

In his discussion of the pyramids' purpose and shape Greaves preferred down to earth explanations to fancier, metaphysical ones. For example, he dismissed any astrological significance attributed to the pyramidal form as if reflecting the signs of the zodiac. He allowed that the pyramids may have represented some sort of a god, an earlier form of idolatry: "before the exact art of making statues was found out, the ancients erecting columns, worshiped these as the image of god" (63). In his own annotated copy, which he gave his brother Thomas, he actually rewrote this section, hypothesizing that the pyramidal shape might be related to the sun god Osiris ("the god of many eyes") and to the cone of vision. Ultimately, however, it was the firmness of the pyramid that he considered the most significant. Following della Valle, who described the pyramids as "utterly steady through all the motions of the heaven, earth and time, assuming no less the firmness than the form of a natural mountain," Greaves emphasized function rather than symbolism in his analysis.<sup>27</sup> Permanence and stability were of prime importance for Greaves's metrological ideas.

Greaves was an ambitious scholar, not very modest in the estimation of his projects. Obviously, he took the most pride in his observations on site, which he narrated in chivalric language of courageous exploration. It is useless, he said, to recount all past measurements of the Great Pyramid's surface. He gave his own instead, obtained "by experience and by diligent calculation," using "an exquisite radius of ten feet," "most accurately divided" (73, 68, preface).<sup>28</sup> As he moved on to describe the interior, Greaves assumed the role of the first discoverer, as if no one had exposed the inner chambers before him. The ancients were silent on the subject, out of "awful regard, mixed with superstition." The Arabians—whose qualities as mathematicians, albeit not as historians, Greaves greatly admired—added so many inventions "that the truth had been darkened, and almost quite extinguished by them" (79, 80). Thus he quoted at great length from Ibn Abd al-Hakam (d. 871/H. 257), a medieval Arab historian of the conquest of Egypt, North Africa, and Spain, only to dismiss his account as "litle better than a *Romance*" (80-84). That noted travelers of his

<sup>26</sup> Bodley Ms. Smith 15, f. 9. Ulugh Beg, *Epochae Celebriores, Astronomis, Historicis, Chronologis, Chataiorum, Syro-Graecorum, Arabum, Persarum, Chorasmiorum, Usitatae: Ex Traditione Ulug Beigi* (Londini, 1650); John Bainbridge, *Canicvlaria, una cum demonstratione ortus Sirii Heliaci ...* (Oxoniae, 1648).

<sup>27</sup> "... rende saldisimo, ad ogni motiuo del cielo, della terra, e del tempo, pigliando non men la fermezza, che la forma di un monte naturale." *Viaggi di Pietro della Valle il pellegrino ...* (Roma, 1650), 360. G. Bull's translation in *The Pilgrim: The Travels of Pietro Della Valle* (London, 1989), 51. See also Peter Heyns's entry in Abraham Ortelius' *Album amicorum*, ed. Jean Puraye (Amsterdam, 1969), f. 7; and in Francesco Colonna, *Hypnerotomachia Poliphili: the Strife of Love in a Dream*, tr. Joscelyn Godwin (London, 1999), 30 (b3<sup>v</sup>).

<sup>28</sup> See John J. Roche, "The Radius Astronomicus in England," *Annals of Science*, 38 (1981), 1-32.



own time—such as Grimani, Belon, della Valle, whose works he quotes in other contexts—described and measured the inner chambers Greaves conveniently failed to mention.<sup>29</sup> Greaves appropriated into his epic even the most casual touristic rituals surrounding the typical Janissary-guided European “discovery” visit to Giza: instead of the Janissary firing into the entrance to frighten potential robbers,<sup>30</sup> it is now Greaves himself firing in order to hear the four-fold echo referred to by Plutarch (90).<sup>31</sup> Other common traveler practices referred to by previous travellers (Belon, della Valle), such as breaking a chip off the King’s monument in the chamber, climbing and shooting arrows atop the Pyramid, to see whether they reach beyond its base, were presented by Greaves as natural experiments (77-8, 95).

Greaves’s cathartic exit from the Great Pyramid is worth quoting in full:

And thus have I finished my description of all the inner parts of this Pyramid: where I could neither borrow light to conduct me, from the ancients: nor receive any manduction from the uncertaine informations of modern travellers, in those dark, and hidden paths. We are now come abroad into the light, and Sunne, where *I* found my Janizary, and an English Captain, a little impatient to have waited above three hours [...], who imagined whatsoever they understood not, to be an impertinent and vain curiosity (101).

Unlike Poliphilo, an earlier compulsive pyramid-measurer, who was chased out of the immense obelisk-mounted pyramid of the *Hypnerotomachia* by a dragon, Greaves came out a victor.<sup>32</sup> His heroic imagery of darkness overcome by light is reflected in the impressive image of the interior of the Great Pyramid—the first elevation section ever drawn for it (figure 1). With his other illustrations of architectural detail, Greaves sharply broke away from the traditional depiction of pyramids among scattered mummies in a symbolic desert of Egyptian memorabilia.<sup>33</sup> Yet while designing the image Greaves wished perhaps to convey more than the accurate geometrical organization of the building. Producing such a heavily dark image at the expense of clarity and aesthet-

<sup>29</sup> Pierre Belon has found the King’s chamber to be “quarrée de six pas de long, et quatre pas de large, qui et de quatre à six toises de hauteur.” *Observations de plusieurs singularitez...* (Anvers, 1555), 202; della Valle, 365, *The Pilgrim*, 52 “on measuring it by my own feet I found it to be twenty-one across and about forty long.”

