Archimedes in the Twenty-First Century Imagination

Mary Jaeger

Any discussion of Archimedes in the twenty-first century imagination must reach backward into the twentieth, because so much recent work arises from or responds to the sale of the codex containing the Archimedes Palimpsest at Christie's in New York, on October 28, 1998, and its installation in the Walters Art Gallery in Baltimore in 1999. The years since have seen the publication of the palimpsest by Reviel Netz and Nigel Wilson and the rest of their team; images are online, as is a transcription of the text [1]. In addition, Netz has published part of his ongoing project of translating Archimedes: three volumes are to come out of Cambridge University Press, the first of which, *The Two Books on the Sphere and Cylinder*, appeared in 2004. Netz has also written a three-part study of Mediterranean mathematics: *The Shaping of Deduction in Greek Mathematics* (1999); *The Transformation of Mathematics in the Early Mediterranean World: from Problems to Equations* (2004); and *Ludic Proof* (2009). Finally, and firmly in the twenty-first century, an international conference on Archimedes held at Syracuse in June 2010 has resulted in a hefty volume of conference papers (*The Genius of Archimedes--23 Centuries of Influence on Mathematics, Science, and Engineering. eds.* S. A. Paipetis, Marco Ceccarelli. Springer: New York).

Clearly the specialist in ancient mathematics has plenty to work with. What about the writers who aim at a general audience, and the nonspecialist scholars and artists themselves whose projects include pedagogical material, historical fiction, and artistic representation? With some exceptions, what has captured their imaginations is not so much Archimedes' mathematics as the stories about the man, especially three: [2] first, that in which the bathing Archimedes, noting the water displaced by the submerged part of his body, realized how he might determine whether a crown made for the Syracusan king Hieron was solid gold or not, and ran naked through the streets of Syracuse crying Eureka! Eureka! ("I have found it! I

M. Jaeger (✉)
Department of Classics, University of Oregon, Eugene, OR, USA
e-mail: maryjaeg@uoregon.edu

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have found it!"); second, the account of his defending Syracuse with his siege engines, including the fictitious "death ray" or burning mirrors; and third, the story of his death at the hands of a Roman soldier [3]. None of these stories was told by an eyewitness; every ancient source that reports them has its own agenda; but together they are compelling, forming as they do a neat narrative with a beginning, middle, and end.

The Eureka anecdote appears first probably because it is the most famous and possibly also because, although modern images invariably portray the bathing Archimedes as fully adult and bearded, if not old, Archimedes' emerging from the bath with a new discovery makes a nice story of origins, like that of the emergence of life from a primordial ooze. Moreover, modern artists and writers have constructed and presented this story so as to make its Archimedes appealing to children. Consider, for example, the cover art for Pamela Allen's 1994 children's book *Mr. Archimedes Takes a Bath*, or a poster from Ogilvy and Mather's 2004 ad campaign for Mentos [4]. In both cases the figure of Archimedes is that of a comical and therefore unthreatening old man, rather like the famous picture of Einstein sticking out his tongue.

The "middle" of the narrative, namely, the account of Archimedes' siege engines and other mechanical inventions, has provided material for a number of reconstructive projects and documentaries: In 2001, Chris Rorres and Harry G. Harris produced a scale model and delivered a paper titled "A Formidable War Machine: Construction and Operation of Archimedes' Iron Hand" [5]; a 2005 Discovery channel episode, from the series "Superweapons of the Ancient World," records the activity of a crew of architects and engineers reconstructing Archimedes' Claw (or 'hand') in Tunisia; and every generation, it seems, explores anew the possibility of Archimedes' using mirrors to set the Roman ships afire. After the show "Mythbusters" argued that it could not be done, in 2005 a group of students from David Wallace's Product Development class at MIT showed that it was theoretically possible to set fire to a ship by using mirrors. And they did so, first setting fire to a mock-up using 127 one-square-foot mirrors at a distance of 100 feet, then using something closer to what they thought approached the real thing. But they could achieve ignition only under ideal (i.e., windless) conditions.

