Isidore of Miletus and Hypatia: On the Editing of Mathematical Texts

Alan Cameron

Geoffrey de Ste. Croix octogenario

EARLY IN THE SIXTH CENTURY Eutocius of Ascalon produced commentaries on various works of Archimedes. The best witness to the text, *Laurentianus* 28.4, offers the following explicit to his commentary on Book I of *De sphaera et cylindro*:[1]

Εὐτοκίου Ἀσκαλωνίτου ὑπόμνημα εἰς τὸ πρῶτον τῶν Ἀρχιμήδους περὶ σφαίρας καὶ κυλίνδρου, ἐκδόσεως παραναγνωσθείσης τῷ Μι- λησίῳ μηχανικῷ Ἰσιδώρῳ ἡμετέρῳ διδασκάλῳ.

The explicit to the commentary on Book II is identical except for the numeral. And the explicit to his commentary on Archimedes' *In dimensionem circuli* is identical again except for the title of the work commented. "Isidore the Engineer" is the celebrated architect Isidore of Miletus who, jointly with Anthemius of Tralles, was charged with the design of the new S. Sophia by Justinian in 532. The question is: what rôle did he play in Eutocius' commentaries on Archimedes?

According to the first thoughts of J. L. Heiberg, the distinguished editor of so many mathematical texts, Isidore edited the text of Archimedes on which Eutocius' commentary was based.[2] But in 1884 P. Tannery offered a different interpretation.[3] First, he argued that the evidence of the explicits did not square with Eutocius' other references to contemporaries. The commentary on *De sphaera et cylindro* is dedicated

---

[1] F in Heiberg's first edition of 1888, A in his second of 1915 (*Archimedis opera omnia cum commentariis Eutocii* III² [Leipzig 1915] 48.26; *cf.* 224.7, 260.10).

[2] "Ueber Eutokios," *NJbb* Suppl. 11 (1880) 359.

[3] "Eutocius et ses contemporains," reprinted in J.-L. Heiberg and H.-G. Zeuthen, edd., *Mémoires scientifiques* II (Toulouse 1912) 119.

respectfully to an Ammonius who can only be the influential philosopher who taught at Alexandria for many years at the end of the fifth and beginning of the sixth centuries. It has usually (and no doubt rightly) been assumed that Eutocius had been one of Ammonius' many students. The probability is increased, now that we know that Eutocius at one stage lectured on Aristotle's logic (apparently at Alexandria) and may even have succeeded to Ammonius' chair of philosophy.[4] The later commentary on Apollonius' *Conica* is dedicated to Anthemius, who is addressed in the prefaces to its four books as "dear friend" and so presumably a contemporary, more or less. According to Tannery, since Ammonius lived no later than 510 and Isidore was a younger contemporary of Anthemius, Eutocius cannot have been a pupil of Isidore.

Though embraced at once by Heiberg in his second edition of 1915 (*supra* n.1: xciii), Tannery's own interpretation is so remarkable that no summary could do it justice:

> un élève d'Isidore de Milet aura fait, à Constantinople, une édition des trois commentaires dont il s'agit,[5] commentaires publiés à Alexandrie et ayant déjà une certaine date; pour recommander son édition, au lieu d'y inscrire son propre nom, encore obscur, il l'aura mentionnée comme revue par son maître, l'architecte de Sainte-Sophie.

That is to say, some anonymous pupil of Isidore's is alleged to have signed his *revision* of Eutocius' commentaries with his teacher's name instead of his own. If Isidore was a younger man than Eutocius, then this hypothetical pupil will have been younger still, and his alleged revision could hardly be dated earlier than *ca* 550, obviously after Eutocius' death.

For the moment we may leave aside that παραναγιγνώσκειν does not mean 'revise' in the sense here envisaged. But why did this person revise someone else's commentary anonymously instead of doing what every other late antique commentator did, appropriate its contents and republish them under his own name? To go no further than the subjects of this paper, Eutocius evidently took (unacknowledged) all that was worth taking from earlier commentators on Archimedes and Apol-

[4] See the new text published by L. G. Westerink, "Elias on the Prior Analytics," *Mnemosyne* SER. 4 14 (1961) 126–39, at 129.