<sup>30</sup> George Sandys, *A Relation of a Journey begun An. Dom. 1610* (London, 1621<sup>2</sup>), 129; on Sandys’s journey see Jonathan Haynes, *The Humanist as Traveler* (Rutherford, 1986). See Georges Goyon, *Les inscriptions et graffiti des voyageurs sur la grande pyramide* (Le Caire, 1944), xxxiv-xli.

<sup>31</sup> In *De placitis philosophorum* IV, 20.

<sup>32</sup> Colonna, *Hypnerotomachia Poliphili*, 58 (d1<sup>v</sup>) -67 (d6).

<sup>33</sup> Sandys, 128; and see Paoletti and Whitehouse.

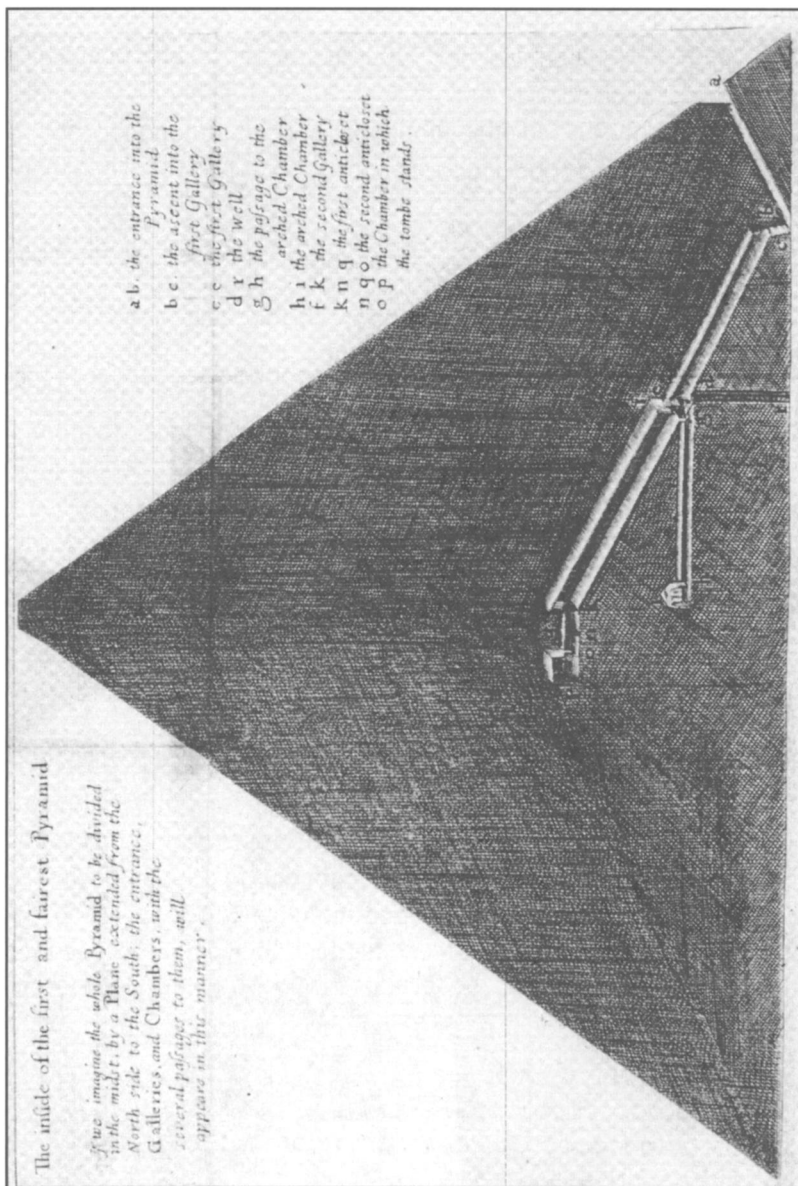


Figure 1: interior of the Great Pyramid, J. Greaves, *Pyramidographia* (London, 1646), opp. 78. With permission, Princeton University Library.

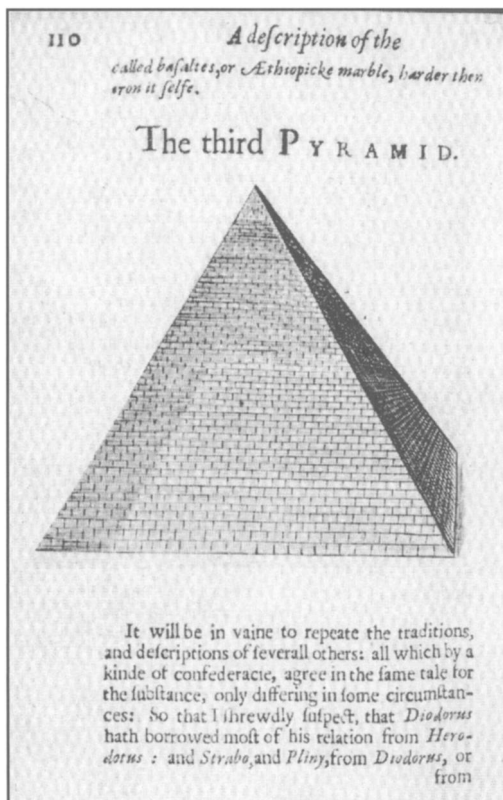


Figure 2: exterior of the third Pyramid, J. Greaves, *Pyramidographia* (London, 1646), 110. With permission, Princeton University Library.

ics, he tried to illustrate the experience of penetrating into the mysterious, obscure sepulcher. In comparison to this impressive image the illustrations of the three pyramids' exteriors are disappointing, following the conventional steep form influenced by Cestius's Pyramid in Rome, and being uninformative in terms of texture and detail (figure 2).