I have found few recent images of Archimedes' death. The New Hampshire-based educator Marek Bennett devotes a 2014 comic strip to Valerius Maximus' version (and quotes the Latin at the end); otherwise, we have to reach farther back, to the 1950s and 1960s, when the Greek surrealist poet and painter Nikos Engonopoulos was representing mythological and historical scenes, including "The Death of Archimedes, With Syracuse in Flames"; and to 1972, when the German sculptor Gerhard Thieme installed versions of a bronze sculpture of Archimedes in various sites in Germany [6]. Thieme's bronze shows Archimedes contemplating geometrical figures drawn in the sand, just as Livy and Vitruvius say he was doing when the soldier killed him. Although this Archimedes seems absorbed in his work, his position and attitude themselves do not mean he is about to die. Unlike Archimedes in the bath, Archimedes about to die does not appear on the covers of children's books, probably because their authors would rather extol the many virtues

of taking a bath than suggest that devotion to mathematics can be dangerous to one's health. As of this writing, however, it was possible to buy a "Death of Archimedes in Sack of Syracuse Twin Duvet" on Cafe Press. I do not know what psychological effect being tucked into bed under such a scene of carnage will have on the freshly bathed young mathematician.

A number of writers, some of them educators, have used the interest in Archimedes' story as a way of stimulating an interest in mathematics: the 2009 book *Eureka Man*, for example, both discusses Archimedes' biography and explains his mathematical contributions. (Its author, Alan Hirschfeld, a specialist in the history of physics and astronomy, directs the physics teacher-training program at the University of Massachusetts, Dartmouth.) The first chapter in mathematician Clifford Pickover's *Archimedes to Hawking: Laws of Science and the Great Minds Behind Them* (2008) does pretty much the same. In 2010, John Monahan, a science teacher in Baltimore, published *They Called Me Mad: Genius, Madness and the Scientists Who Pushed the Outer Limits of Knowledge.* The book's cover image, which includes the portraits of Einstein and Tesla, is just sufficiently a caricature to make both men appear less intellectually intimidating. The cover artists did not have to do this to Archimedes: Monahan's first chapter is titled "Eureka! The Mad Scientist is Born"; and, once again, the bath story is enough to make Archimedes a nonthreatening archetype of the absent-minded professor.

These authors have laudable goals: to increase science literacy and inspire young people to study STEM subjects. As a classicist, however, I hope the Archimedes anecdotes will draw readers to explore their ancient sources and in doing so learn more about other great minds of classical antiquity: the historians Polybius and Livy, for example, and Cicero, Plutarch, and Vitruvius. For those whose interest tends toward the historical and literary, several scholars provide useful guides to the ancient sources. A good starting point for the nonspecialist is Chris Rorres' Archimedes website, which offers information on all aspects of Archimedes' life, career, and times [7]. In addition to essays on Archimedes' mathematical and technical achievements, the site includes timelines, animations, videos, and a wide array of images.

Rorres' website also includes a bibliography of the many valuable papers on Archimedes by D.L. Simms. A Londoner who entered the British Scientific Civil Service and earned his PhD for work on the ignition of materials through radiation, Simms spent his early career researching the ignition and spread of fires. (This experience proved useful as he refuted again and again the argument that Archimedes used burning mirrors against the Roman fleet at Syracuse.) Simms also wrote a major report on irrigation in Great Britain and spent the later part of his career working on projects that aimed at controlling pollution. Once retired, he engaged himself full time in his research on the history of science and technology [8]. A series of articles, beginning in 1965 ("The Legend of Archimedes and the Burning Mirrors of Syracuse" in *Fire Research Notes*), and continuing until 2010 ("Adventures of an Invention Through Two Millennia: The Water-Screw and its Variants; Part III: Back in Use" in *Atti della Fondazione Giorgio Ronchi*), covers all aspects of Archimedes' life and technical achievements. Simms' work displays a thorough knowledge of the

ancient sources on Archimedes and a rigorous and honest use of them in argument. Some of Simms' papers, because they appeared in regional journals or proceedings of esoteric organizations, can be difficult to find. Rorres' website has links to a number of them.