[5] By "three commentaries" he presumably means Eutocius' two books *De sphaera et cylindro* and the one *In dimensionem circuli*.

lonius, as Theon did (with acknowledgement) from Pappus for his *Almagest* commentary. What sense did it make for this anonymous to ascribe his alleged revisions to his teacher? And what of the reference at p.84.8 to the compass invented by "Isidore our teacher," now falsely (on Tannery's hypothesis) implying that Eutocius was Isidore's pupil? Tannery had the courage of his convictions. He did not hesitate to dismiss this passage too as "an interpolation of the editor." Heiberg duly bracketed all four passages as interpolations in his second edition, and all modern scholars have concurred, notably Heath, Bulmer-Thomas, and Knorr.[6]

But quite apart from the absurdity of the notion that this anonymous pupil of Isidore added no fewer than four references to "my teacher" without apparently realising that they falsely implied that it was not he, but Eutocius who had been Isidore's pupil, the chronological objections simply do not stand up. Westerink has shown that Ammonius must still have been alive in 520 and perhaps even a year or two later.[7] So it is no longer necessary, with Tannery, to place Eutocius' birth as early as 480. If born in (say) 490, he could have studied with Ammonius from *ca* 510. G. J. Toomer has made the attractive suggestion that a horoscope for 28 October 497, said in one manuscript that carries it to be from an astrological work by Eutocius, may actually be Eutocius' own horoscope.[8] If Anthemius was his contemporary (and perhaps fellow student), he would have been in his early forties when entrusted with the building of S. Sophia in 532, quite old enough to have made his name. That Isidore was apparently Anthemius' junior colleague

---

[6] Tannery's hypothesis is stated as fact in T. L. Heath's influential *History of Greek Mathematics* II (Oxford 1921) 540, whence the statement in *PLRE* II (Cambridge 1980) 439 that the allusions in Eutocius to Isidorus "the later architect ... are to be regarded as interpolations"; and (at disproportionate length) by I. Bulmer-Thomas in the entries for both Eutocius and Isidore in *Dictionary of Scientific Biography* IV (New York 1971) 488, VII (1973) 28, and again in *Historia Mathematica* 8 (1981) 482f, rebuking J. Warren, *Greek Mathematics and the Architects to Justinian* (London 1976) 8, for ignorance of modern dogma. *Cf.* W. KNORR, *Textual Studies in Ancient and Mediaeval Geometry* (Boston 1989 [hereafter 'Knorr']) 229f.

[7] *Anonymous Prolegomena to Platonic Philosophy* (Amsterdam 1962) xi; *BZ* 64 (1971) 10–13.

[8] O. Neugebauer and H. B. van Hoesen, *Greek Horoscopes* (Philadelphia 1959) L 497; 152–57, 188f; G. J. Toomer, *Diocles on Burning Mirrors* (Berlin/New York 1976) 18 n.2.

in the S. Sophia project[9] need not mean that he was a younger man. According to Agathias, Anthemius was "long dead" when the dome of S. Sophia fell in 558.[10] The repairs were entrusted to Isidore's homonymous nephew, which suggests that Isidore too was dead. Inscriptions at Chalcis sub Belo in Syria show the nephew's fame as an architect established by 550 (*IGLS* II 348f), and Procopius (*Aed.* 11.8.25) describes work done by him at Zenobia in Mesopotamia "while still a young man but showing a natural ability beyond his years." At *BP* 2.5.7 Procopius re-marks that Zenobia was "uninhabited and destitute of all good things," with the result that the Persians simply bypassed it during their invasion of 540. According to *Aed.* 11.8.9 it was precisely because it was uninhabited and no obstacle to the Per-sians that Justinian rebuilt the city. If follows that Isidore's work here must be dated after 540; we might guess that he was born between 510 and 520. A date of *ca* 475 for the birth of the elder Isidore would accommodate all known evidence. He might have been 10 or 15 years older than Anthemius—and Eutocius. Eutocius could easily have been a pupil of both Ammonius and Isidore, and a contemporary of Anthemius.