Greaves's images betray his heavy reliance on the Roman catacomb explorers, most notably on Antonio Bosio, who had provided in his *Roma sotterranea* (published posthumously, 1632, figure 3) a fine model to emulate. It is not for nothing that Greaves visited the catacombs, "For I took so much pains for my own satisfaction to enter those wonderful grottos and to compare his descriptions."<sup>34</sup> He also consulted the Roman antiquaries who were involved in the project: the Vatican librarian Lucas Holsten, "a learned companion of

<sup>34</sup> Marginal note in his copy of *Pyramidographia*, 98. See Simon Ditchfield, *Liturgy, Sanctity, and History in Tridentine Italy: Pietro Maria Campi and the Preservation of the Particular* (Cambridge, 1995), 86-89; Francis Haskell, *History and Its Images: Art and the Interpretation of the Past* (New Haven, 1993), 113-14; Anthony Grafton, "The Ancient City Restored: Archaeology, Ecclesiastical History, and Egyptology," in *Rome Reborn: The Vatican Library and Renaissance Culture* (New Haven, 1993), 115-16.

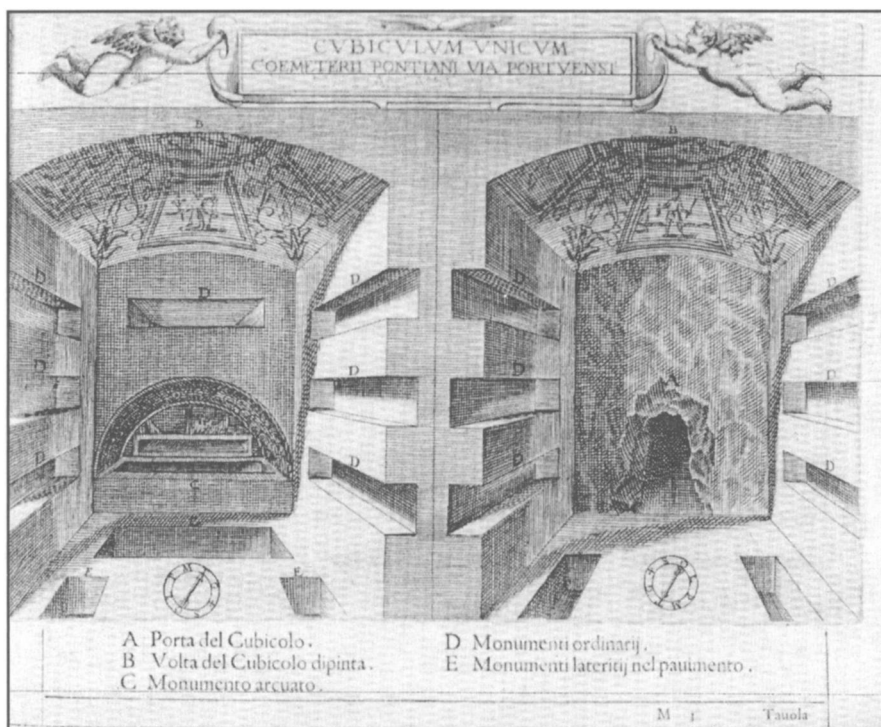


Figure 3: interior of catacombs, A. Bosio, *Roma sotterranea* (Rome, 1632), lib. II.xxi, 137.

With permission, Marquand Library of Archaeology, Princeton University.

Cluverius, in those honourable travails of his, for the restauration of the ancient Geography,” and editor of early martyrdom texts; and Gasparo Berti, “a man curious, and judicious.”<sup>35</sup> Berti, who surveyed the catacomb complexes for the *Roma sotterranea*, even walked Greaves through the Roman monuments: “being an *Academic*, he would not believe almost any thing in writings but what he saw, and would have others to do the same.” (It is interesting that Greaves, unlike Berti in the Catacombs, did not produce a general plan of the Giza complex.)<sup>36</sup>

In spite of Greaves’s bravado, however, it is clear that he did perform his measurements very carefully. While Belon and della Valle, among others, gave approximate measures and thus enabled their readers to create only a rough impression of the inner paths and chambers, Greaves made accurate measure-

<sup>35</sup> *Romane Foot*, 26; Gasparo Berti (c. 1600-1643) is remembered mostly for his pioneering experiments in barometry, his calculation of the latitude of Rome, and the survey of the catacombs under the patronage of Cardinal Barberini.