Readers of Italian will profit from Mario Geymonat's *II Grande Archimede* [9]. Most classicists recognize the name of the late Geymonat for his magisterial edition of Vergil and his extensive work on the Vergilian commentators. However, Geymonat also had a lifelong interest in ancient science and, among his other editorial contributions, published the first edition of the fragments of the Latin translation of Euclid [10]. *II Grande Archimede* (first ed., 2006) boasts both an introduction by the Nobel Prize-winning Zhores Alferov (2000, Physics) and a preface by the historian Luciano Canfora. Already in its third Italian edition by 2008, it has won the Corrado Alvaro award for Italian literary excellence. It has also appeared in English, translated and edited by Alden Smith (Baylor, 2010).

II Grande Archimede first surveys Archimedes' life and times, including his experience in Alexandria and the contacts he made there with Eratosthenes, Conon, and Dositheus, his use of Doric and the style of his treatises, the intellectual range of his work, his method of argumentation, his ability to unite the theoretical and the practical, and the ancient world's social and intellection prejudices against the practical application of theory. The rest of the book covers first Archimedes' major mathematical contributions and then his mechanical inventions. The last chapter gives a history, sometimes whimsical, of legends about Archimedes, tracing them from Cicero to Walt Disney. An appendix lists references to Archimedes in Latin poetry. The book nicely interleaves the discussion of particular geometrical problems, the testimony of Archimedes himself and other ancient authors, and the ancient anecdotes.

Solving a problem by manipulating geometric features is essentially a visual activity; it is thus no surprise that a strong strand of interest in the visual runs through a number of the recent studies. Netz's work, from the commentary to the popular *Archimedes Codex*, pays particular attention to the aesthetics of Archimedes' treatises. In *The Transformation of Mathematics in the Early Mediterranean World*, Netz argues that the problems solved by Archimedes were essentially geometric problems, solved by manipulating lines, triangles, etc., as opposed to the essentially algebraic problems posed by the mathematicians of the Arab world. One of the fascinating aspects of the Archimedes palimpsest is its barely preserved diagrams; and Netz points out repeatedly that the numerical systems in modern texts of the ancient mathematicians are anachronisms: schematic diagrams, representing the topological features of a geometrical object, are what the Greeks used for clarity. When they used numbers, the result, which appears intended, was obfuscation. Netz also lays emphasis on the beauty of ancient diagrams as one of the aesthetic features of ancient Greek mathematics.

By its lavish use of historical illustrations, *II Grande Archimede* participates in this appreciation of the visual: the diagram of Archimedes' first theorem from the *Measurement of the Circle*, taken from Jacopo of Cremona's Latin translation, which gives viewers both a grasp of the relationship between the curved and the

straight and a clear impression of the beauty of early mathematical diagrams as drawings; the beginning of *Measurement of the Circle*, including text, with diagram; the end of *Measurement of the Circle* from Cardinal Bessarion's copy of the Greek manuscript of Archimedes, also including text, with diagram; some sixteenth-, seventeenth-, and eighteenth-century engravings taken from early editions of scientific and architectural works showing Archimedes solving inter alia the problem of specific gravity; and engravings of compound pulleys from Mazzucchelli's eighteenth-century biography of Archimedes. Other color plates include several of Giulio Parigi's wall paintings from the Stanzino delle Matematiche in the Uffizi, including images of catapults, the burning mirrors, the great ship being pulled to shore by pulleys, the naked Archimedes running from the bath, and the highly anthropomorphized picture of the great iron claw (the "hand" of Archimedes) that stymied the Romans at Syracuse.