This brings us to παραναγιγνώσκειν. When advancing his drastic interpretation of the Eutocius explicits, Tannery was evi-dently unaware of an exactly parallel formula, appended (in the oldest MS., *Laur.* 28.18=L) to the heading to Book III of Theon's commentary on Ptolemy's *Almagest*:[11] Θέωνος Ἀλεξανδρέως εἰς τὸ τρίτον τῆς μαθηματικῆς Πτολεμαίου Συντάξεως ὑπόμνη-μα ἐκδόσεως παραναγνωσθείσης τῇ φιλοσόφῳ θυγατρί μου Ὑπατίᾳ. The parallel is more exact than has been generally ap-preciated. In both cases the work is described as a commentary

---

[9] As implied by Procop. *Aed.* 1.1.24 and his omission in Agathias *Hist.* 5.9.4.

[10] *Hist.* 5.9.4. The often repeated claim (*e.g.* G. L. Huxley, *Anthemius of Tralles* [=*GRBM* 1 (Cambridge, Mass.) 1959] 3; O. Neugebauer, *A History of Ancient Mathematical Astronomy* II [New York 1975] 1042; Warren [*supra* n.6] 6) that he died in or even about 534 is without foundation. F. Hultsch's claim that "Nach seinem Tode (um 534) führte Isidoros allein sein Bau weiter," suggests that he has mistakenly taken the Isidore in this passage (the only source he cites) to refer to the elder instead of the younger Isidore. There is no evidence that Anthemius did not live to see the completion of S. Sophia.

[11] Book III was not published till 1943, but the subtitle was known to F. Hultsch, ed., *Pappi Alexandrini Collectionis quae supersunt* III (Berlin 1876–78) xiiif; *cf.* A. Rome, *AnnArchBrux* 46 (1926) 1–14; *BullAcRoyBelg* SER. 5 39 (1953) 507.

by Theon and Eutocius respectively, and there is also mention of an "edition checked" (ἐκδόσεως παραναγνωσθείσης) by some other person. In each case the name and professional qualification (architect/philosopher) of this other person and his/her relationship to the commentator ("my teacher/my daughter") is specified. With four examples, we may surely conclude that this was a stock formula, of which we would have more examples if we had modern editions of more of the technical writings of late antiquity. Hypatia and Isidore were each performing some standard activity that would be identified for contemporaries by the word παραναγιγνώσκειν.

Heiberg had noticed the parallel by the time he published his second edition and seemed to think that it supported the new interpretation of the Eutocius explicits. The exact opposite is the case. Hypatia was both qualified to help Theon and incontestably alive when he was writing. Though most famous as a philosopher (she is so described by Theon), Hypatia was no mean mathematician and astronomer: she wrote commentaries on Diophantus, Apollonius of Perga, and Ptolemy's *Handy Tables.* Isidore too was well qualified to help Eutocius. The Theon parallel surely supports the natural interpretation of the Eutocius explicits, namely that Isidore was indeed Eutocius' teacher, just as Theon was Hypatia's teacher.

Assuming Tannery's hypothesis as fact, however, Knorr (527f, 807) attributes to Isidore or his hypothetical anonymous pupil various interpolations he detects in the original text of Eutocius' commentary. Whether or not such interpolations exist, they can no longer be ascribed to Isidore, an older man than Eutocius. And if they are to be ascribed to a pupil of Isidore, why not to Eutocius himself? Late antique commentaries on the classics are dangerous texts to analyze in this way. They are normally based on earlier commentaries and a variety of specialized monographs, excerpted and assembled with scissors and paste. Unless the commentator is both expert and alert, there are bound to be inconsistencies and contradictions between the different excerpts, written as they were over many centuries. And we know that when Eutocius compiled his commentary on *De sphaera et cylindro* he was a tiro (p.2.13).