<sup>36</sup> *Miscellaneous Works*, II, 490.

ment the center of his visit to the site. Typically, he never missed an opportunity to mention his painstaking efforts to procure instruments, and to measure and re-measure with the utmost preciseness. In fact an anonymous early critic of the *Pyramidographia*—clearly eaten up by envy—attacked Greaves on his hyperbolic language of instrumentation: unimpressed by Greaves’s “exquisite ten feet radius,” he argued that length does not count if the radius was not accurately divided, if the transom was not exactly at a right angle to the staff, and brought up many other objections. “It may seem therefore, that the naming of ten feet is rather to amaze than convince the unskilled reader,” he concluded, not completely without justice.<sup>37</sup> More interesting for the purpose of this study is that the critic found no fault with the idea of Greaves’s project, it is time that we understand what exactly he had in mind when he decided to invest such a great material and intellectual effort in this enterprise.

In a revealing footnote—a location he seems to favor for discussing in print innovative ideas with fellow scholars such as Kircher and William Harvey—Greaves disclosed the core of his grand project: in the second gallery he took his measures as precisely as he could, “judging this to be the fittest place for the fixing of measures for posterity. A thing which has been much desired by learned men, but the manner how it might be exactly done hath been thought of by none.” If only the ancients had done so, he lamented, we would not have been so perplexed today by the puzzle of ancient measures of the “*Hebrews, Babylonians, AEgyptians, Greeks, and other nations*” (94 note b). Hence, Greaves, echoing an idea voiced by Girolamo Cardano almost a century earlier, suggested the Great Pyramid, which stood firm for 3,000 years and is likely to continue to do so, as the solution for the impossible situation of European metrology.<sup>38</sup>

The study of weights and measures was in fact a central preoccupation of antiquarians, theologians, and natural scientists in the early modern period, to an extent that is still largely ignored by modern scholarship.<sup>39</sup> The list of cen-

<sup>37</sup> *Miscellaneous Works*, II, 396ff: “Reflections on Mr. Greaves’s *Pyramidographia*, written by an anonymous Author soon after the Publication of the Book, and now first printed from a manuscript in the Savilian Library at Oxford.” In his own corrected copy Greaves added that his radius was accurately divided into 10,000 parts (A8), and he recalculated the height of the Great Pyramid from 481 to 499 feet (69).

<sup>38</sup> “Si igitur centesima[m] altitudinis certae pyramidis aut latitudinis pro firma mensura quis statuat, constare poterit apud omnes gentes, et per multa secula, et cum mensura certum pondus.” Girolamo Cardano, *De subtilitate libri XXI* (Lyon, 1559), XVII, 609.

<sup>39</sup> See Ronald Edward Zupko, *Revolution in Measurement: Western European Weights and Measures since the Age of Science* (Philadelphia, 1990); Witold Kula, *Measures and Men*, tr. R. Szeleter (Princeton, 1986); R. D. Connor, *The Weights and Measures of England* (London, 1987). For the later period see Ken Alder, “A Revolution to Measure: The Political Economy of the Metric System in France,” in *Values of Precision*, ed. M. Norton Wise (Princeton, 1995), 39-71; and more generally Arnaldo Momigliano, “Ancient History and the Antiquarian,” *Journal of the*

tral figures who devoted full tracts to the subject—from Budé through Mariana and Scaliger to Newton, to name but a few—could amount to an introduction to early modern scholarship. With chorography, genealogy, and etymology, metrology provided local antiquaries and *érudits* a physical link to the past. Just as by etymology Goropius Becanus in *Origines Antwerpiae* crowned his Flemish tongue the most ancient, Snell announced the *pes Rhinlandicus* the true Roman foot, and Budé did the same for the Paris foot.<sup>40</sup> The Spanish Biblical scholar Arias Montano has interpreted weights and measures as a divine gift to post-lapsarian human society and had worked hard through the Talmud to recover the ancient Hebrew units.<sup>41</sup> More cosmopolitan antiquaries like Angelo Colocci and his circle in Rome, whose metrological ideas were carefully studied by Ingrid Rowland, interpreted weights and measures within a Neoplatonic framework. With keen interest in the order of nature and in its mathematical structure, Colocci set out to mine Rome for material evidence for the Roman foot, and immersed himself in the writings of the Roman *agrimensores*.<sup>42</sup> Numismatics, finally, as well as the developing interest in monetary theory were also directly related to the study of metrology, as ancient coins retained their value also in weight.<sup>43</sup> Thus metrology was a central element in early modern antiquarian culture and shared in those immediate political, economic, and theological implications that any search for origins had for antiquaries. To illustrate this point it is worth noting that in England from 1607 to 1758 there were 43 separate weights and measures statutes. While centralization and unification efforts largely failed, standardization and enforcement were always matters of current affairs. That Greaves, still a professor in Gresham College, which was to a degree close to London merchant culture, sought funding (unsuccessfully) for his journey and instruments from the City of London and used a copy of the iron standard in Guildhall, may attest to the practical, contemporary context within which his historical metrology functioned.<sup>44</sup>

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*Warburg and Courtauld Institutes*, 13 (1950), 285-315. Patricia Fortini Brown, *Venice & Antiquity: The Venetian Sense of the Past* (New Haven, 1996); Haskell, *History and Its Images*; Peter N. Miller, *Peiresc's Europe: Learning and Virtue in the Seventeenth Century* (New Haven, 2000); Alain Schnapp, *The Discovery of the Past*, tr. Ian Kinnes and Gillian Varndell (New York, 1997); and Roberto Weiss, *The Renaissance Discovery of Classical Antiquity* (Oxford, 1988<sup>2</sup>).