Smith's English translation has kept the pictures, rearranged slightly the structure of the text, and made some additions to the bibliography. The translation has conflated the two original chapters on the ship Syracusia and the defense engines into one, and has raised the appendix on poetry to the status of a chapter. The transfer of the material on poetry to the main text is welcome, for Geymonat's knowledge of literary Latin together with his interest in the history of science has produced a dossier that will, I expect, lead to interesting results. Emma Gee's *Ovid, Aratus and Augustus: Astronomy in Ovid's Fasti* (Cambridge, 2000), has already shown how fruitful it can be to examine the interactions of science and poetry; Netz's *Ludic Proof* goes so far as to suggest that Hellenistic poetry might have had a role in the shaping of scientific texts. *Il Grande Archimede* joins these works in pointing the way to an exciting subfield of literary/mathematical studies.

The most widely known popular work on Archimedes, *The Archimedes Codex*, was published by Reviel Netz and William Noel in 2007 [11]. It has been translated into at least twenty languages to date and was made into a NOVA special [12]. *The Archimedes Codex* shows how cooperative effort at the highest level of a number of discrete disciplines (Greek paleography, language, literature and textual criticism; history ancient, medieval, and modern; art history; history of the book; mathematics; computer science; and digital humanities) can achieve path breaking, truly interdisciplinary results. The work on the palimpsest has given us the only text of the treatise called *The Method*; it has helped us understand further the relationship of diagrams to text in ancient mathematical works; and it has brought about a reinterpretation of the game called the Stomachion as an exercise in combinatorics.

Part Two: The Fictional Archimedes

In relating first the perils faced by Archimedes' manuscript through the centuries, then its rediscovery and restoration, then the new discoveries in the restored text, Netz and Noel have crafted a suspenseful and exciting narrative. Indeed, Ed Rothstein's New York Times review of the "Secrets of Archimedes" exhibit at

the Walters (Oct. 16, 2011) compared *The Archimedes Codex* to that other twenty-first-century publishing phenomenon, Dan Brown's 2003 *The Da Vinci Code* (the publisher of *The Archimedes Codex* includes on the cover a quote from the TLS that makes the same comparison). As is so often the case, the true story here is much, much more fascinating than fiction.

The allure of the mysterious artifact lost and then recovered and the compelling figure of the expert in esoteric knowledge who discovers ancient "secrets," the very idea that time has created secrets to be "revealed," have all proved inspiring to a number of first-time novelists [13]. Since the turn of the millennium, Archimedes has made several appearances as a fictional character in such works as: Theodore Homa's *Archimedes' Claw*, an anti-*Da Vinci Code of a sort,* in which the hero finds himself at the center of a government conspiracy having to do with time travel, with The Claw serving as a propellant helping thrust him to and fro in time; in Monte R. Anderson's *Archimedes of Syracuse: the Chest of Ideas*, which embeds the life of Archimedes within a night of Renaissance-era storytelling and shows the young mathematician enjoying the pleasures of Alexandria, including Egyptian beer and the city's lovely and compliant woman; and, finally, in Padraic Fallon's *The Circles of Archimedes*, which links the diagrams Archimedes was pondering at his death to Goddess worship and the stone circles at Avebury, England.

Together these novels show that the very scarcity of solid facts about Archimedes' life leaves plenty of room for the imagination. The comic appeal of the story of the bath, the fascinating nature of his siege engines, and his tragic death at the hands of a Roman soldier together form a matrix into which each writer inserts their interests, fantasies, prejudices, and preconceptions. Moreover, they impose their own twenty-first-century interests and experiences on the story and the figure of Archimedes.