According to Theon's editor, A. Rome, Hypatia revised or

edited Theon's work,[12] and his hypothesis has now been carried much further by Knorr (756f). Rome looked for linguistic differences between III and other books—unsuccessfully, as even Knorr concluded. Knorr thought that Hypatia inserted new material here and there rather than revised the whole, and suggested the passage on division by sexagesimals at the end of III.1 as an example (*cf.* Rome [1953: *supra* n.11] 841f n.3). The same procedure is also described in Books I, IV, and IX. According to Knorr, "stylistic discrepancies so strongly distinguish the account in Books III and IV from that in Book I that they seem hardly compatible with the hypothesis of single authorship." He suggests accordingly that the account in I derives from Theon and those in III and IV from Hypatia. He then finds that the author of IX, though he "explicitly draws from the text of III and IV and expounds the same method as they," is nonetheless closer to I in both style and technical execution. He concludes "that the author of IX is not that of III and IV, but of I, namely Theon; for there is no other way to account for the stylistic affiliation." He is thus driven to the paradoxical conclusion that when "writing his commentary on Book IX, Theon is already aware of the second (Hypatian) edition of Books III and IV."[13] This he explains by the hypothesis that Theon "delegated" the publication of his notes on these books to Hypatia.[14]

But he has misunderstood the practice of the Neoplatonist commentator Ammonius to which he refers as his only parallel and support. Here a quite different formula is used. Asclepius and Philoponus state quite openly that they are publishing their commentaries ἀπὸ φωνῆς Ἀμμωνίου, which means, in effect, "from the lecture notes of Ammonius."[15] It seems that Ammonius preferred to recycle his work endlessly in class rather than publish it (a practice not unknown among academics

---

[12] *Commentaires de Pappus et de Théon d'Alexandrie sur l'Almageste* III (=*Studi e testi* 106 [Vatican 1943]) cxvii–cxxi.

[13] All four citations from Knorr 761f. That is to say, on stylistic grounds Knorr extends Hypatia's revisions to Book IV of Theon's commentary.

[14] Tihon comes close to this position: "Théon avait chargé sa fille Hypatia d'en faire l'édition," which goes well beyond what Theon says. See T. Mogenet and A. Tihon, *Le 'Grand Commentaire' de Théon d'Alexandrie aux Tables faciles de Ptolémée* I (=*Studi e testi* 315 [Vatican 1985]) 221.

[15] See M. Richard, "Ἀπὸ φωνῆς," *Byzantion* 20 (1950) 192; Westerink (*supra* n.6) xi.

of other times and places). It was his pupils who preserved his work, no doubt after his death, with Philoponus (but not Asclepius) indicating that he had added material of his own. When we have versions by both Asclepius and Philoponus of the same lectures of Ammonius, the similarities are often very close.[16] That is to say, they are *reports* of Ammonius' actual lectures, with or without additions. There is no clear indication that these were perceived as publications at all, much less publications authorized by Ammonius. Rather they were notes copied down by Asclepius and Philoponus in Ammonius' classes and later re-used by them when they were professors.[17] The situation is thus quite different from the relation of Hypatia to Theon or Isidore to Eutocius.

Even if we accept Knorr's analysis of the differences between these four passages of Theon, his hypothesis of later editorial insertion is by no means the only or the most natural solution. Such variations and inconsistencies in the compilations of late antiquity are normally seen as pointers to the different *sources* employed. Knorr concedes that neither Hypatia nor Theon invented this method of division. To go no further back in time, it is described in detail by Theon's predecessor Pappus, whose commentary Theon pillaged heavily for his own. As a consequence, most of Pappus' commentary has perished, but the so-called *Prolegomena to the Almagest* preserve a fragment that ascribes to him the same method with the same example (360 divided by 365 14′ 48″) as in Theon Book III.[18] Knorr allows that Hypatia's alleged addition to Theon derives from Pappus, but since Pappus was Theon's own major source, this is hardly a safe criterion for distinguishing between Theon and Hypatia. Knorr's hypothesis makes it no easier than any other to under-

---

[16] See L. Tarán, *Asclepius of Tralles: Commentary to Nicomachus' Introduction to Arithmetic* (Philadelphia 1969) 10f.