<sup>40</sup> *Romane Foot*, 2, 17-18.

<sup>41</sup> Benito Arias Montano, *Antiquitates Judaicae* (Leiden, 1593), 108-12.

<sup>42</sup> Ingrid D. Rowland, "Abacus and Humanism," *Renaissance Quarterly*, 48 (1995), 695-727; *The Culture of the High Renaissance: Ancients and Moderns in Sixteenth-Century Rome* (Cambridge, 1998), ch. 5-6; "Raphael, Angelo Colocci, and the Genesis of the Architectural Orders," *Art Bulletin*, 76 (1994), 86-104; Hubertus Günther, "Die Rekonstruktion des antiken römischen Fussmasses in der Renaissance," *Sitzungsberichte der Kunstgeschichtlichen Gesellschaft zu Berlin*, N.F. 30, 18 December 1981, 8-12.

<sup>43</sup> See Haskell, ch. 1, and John Cunally, *Images of the Illustrious: The Numismatic Presence in the Renaissance* (Princeton, 1999).

<sup>44</sup> Zupko, 50; Julian Hoppit, "Reforming Britain's Weights and Measures, 1660-1824," *English Historical Review*, 108 (1993), 82-104, cf. Mordechai Feingold, *The Mathematicians'*

Greaves was working then within a well-established tradition. In 1647, a year after the *Pyramidographia* saw light, he published his treatise on Roman weights and measures, based on his fieldwork in Rome on the way to Egypt. Unhappy with the conclusions of his predecessors, he decided to leave aside speculation and “have recourse to such monuments of Antiquity, as have escaped the injury, and calamity of time.” Moreover, he claimed to be the first who both took actual measurements and made comparisons with contemporary standards. As we have seen, reconstructing the ancient Roman foot was a desired goal in itself. Ultimately, however, Greaves wished to “transmit” his figures “to posterity” and once and for all to establish the standard for modern metrology on the secure basis of “the most lasting monuments of the Ancients.”<sup>45</sup>

Greaves entered this well-trodden path blazed by Colocci, Agustín, Villalpando, and others with fresh empirical zeal. He began with the monument of T. Statilius Vol. Aper in the Vatican Gardens:

In the copying out of this upon an English foot in brasse, divided into 2000 parts, I spent at the least two houres (which I mention to shew with what diligence I proceeded in this, and the rest) so often comparing the several divisions, and digits of it respectively one with another, that I think more circumspection could not have been used; by which I plainly discovered the rudeness, and insufficiency of that foot.<sup>46</sup>

The marks in the Via Appia, on columns, and pavement stones in the Pantheon, as well as the Roman brass feet (“carefully preserved by the antiquarians”) that he examined were equally disappointing.<sup>47</sup> Having consulted the above mentioned Gasparo Berti and Lucas Holsten he even considered measuring the distance between Roman milestones and dividing the result by 5,000. He gave up on the idea for fear of inaccuracies and robbers.<sup>48</sup> He concluded, cautiously, that the Pes Colotianus on the monument of Cossutius, which used to stand in Angelo Colocci’s famous garden, “is the true Romane foot.”<sup>49</sup> Greaves was not the first to prefer this monument as the most reliable: Colocci, after whom it was named, and others thought so as well. However, Greaves seems to have

*Apprenticeship: Science, Universities and Society in England, 1560-1640* (Cambridge, 1984), 166-89; and Tyacke.

<sup>45</sup> *Romane Foot*, 14-20.

<sup>46</sup> *Ibid.*, 21.

<sup>47</sup> Greaves cites a letter of Peiresc to J.-J. Bouchard: *ibid.*, 22-23. “I cannot sufficiently wonder at the inequality which I have found in the divisions by digits, and inches, of the ancient Romane feet; which seems to me to have been made for fashion sake”; and see Miller, 162, n. 13, 78, 133.

<sup>48</sup> *Romane Foot*, 26.

<sup>49</sup> *Ibid.*, 32. Greaves determined the Roman foot to be 294mm, while the accepted figure today, as established by Hussey in 1834 is 296mm.

41

**Of the Romane Foot.**

*The English-foot taken from the iron Standard at Child-hall in London, and compared with the Standards for measures of divers Nations.*