The author of my last example imposes contemporary experience as well but, unlike the other authors, notes it explicitly. This is *The Sand-Reckoner*, which came from the pen of Gillian Bradshaw in 2000. As Bradshaw points out on her website, "real historical figures usually have too many inconvenient facts about their lives to allow for good fiction, but there aren't that many facts known about Archimedes, so I got away with it." [14] Bradshaw differs from the authors listed above in that she is a seasoned writer of historical and fantasy fiction; depending on how you count them, *The Sand-Reckoner* is her thirteenth or fifteenth novel. She is moreover, a trained classicist, who won prizes for her Greek at the University of Michigan, and then studied further at Cambridge. When she published her first historical novel and discovered that she could make a living by her writing, she said farewell to academe, except for the family connection she made by marrying the British academic physicist Robert Ball (University of Warwick). She writes of *The Sand-Reckoner*, "in a way it's a very personal book, as I drew upon the many physicists I've known to portray the man."

The Sand-Reckoner covers less than a year of Archimedes' life: his return from Alexandria, the death of his father, and his first interactions with Hieron, tyrant of Syracuse. The book does a nice job of weaving some the most tenuous strands of the biographical tradition into a compelling narrative. For example, Plutarch says that Archimedes had a connection to the royal house of Syracuse. Accordingly, Bradshaw

gives Hieron a half-sister, Delia, who is an excellent musician on the aulos (the double-flute), as is Bradshaw's Archimedes. Once Hieron realizes Archimedes' importance to Syracuse's defense system, he has to find a way to keep him there. What better way than encouraging a lot of duets on the aulos and an eventual marriage alliance?

Bradshaw has a secure knowledge of ancient history and an excellent grasp of the *realia*: there are fine descriptions of neighborhoods in Syracuse, of houses and banquets, of the nature of the double flute. Her Archimedes is a charming figure, a young man who is always thinking creatively, as when, lying in bed he watches the patterns of sunlight on the wall, or sees a dead fish floating belly-up in the harbor and loses track of a conversation as he wonders why it floats that way. And he is as absent minded as Plutarch claimed: someone (usually his fictional slave Marcus) has to wake him from his trance and drag him off to a meal, a haircut, or a bath. Bradshaw also captures Archimedes' loneliness: his longing for Alexandria's lively intellectual life; his panic at his father's approaching death, which meant there would be no one at Syracuse at all capable of understanding his interests; and his desperate attempt to make himself clear to people who cannot understand what he's talking about (he knows he's not a good teacher). Or perhaps we should say instead "his research is stronger than his teaching," because this Archimedes seems very much like a modern academic. He would make an excellent professor at a research university, if he had the office staff to keep him on schedule.

Bradshaw's Archimedes is smart and creative; he is also considerate to slave and free and fond of strong women (Delia ends up running the practical side of their married life, including the considerable estate that was her dowry). He is a loyal citizen; and he speaks truth to power (Hieron), because he knows that high-tech defense jobs are always available. But he feels the emotions, shared by so many mathematicians and physicists of this past century, upon realizing that their calculations, embodied in weaponry, work as intended, which means that they wound and kill human beings.

In all these popular accounts of Archimedes, fiction and nonfiction alike, one phrase surfaces again and again: "killed by a Roman soldier." Indeed, the figure of the Brutal Roman has become essential to the twenty-first-century portrait of Archimedes, even though that figure appears in various guises, whether as the killer himself, or as another character onto whom Roman brutality is transferred. *Archimedes' Claw* begins with a brief scene of the kill; *The Chest of Ideas* saves it for nearer the end, as does *The Circles of Archimedes. The Sand-Reckoner* anticipates and prefigures it. Clifford Pickover (*Archimedes to Hawking* p.41) writes "Close to the time when Archimedes discovered his Principle of Buoyancy, the Septuagint Greek version of the Old Testament was being written, the La Tène Iron Age people invaded Britain, the first Roman prison Tullianum was erected, and the Carthaginian general Hannibal was born." Note the tendentious nature of Pickover's collocation of events: granted, archaeologists date the structure of Rome's prison to some point in the third century BCE. But other things happened in Rome then: the transition in temple style from more Etruscan to Hellenistic, the development of native Roman drama, the development to its highest level of the native Italian meter

called Saturnians, and an act of translation that was in its own way as important as the translation of the Septuagint: Livius Andronicus' translation of the *Odyssey* into Latin verse, the first translation we know of, of a *literary* text. But a prison is a useful thing to list if you want to cast Romans as brutes.