[17] This practice was perpetuated among Ammonius' successors, the greater part of whose extant commentaries are more or less verbatim transcripts of lecture notes (whence the frequent problems of ascription).

[18] J. Mogenet, "La division selon Pappus d'Alexandrie," *BullAcRoyBelg* SER. 5 37 (1951) 16–23; see the translation in Knorr 787–93, who describes this account as a "rambling mess ... more than four times longer than the account from Theon-Hypatia's Book III." But he allows that this is probably the fault of the later compiler who preserves the material—none other than Eutocius, according to Mogenet (*L'introduction à l'Almageste* [=*MémAcRoyBelg* 51.2 (1956)], disputed at length by Knorr 155–211).

stand why Theon allowed these inconsistencies (if such they are) to stand. The simplest explanation is that they derive from different stages of composition in a long work based on various sources and not consistently revised.

In itself, the idea that a well qualified daughter might assist her father in the immense labour of writing a commentary on all thirteen books of the *Almagest* seems eminently reasonable. But the precise form of the heading to Book III seems to exclude the two obvious forms this assistance might have taken: namely that they wrote the commentary jointly between them, (*e.g.* Knorr's hypothesis that Theon "delegated" some books to Hypatia) or that Hypatia completed or revised Theon's work after his death, or at any rate after he had finished.[19] Whatever Hypatia did, she evidently did while Theon was still at work, for it is Theon who mentions her rôle, as early in so long a project as Book III. And even in the case of Book III, Theon still claims the authorship of his commentary (Θέωνος ὑπόμνημα).

According to Heath, Hypatia's revision was confined to Book III, which "may ... account for the fact that Theon's own Book III disappeared from all MSS other than L" (*Laur.* 28.18).[20] If there really were two versions, it is understandable that Hypatia's revision might replace Theon's original.[21] But why should this account for copies lacking Book III altogether? According to Rome, Hypatia's "revision" made the book somehow "less authentic."[22] The truth is that *all* MSS. of Theon's commentary (including L) are fragmentary. L has III but (like other MSS.) lacks V; the other MSS. lack other books or portions of books in addition to III and V (the end of X, all of XI, and the beginning of XII). There is surely no significance in III's preservation by L alone. J. Mogenet has recently published some scholia to Book III from two Vatican MSS. Some of them are more or less identical to Rome's text, some contain additional details or omit short phrases. According to Mogenet, since the Rome text "était le résultat d'une révision faite par Hypatie, les variantes

---

[19] *E.g.* Rome (*supra* n.11 [1926] cxvi) compared Hypatia's revision of Theon to Theon's revision of Pappus.

[20] *CR* 52 (1938) 40.

[21] See the reservations about second editions in n.45 *infra*.

[22] Rome (*supra* n.11 [1926]) 6.

pourraient provenir de l'édition antérieure due au seul
Théon."[23] But it would be remarkable indeed if the scholiast had
quoted his source(s) with perfect fidelity.[24] Some of the scholia
are certainly much later than Theon, and it is a reasonable guess
that some derive from Theon's own lost source Pappus. Add to
this the numerous short lacunae in L's text of Book III, and it
should be clear that no confidence can be placed in any attempt
to reconstruct Hypatia in this way.

Furthermore, Anne Tihon has recently announced the dis-
covery of most of the hitherto missing Book V of the *Almagest*
commentary, in the form of scholia to the text of the *Almagest*
in *Vat. gr.* 198.[25] One of the most interesting novelties is the
discovery that Book V is closely related to Book III, with
several direct cross-references back to the earlier book. The
same dates appear in the examples cited. Book III calculates the
longitude of the sun on 5 January 323, while Book V the longi-
tude of the moon on the same date, explicitly referring to the
calculation in Book III. That this date falls earlier than the life-
time of Theon suggests that both examples were taken over
from Pappus. All these scholia are expressly ascribed to Theon,
who is also given as the author of the passages cited from Book
III. Clearly there is no support here for the hypothesis of a
substantial revision of Book III by Hypatia. Indeed, the text of
Book III as extant gives little enough support to the idea that it
was revised by anybody, even Theon. In another paper Tihon
describes it as "fort abîme, ou fort mal rédigé."[26] It is very singu-
lar that the only book expressly described as having been re-
vised should show the least signs of having been revised at all.