Such parts as the English foot contains	1000
The Romane foot, or that on the monument of <i>Cassinus</i> in Rome, contains	967
The Roman foot, or that on the monument of <i>Stratius</i> in Rome, contains	972
The foot of <i>Vittelpandus</i> , deduced from the <i>Congius</i> of <i>Pisapia</i> , contains	586
The Greek foot	1007.12
The Paris foot	1068
The Venetian foot	1162
The Rhinland foot, or that of <i>Sualius</i>	1032
The Derah, or cubit, at <i>Cairo</i> in <i>Egypt</i>	1824
The Persian arch	3197
The greater Turkish pike at <i>Constantinople</i>	2100
The lesser Turkish pike at <i>Constantinople</i> in proportion to the greater, as 3 to 32	
The braccio at <i>Florence</i>	1912
The braccio for woollen at <i>Sienna</i>	1242
The braccio for linnen at <i>Sienna</i>	1974
The canna at <i>Naples</i>	2100
The vara at <i>Almaraz</i> & at <i>Gibraltar</i> in Spain	6880
<i>Il palmo di Architeti</i> at Rome, whereof X make	2760
<i>Il piede di Spagna</i> at <i>Almaraz</i> & at <i>Gibraltar</i>	752
<i>Il piede di Roma</i> at <i>Almaraz</i> & at <i>Gibraltar</i>	
<i>Telle</i> at Rome this and the former are both in- graven in a white marble stone in the Capitol with this inscription <i>Cirante L. H. P. et O</i>	695.1
The <i>Genoa</i> palm	815
The <i>Amswerp</i> ell	128
The <i>Amswerp</i> ell	228
The <i>Leiden</i> ell	228
The <i>Leiden</i> ell	228
<i>This Table I made by the Standards, the former by proportion.</i>	

Figure 4: comparative tables of measure units, J. Greaves, *Discourse of the Romane Foot, and Denarius* (London, 1647), 40-41.  
With permission, Huntington Library.



brought an element of unprecedented precision and universality into the study of the Roman foot, as may be seen in his comparative table (figure 4). Greaves condensed into this chart, reminiscent of his chronological “synchronism,” all his metrological findings: all the standards he could lay his hands on—eastern, western, ancient and modern—were compared first to the Roman foot, and then to the English foot of Guildhall. It is worth noting that Archbishop Ussher has found this table interesting enough as to copy it in his own hand into his *collectanea*.<sup>50</sup>

Hence Greaves promoted both explicitly and tacitly the English foot, conveniently the closest to the Roman among all other European standards. It was through the English foot and no other unit of measure that Greaves sought to establish the authority of ancient monuments as a common measure of modern European metrology. The idea suggests the broader motives of his powerful patron, Archbishop William Laud, for promoting Oriental studies. Laud saw the ancient Eastern Church (being non-Roman yet Episcopalian) as the fount of Anglican legitimacy, and he used this image in his attempt to construct a hierarchical, centralized, and unified state-church.<sup>51</sup> Greaves was presenting a High-Church metrology as it were, looking for ancient measures as the ultimate source of the independence and authority of the English foot and projecting this authority both toward the rest of Europe and toward England.

“As a coronis to the whole work,” Greaves wished to clearly demonstrate “how the Originals, and Standards, of weights and measures, notwithstanding the revolutions and vicissitudes of Empires, may be perpetuated to posterity.” Greaves devised for that purpose a list of ancient monuments “in remote Countries, that have stood unimpaired for many hundred years, and are like to continue many more,” at the top of which stood, naturally, the Great Pyramid. There followed the measures, all in English feet, of the basis of “that admirable Corinthian pillar . . . a quarter of a mile distant to the South of Alexandria. . . ; of the rock at Tarracina, or Anxur, where it adjoins the Via Appia. . . . Of the gate, or entrance to the Pantheon or Temple of Agrippa. . . . Of the Porta Sancta, in that new and exquisite structure of Saint Peters Church in Rome.”<sup>52</sup> Hence, Greaves’s method is supposed to work thus: if, say, a fire would destroy any kingdom’s standards (which actually happened on 16 October 1834 in London),<sup>53</sup> one could simply pick up a copy of Greaves’s *Romane Foot*, travel to Egypt, and read for example in p. 125: “Within the Pyramid, and the midst of it,

<sup>50</sup> Bodley Ms. Add. A. 379, f. 181<sup>v</sup>. On Greaves’s working methods see his letter from Leghorn, Italy, to Edward Pockocke at Constantinople, 28 February 1638/39, British Library Ms. Add. 6193, fols. 73<sup>r</sup>-75<sup>v</sup>.

<sup>51</sup> Hugh Trevor-Roper, *Archbishop Laud, 1573-1645* (Hamden, Conn., 1962<sup>2</sup>), esp. 281-84. Alastair Hamilton, “The English Interest in the Arabic-Speaking Christians,” in *The “Arabick” Interest*, 30-53; also “Eastern Churches and Western Scholarship,” in *Rome Reborn*, 225-50.

<sup>52</sup> *Romane Foot*, 123.

<sup>53</sup> Connor, 161-67.

there is a fair room.... In it there stands a hollow tombe...: the breadth of the west side of the same room at the joint, or line, where the first, and second row of stones meet, is 17 feet 190/1000." Then one could remeasure the same monument and recover the lost standard.

Thus the Great Pyramid was but one of many similar massive stone structures which in Greaves's view served as everlasting metrological standards. It is impossible therefore to recruit Greaves into the militias of modern Pyramid devotees, as some of them, and of their critics, have gladly done. Peter Tompkins, a spy turned guru, had argued that Greaves "hoped to find in the Great Pyramid a datum that might help to establish the dimensions of the planet" and that he brought instruments "for obtaining the declination and right ascension of the stars above it."<sup>54</sup> Daniel Boorstin, in a popular essay on the history of Western pyramidomania, also claimed that Greaves sought clues in the Pyramid for the precise dimensions of the Earth.<sup>55</sup>

Unfortunately for both Tompkins and Boorstin, nothing of the sort is to be found in the pages of the *Pyramidographia*. It seems that Greaves consciously avoided placing his study in any astronomical-astrological context. For example, he explicitly discounted Proclus's argument (in his commentary on Plato's *Timaeus*) that the Egyptian priests were making astronomical observations atop the pyramids (73). Unlike the *Hypnerotomachia* imaginary pyramid, where "the ingenious and gifted architect had displayed the highest degree of intellect by creating a number of lighting channels which corresponded to the movements of the sun..." Greaves's Great Pyramid was simply a massive structure.<sup>56</sup> It is exactly on this point—the lack of any astronomical or geodetic elements in the treatise—that a more careful reader, Robert Hooke, attacked Greaves's project. Discussing the question whether the axis of the Earth's rotation changes over time, Hooke wished that the "Meridian Line on some Building or Structure now in being," had been known, in order to compare it with their present state.