The role of Brutal Roman extends even to the philhellenic general Marcellus: in the *Chest of Ideas*, we are told that he can barely read Latin much less Greek. After Archimedes' death, Archimedes' daughter tells Marcellus that her father wanted a diagram of the sphere and cylinder on his tomb. Marcellus answers:

> When I was in Alexandria, I saw the defenses he constructed around the city; the signal towers, the catapults, and other machines. His idea of using mirrors to signal commands was ingenious. I saw his invention of the water screw being used in silver mines in Spain. They even called it the Archimedes Screw. I saw the ship he built, the Syracusia. It was magnificent. Had he been a general, he would have conquered the world by now. And yet, he thinks a mathematics formula is his crowning achievement. I will never understand these scholars.

Likewise, at the end of *The Sand-Reckoner*, in a scene that anticipates Archimedes' death, Gaius Valerius, the brother of Archimedes' Roman-born slave Marcus, returns to Syracuse to restore to its owner the flute Archimedes had lent Marcus, who is dead. Valerius' friend Fabius comes along to translate. The interview turns sour when Fabius sees a contraption Archimedes is building, and asks what it is. Told it is a water-aulos, he infuriates Archimedes by saying what a comedown it is for the designer of great siege engines to be making musical instruments. When Fabius catches sight of Archimedes' figures of sphere and cylinder, he asks, "What use is it?" His reaction further enrages our hero, who points out that this is what is wrong with Romans: they are brutes who understand only the practical. If Bradshaw's Archimedes is the professor defending the liberal arts (especially music and mathematics), Fabius is the academic's worst kind of barbarian: a provost advocating for purely vocational education.

Both the prefigured killer, and the figures of sphere and cylinder (which would later decorate the tomb) help make this scene anticipate Archimedes' death. It continues to do so with Archimedes' last actions, because he turns away from his guests to his geometry, the circles he would later defend (p.346):

> The others [Gaius and Fabius] looked at him [Archimedes] in surprise, but he was already oblivious to them. The compass marked out its precise reckonings in the fine sand, and his face following it was rapt, intense, and joyful. For the first time in his life, Fabius felt the foundations of his own certainties tremble. The suddenly quiet room was filled with something that made the hair stand up along his arms, something that existed for no human use. Perspective altered dizzyingly, and he wondered what his own use was to a universe. Unaccountably afraid, he ducked his head and backed away.

If it feels as if some kind of conversion is imminent, that is no surprise. Bradshaw is very much a historical novelist of the old school; and *The Sand-Reckoner*, in many ways, resembles the sword-and-sandal novels of the nineteenth and early twentieth century. Consider, for example, *Ben Hur*, *The Robe*, and *Bride of Pilate*, all of which portrayed an extraordinary and mystifying character killed by Roman brutes who knew not what they did. In the imagination of the new millennium, the pure scientist dies for the sake of all scholars.

Finally, one very different literary Archimedes: Peter Hobbs' recent short story collection, *I Could Ride All Day in My Cool Blue Train* (Faber & Faber 2006), closes with "The Dead Ancients Trilogy," three vignettes portraying Archimedes, Pythagoras, and Sisyphus. Hobbs' figure of Archimedes combines the running Archimedes of the Eureka story and the idea expressed in the expression "give me a place to stand and I will move the world." In his story, Archimedes runs on the surface of the earth, like a hamster on the *outside* of his wheel, the force of his footsteps making it rotate. Like the Archimedes of the Eureka story, he too is a comic old figure, who "has lifted his robes to his waist so as not to stumble when they become tangled with his legs. His long white beard has been thrown with similar intent over his right shoulder… He's a wiry old man. His sandals flap a little as they kick back." Hobbs plays imaginatively with the idea of leverage and the idea of Archimedes' sphere. His Archimedes is on the verge of inventing the bicycle but restrains himself because the materials for such a thing are not yet available.