The solution to the problem is provided by the headings to
Books I and II of Theon's commentary, the headings that do
not mention Hypatia: Θέωνος ᾿Αλεξανδρέως τῆς παρ᾽ αὐτοῦ
γεγενημένης ἐκδόσεως εἰς τὸ πρῶτον (δεύτερον) τῆς Συντάξεως

[23] "Sur quelques scolies de l'Almageste," in *Le monde grec: hommages à
Claire Préaux* (Brussels 1975) 305.

[24] Compare the case of Porphyry's *Homerika Zetemata*, transmitted both as
an independent text and in the form of scholia, with "enormous discrepan-
cies": N. G. Wilson, "A Chapter in the History of Scholia," *CQ* N.S. 17 (1967)
245.

[25] "Le livre V retrouvé du *Commentaire à l'Almageste* de Théon d'Alexan-
drie," *AntCl* 56 (1987) 201–18.

[26] "Théon d'Alexandrie et les *Tables Faciles* de Ptolémée," *Archives inter-
nationales d'histoire des sciences* 35 (1985) 121 n.37.

Πτολεμαίου ὑπόμνημα. According to Rome, this is "L'édition originale, par opposition à l'édition d'Hypatie."[27] But there are obvious problems here. In the first place, when Theon was writing his commentary on Books I–II, we might naturally assume that he had not yet written his commentary on III, much less seen it revised by Hypatia. In the second, the real opposition, blurred by all modern commentators, is surely between ἐκδόσεως and ὑπόμνημα. According to T. L. Heath, for example, the heading of Book III "describes it as the commentary of Theon on Ptolemy's Book III 'in the recension of my philosopher-daughter Hypatia', while Books I and II have titles stating that they belong to Theon's own edition."[28] Yet while it is at least possible to speak of a commentary of Theon in an edition (*i.e.*, revision) by Hypatia, it is nonsense to speak of a commentary of Theon in his own edition. In the ordinary way, one's own books are always in one's own edition. Unless there are some special circumstances (a posthumous or revised edition), this is too self-evident ever to be worth stating at all. It is difficult to think of a single parallel for so strange a formula. There is no such reference to an ἔκδοσις in the titles to any of Theon's other commentaries.[29] In the lexicon of the scholar, ἔκδοσις and ὑπόμνημα normally denote two quite separate sorts of book, the edition *of* and the commentary *on* the text in question.

Certainly this is how Theon normally used the terms. For example, in the course of Book I of his commentary, he remarks: "that sectors of equal circles are to one another as the angles on which they stand, I have proved in my *edition* of the *Elements* (δέδεικται ἡμῖν ἐν τῇ ἐκδόσει τῶν Στοιχείων) at the end of the sixth book."[30] Theon did not write a commentary on Euclid, but he did produce an edition of the text. And just such

---

[27] A. Rome, *Commentaires de Pappus et de Théon d' Alexandrie sur l'Alma-geste* II (=*Studi e testi* 72 [Vatican 1936]) 317 n.1; *cf.* III (*supra* n.12) cxvi–xxi.

[28] Heath (*supra* n.20) 40. So too K. von Fritz, *Gnomon* 15 (1939) 276: "Die Überschriften der verschiedene Bücher des Kommentares des Theon lassen keinen Zweifel darüber, daß es sogar von dem Theonkommentar selbst ver-schiedene Ausgaben oder Auflagen, die eine von Theon selbst, die andere von seine Tochter Hypatia besorgt, gegeben hat."

[29] A point noted but not explained by Tihon (*supra* n.14) 71: "cette fois, il ne nous est pas précisé que cet ὑπόμνημα a fait l'object d'une ἔκδοσις. Faut-il voir là une différence significative?"