Upon this account I perus'd Mr. Graves his Description of the great Pyramid in AEGypt, that being Fabl'd to have been built for an Astronomical Observation [...]. I perus'd his Book I say, hoping I should have found ... some Observations perfectly made, to find whether it stands East, West, North and South, or whether it varies from that respect of its sides to any other part or quarter of the World [...]; but to

<sup>54</sup> Peter Tompkins with Livio C. Stecchini, *Secrets of the Great Pyramid* (New York, 1971), 21, 24.

<sup>55</sup> Daniel J. Boorstin, "Afterlives of the Great Pyramid," *Wilson Quarterly*, 16 (1992), 130-39; and see Martin Gardner, *Fads and Fallacies in the Name of Science* (New York, 1957).

<sup>56</sup> *Hypnerotomachia*, 27-28 (b2-b2'). See Brian Curran, "The *Hypnerotomachia Poliphili* and Renaissance Egyptology," *Word and Image*, 14 (1998), 156-85, and Tamara Griggs's "Promoting the Past: the *Hypnerotomachia Poliphili* as Antiquarian Enterprise," *ibid.*, 17-39.

my wonder, he being Astronomical Professor, I do not find that he had any regard at all to the same, but seems to be wholly taken up with one Inquiry, which was about the measure or bigness of the whole and its parts, and the other matters mention'd, are only by the bye and accidental.... Nor do I find that he hath taken the exact Latitude of them, which methinks had been very proper to have been retain'd upon Record with their other Description.<sup>57</sup>

The critique is very accurate, even though somewhat amusing in blaming Greaves for not conducting Hooke's own research. Moreover, because they have never been published, Hooke was perhaps unaware that Greaves did conduct astronomical observations of the kind he required in the East. Yet the *Pyramidographia* is indeed innocent of any astronomical, geodetic, let alone Hermetic elements. Greaves's technique of standardization could have functioned, in principle, on any random stone slab.<sup>58</sup>

But why the Great Pyramid? Despite its non-Kircherian, de-theologized, and pragmatic character, Greaves's science was influenced by the Herodotean paradigm. Egypt was the land where traditions went uninterrupted from time immemorial and where time's effects were the least destructive. For Greaves, a scholar who devoted his whole career to synchronizing past human records and natural phenomena, Egypt was a perfect laboratory. Thus he entered the Great Pyramid as if it was the Holy of Holies of metrology and where the ossified Egyptian past could standardize the present. His concluding anecdote in the *Pyramidographia* illuminates this conception: he ridiculed the stones that are sold in Cairo as the fossilized loaves of bread the Israelites took with them upon their exile. He immediately discovered the imposture by their shape, which was that of regular and not unleavened bread (119-20 [wrongly numbered 142]). While we do have samples of fossilized Egyptian bread, Greaves could have devised a more plausible way to refute the authenticity of the loaves had he been less prone to see Egypt itself as immutable.

Despite Hooke's attack, Greaves's measurements were respected and mined by later authors on metrology: Edward Bernard, also an Orientalist and Savilian Professor; Richard Cumberland (later Bishop of Peterborough), whose treatise rested almost exclusively on figures provided by Greaves; George Hooper, Bishop of Bath and Wells; and most notably, Isaac Newton.<sup>59</sup> However, their

<sup>57</sup> Robert Hooke, *The Posthumous Works of Robert Hooke ... Containing His Culterian Lectures, and Other Discourses* (London, 1705), 353.

<sup>58</sup> The anonymous work, based on Greaves's *Pyramidographia*, *The Origine and Antiquity of Our English Weights and Measures: Discover'd by Their near Agreement with Such Standards That Are Now Found in One of the Egyptian Pyramides* (London, 1706), and its 1727 and 1745 subsequent editions is wrongly attributed to him.

<sup>59</sup> Bernard, *De mensuris et ponderibus antiquis libri tres* (Oxoniae, 1688); Cumberland, *An Essay Towards the Recovery of the Jewish Measures & Weights* (London, 1699 [1686]); Hooper,

interest in his figures was related to their attempt to recover the ancient measure units of the Jews, the Sacred Cubit in particular, rather than in standardizing Europe's. Newton fully adopted Greaves's figures for the Great Pyramid, estimating him as the most accurate of all earlier authors on weights and measures (such as Agricola, Paetus, Villalpandus, Snellius).<sup>60</sup> Assuming quite reasonably that the lengths of many architectural elements in the Great Pyramid are dependent upon each other—i.e., based on the same length unit—Newton was able to reach some conjectures as to its value. His ultimate goal is clear, however, from his opening sentence: "To the description of the Temple belongs the knowledge of the Sacred Cubit; to the understanding of which, the knowledge of the Cubits of the different nations will be conducive."<sup>61</sup> Here too, Tompkins and Boorstin are too quick to interpret Newton's interest in Greaves's studies as a sign for the belief that the Pyramid encoded natural or cosmological knowledge. As Robert Palter has argued in his critique on Bernal's *Black Athena*, there is no evidence to show that Newton related his interest in the Egyptian cubit to his physics and geodesy.<sup>62</sup> It is in fact the Temple and the ancient Jewish measures rather than the Pyramid which were at Newton's center of attention.