Archimedes continues to stimulate the imagination in a wide variety of ways: novelists rewrite his life; other writers meditate on his ideas; nor is reapplication of those ideas limited to literature. Let me close this survey with two examples of Archimedes' influence on modern design: first, the Italian firm Acquacalda has produced an Archimedean measuring bowl, a ceramic bowl with a series of Plimsoll lines engraved and painted on the outside. Place bowl in water; place the item to be measured inside; read from the water level and the lines the exact amount of displacement. Finally, according to Cicero, who said he saw it, Archimedes' tomb had on it a representation of the sphere enclosed by a cylinder and some verses expressing the ratio of their volumes. Artists have traditionally represented this as a column with a three-dimensional sculpture on top, although Netz argues that the marker held a simple diagram. I think Archimedes would have liked the idea that one early use of a 3-D printer (before its use to print a working weapon!) brings together both the "beginning" and "end" of his story. It is a three-dimensional model illustrating the relationship of the volumes of sphere and cylinder by showing the volume of water each contains [15].

Notes and References

1. *The Archimedes Palimpsest*. Reviel Netz, William Noel, Nigel Wilson and Natalie Tchernetska, eds. Cambridge University Press 2011. See also http://archimedespalimpsest.net/Supplemental/ArchimedesTranscriptions/
2. An exception is Sherman Stein's *Archimedes: What did He Do Besides Cry Eureka?* (Mathematical Association of America, 1999). Stein gives a brief biography then focuses exclusively on introducing the math.
3. The bath story appears in Vitruvius; the most important sources for the siege engines are Polybius, who could have consulted eyewitnesses, and Plutarch. The earliest references to Archimedes' death appear in Cicero, then Livy.
4. http://www.coloribus.com/adsarchive/prints/mentos-candy-archimedes-6428655/
5. The paper is available on Chris Rorres' website.
6. The most well-known is at Berlin-Treptow.

7. https://www.cs.drexel.edu/~crorres/Archimedes/contents.html
8. Information from Chris Rorres' website.
9. It was translated into English (A. Smith Baylor University Press, 2010), with additions to the original appendix on Latin poetry, but something *has* been lost in translation: *pi* has fallen out of a couple of equations (p.44); and there are some mistakes in the rendering of the Italian: Hieronymus succeeded his grandfather at the age of fifteen not "fifteen years later," (Smith, p.64). Likewise, Smith, "[a] year after Ennius' death in 168 BC, the Roman historian Polybius, who wrote in Greek, brought Archimedes to Rome as a hostage": (Smith, p.75), incorrectly renders the Italian (Geymonat, p.105), which states (correctly) that Polybius of Megalopolis came to Rome as a hostage.
10. M. Geymonat, *Euclidis Latine facti fragmenta Veronensia*, Milan, 1964.
11. *The Archimedes Codex: How a Medieval Prayer Book is Revealing the True Genius of Antiquity's Greatest Scientist.* R. Netz and William Noel (Da Capo) 2007.
12. "Infinite Secrets," PBS, originally broadcast Sept. 30, 2003.
13. They include a physician (Homa), a retired military officer (Anderson), and a former publisher and journalist (Fallon).
14. http://www.gbradshaw.net/
15. Oliver Knill and Elizabeth Slavkovsky "Thinking Like Archimedes with a 3-D Printer," Jan. 28, 2013; see also *New Scientist*, issue 2902, Jan. 30, 2013.