[30] Rome (*supra* n.27) II 492.6ff (tr. T. L. Heath).

a proposition appears in the text of almost all extant MSS. of Euclid's *Elements* at the end of 6.33. Indeed, some of these MSS. are explicitly stated to be "from Theon's edition" (ἐκ τῆς Θέω-νος ἐκδόσεως). It was not till the beginning of the nineteenth century,

> when Peyrard discovered that the manuscript Vaticanus Graecus 190, which lacks that proposition and is significantly different from the vulgate in other respects, must be an example of the pre-Theonic text, that it became possible to determine the nature of Theon's alterations of Euclid. They are many but mostly trivial ... a very few are corrections of real mistakes in Euclid's text. More are due to Theon's misunderstanding the original. In some cases he apparently omits what he considers wrong. He makes frequent additions to fill what he considers gaps in Euclid's reasoning, even interpolating whole propositions.... On the whole, his edition can hardly be said to improve on the original, although it may well have fulfilled its purpose of being easier for his students to use.[31]

We now know that Theon produced similar "editions" of two other works of Euclid, the *Data* and the *Optics*, the latter less an edition (even in Theon's terms) than a simplified reworking in his own words; it is described in one MS. as being according to the "version" of Theon (ἐκ τῆς Θέωνος ἐξηγήσεως).[32]

The possibility that Theon might have produced a similar "edition" of Ptolemy was long ago aired by Heiberg on the basis of interpolations in certain MSS.:

> ratio genusque interpolationis, quam in archetypo codicum DG incohatam et in utroque propagatam vidimus, peritis in memoriam revocabit recensionem Elementorum Euclidis a Theone factam.[33]

These interpolations, he suspected, were the work of the school of Alexandria, "ubi Syntaxis sine dubio semper in mani-

[31] G. J. Toomer, *Dictionary of Scientific Biography* XIII (1976) 322; *cf.* K. Ziegler, "Theon (15)," *RE* 5A (1934) 2078f; for the details, Heiberg, *Euclidis opera* V (Leipzig 1888) xxivf, li–lxxvi; Heath, *The Thirteen Books of Euclid's Elements* I² (London 1926) 46–63.

[32] Toomer (*supra* n.31) 322f; Ziegler (*supra* n.31) 2078f; H. Menge, *Euclidis opera* (Leipzig 1883–1916) VI xxxii–xlix; VII xlix–l; J. L. Heiberg, *Litterar-geschichtliche Studien über Euclid* (Leipzig 1882) 129–48. For ἐξήγησις as 'version' see Lampe, *PGL s.v.* 2 (of the Septuagint).

[33] *Claudii Ptolemaei opera* II (Leipzig 1907) cxxvi.

bus magistrorum discipulorumque mansit et docendo tracta-
batur." He quoted one or two passages from Pappus and Theon
in the unpublished collations of F. Hultsch that agreed with
what he considered interpolations, but conceded that full
confirmation or refutation of his suspicion would have to wait
until there was a critical edition of Theon's commentary. On
the basis of his own work on the text of Theon, Rome stated
(without detailed argument) that in his view Heiberg was right.[34]
But the situation is not as simple as it once appeared. For Gerald
Toomer has shown that in many cases readings of D that
Heiberg rejected must in fact be correct, often numerical com-
putations where there is no room for doubt.[35] But the lack of
straightforward correlations between Theon's interpolations
and one MS. or group of MSS. does not mean that they do not
exist or cannot be detected. This after all was the situation in the
Euclid tradition until the discovery of the sole pre-Theonic MS.
And there too the situation is now seen to be more complex
than Heiberg originally thought. Not only do the Theonic MSS.
differ among themselves, each at one place or another alone
agreeing with the Vaticanus against its fellows: the pre-Theonic
P.Fayum 9 agrees with the Theonic MSS. against the *Vaticanus*.[36]
Perhaps we are in the unfortunate positon of having no pre-
Theonic Ptolemy MS. Toomer has detected a series of inter-
polations, several of them later than Pappus but all earlier than
the copies used by the Arabic translators.[37] He is too cautious to
attribute them to Theon, but this is an obvious possibility.