One may hypothesize that the mystique surrounding the measures of the Great Pyramid emerged in the early nineteenth century as an indirect outcome of the decipherment of the hieroglyphs. Once one cloud of esoteric knowledge was dispersed, others gathered over Giza.<sup>63</sup> Going back to Greaves, however, it is quite clear that his approach to the Great Pyramid was remarkably concrete. On the whole, one might add, Greaves appears to be indifferent to matters spiritual or religious. Some circumstantial facts may attest to that: he was never ordained; in his first trip to Italy (1635) he visited Rome despite the explicit restriction in his passport;<sup>64</sup> as we saw above, he was even thrilled by St Peter's Porta Sancta at the heart of the Catholic world, and enjoyed "the favour" of being shown some relics—St. Thomas the Apostle's finger, for example.<sup>65</sup> While

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*The Works of ... George Hooper, D.D.* (Oxford, 1757), 345-517; Newton, "A Dissertation upon the Sacred Cubit of the Jews and Cubits of the several Nations; in which, from the dimensions of the greatest Egyptian Pyramid, as taken by Mr. John Greaves, the ancient Cubit of Memphis is determined. Translated from the Latin of Sir Isaac Newton, not yet published," in *Miscellaneous Works*, II, 405-33.

<sup>60</sup> Newton, 406.

<sup>61</sup> See also Newton's discussion of sacred weights and measures in Yahuda MS. 6, folio 18, published in Appendix B of Frank Manuel, *The Religion of Isaac Newton* (Oxford, 1974), 135.

<sup>62</sup> "Black Athena, Afro-Centrism, and the History of Science," *History of Science*, 31 (1993), 227-87, here 245ff.

<sup>63</sup> See Simon Schaffer, "Metrology, Metrication, and Victorian Values," in *Victorian Science in Context*, ed. Bernard Lightman (Chicago, 1997), 438-74.

<sup>64</sup> Greaves's passport in PRO SP 16/294, no. 64. See Toomer, 129-30.

<sup>65</sup> *Miscellaneous Works*, II, 496.

his Roman activities may suggest that he was a crypto-Catholic, his religion does not bear directly on his metrological and chronological ideas.<sup>66</sup>

Identifying real problems yet proposing conservative solutions, Greaves was obviously in the wrong track on the highway of seventeenth-century science. A non-Copernican astronomer, he overemphasized old manuscripts and observations over modern telescopes.<sup>67</sup> While Burattini, his collaborator in the pyramids, parted with the attachment to ancient monuments and developed a metrical system (*Metro Cattolico*) based on the pendulum, Greaves's metrological system, although erudite, empirical, and precise, took monuments as the ultimate source of authority and was unrelated to natural units.<sup>68</sup> However, while it is not surprising that our *Dictionary of Scientific Biography* wrote him off, we may quite safely assume that had Greaves lived a bit longer, we would have seen him as a founder-member of the Royal Society. Greaves, as a representative mainstream scholar, and his *Pyramidographia* have an interesting, complex story to tell about the development of early modern scholarship and science.

Greaves's obsession with ancient metrology attests to the liveliness in mid seventeenth-century Europe of the tradition of Alberti and Colocci, which mixed books and instruments. While quantifying and tabulating ancient monuments with ever growing modern preciseness and empirical ideals, those scientific antiquarians still appealed to the authority of the ancient knowledge they were documenting, and were convinced of its vital importance for modern natural philosophy and for a whole range of practical issues, such as standardization of weights and measures, or calendar reform. Like his translation of Ulugh Beg's work (and the belief that it was crucial for the science of astronomy) Greaves's *Pyramidographia* shows how easily minds and questions still moved between instruments and monuments, west and east, ancients and moderns, and from the pyramids to seventeenth-century England.

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<sup>66</sup> Greaves was also accused by the Parliamentary Visitors of feasting the Queen's confessors (Wood, *Athenae Oxonienses*, 1813 ed., III, col. 325). In 1648 his parliamentary enemies expelled him from Oxford.

<sup>67</sup> Phyllis Allen, "Scientific Studies in the English Universities of the Seventeenth Century," *JHI*, 10 (1949), 219-53, here 227.

<sup>68</sup> Pietro Alessandro Giustini, "Tito Livio Burattini e la nascita della metrologia scientifica," in *La matematizzazione dell'universo: momenti della cultura matematica tra '500 E '600*, ed. Lino Conti (Assisi, 1992), 360-62; and see Zupko, ch. 2, 113-35. In retrospect Greaves's metrology is vindicated by the adoption of the Imperial System in 1855, which relinquished natural units and went back to arbitrary, traditional ones.