In the case of Euclid, the famous remark in the *Almagest* com-
mentary alerted scholars to the existence and nature of Theon's
edition long before the discovery of *Vaticanus* 190. Under the
circumstances, it is curious that his scarcely less explicit allu-
sions to his own edition of the *Almagest* have not been
recognized. But the participle γεγενημένης surely makes that
inescapable. It was the "edition done" (*editio facta*) by himself.
This is no more than a variation on the formula ἐκδόσεως
παραναγνωσθείσης, with γεγενημένης a gloss on παρανα-
γνωσθείς. So too the reference to Hypatia's edition. It was not

---

[34] Rome (*supra* n.11 [1953]) 513.

[35] G. J. Toomer, *Ptolemy's Almagest* (London 1984) 3; in many cases D's
"obviously correct readings are shared by all or part of the Arabic tradition."

[36] See Heath (*supra* n.31) 51–54.

[37] Toomer (*supra* n.35) 4f and 684 for a list.

her father's commentary that she edited, but the text of the *Almagest*. If it had been the commentary, why introduce the misleading ἐκδόσεως? What we should then have expected is the neuter παραναγνωσθέν agreeing with ὑπόμνημα: "the commentary of Theon revised by ... Hypatia." What we in fact get is a genitive absolute and an antithesis between commentary and edition: "the *commentary* of Theon, with the *edition* revised by ... Hypatia."

It is now possible to see exactly how the labour was divided between father and daughter. To start with, Theon did both text and commentary, but after he had completed the first two books he asked Hypatia to undertake the text. According to Rome (the only person who has looked at the MSS. for the rest of the commentary) there are no more such subheadings to Books IV–XIII.[38] So there is no way of telling whether she prepared the text of the remaining ten books. But the natural assumption is that Theon found the task of both text and commentary too much for him, and persuaded Hypatia to take over the text for the rest of the project. It will not (of course) have been any more of a critical edition in the modern sense than Theon's of Euclid. It was just a simplified and 'corrected' text for the use of students—the same students who (according to the preface to Book I of Theon's commentary) had asked him to publish his lecture notes in that form. Naturally they wanted a reliable text to go with Theon's commentary. Hypatia had doubtless worked through the text of the *Almagest* many times with her father, so it cannot have been too difficult for her to produce a version that would harmonize with his views.

That this is what the subtitles to Theon's commentary mean is put beyond reasonable doubt by the subtitles to all four books of Eutocius' commentary on the *Conica* of Apollonius of Perga (II 168, 290, 314, 354 Heiberg): Εὐτοκίου Ἀσκαλωνίτου εἰς τὸ α΄ [β΄, γ΄, δ΄] τῶν Ἀπολλωνίου κωνικῶν τῆς κατ᾽ αὐτὸν ἐκδόσεως. As with Books I and II of Theon, Eutocius cannot be saying that this is his own edition of his own commentary. Who else's edition could it be? There can be no question (as Heiberg saw already in his paper of 1880) that Eutocius is referring to his own commentary *and* his own edition of the text of Apollonius.

[38] Rome (*supra* n.27) II 318 n.1: "A partir du 4ᵉ livre ces mentions disparaissent."

The edition is referred to quite explictly in the preface to Book
IV:

> Book IV, my dear friend Anthemius ... is particularly elegant and
> clear for readers, thanks to my edition with its commentary; the
> notes[39] make up for anything left unsaid.[40]

It seems clear from these words that Eutocius' work included
an edition of the text as well as a commentary. One of the three
Banū Mūsa brothers, who commissioned the Arabic translation
of Books I–VII in the ninth century, collated the Eutocian
version of I–IV against a pre-Eutocian text, and found "that the
errors in these were fewer than in the original." The first four
books of their translation (all that Eutocius edited) "came out
according to the restoration of Eutocius, and the following ac-
cording to the composition of Apollonius."[41] The brothers re-
peatedly apply the terms "restore" and "correct" to his labours
on the text.

In his commentary Eutocius frequently cites alternative ver-
sions to be found "in some copies" (ἐν τισιν ἀντιγράφοις, as he
writes in the first three books, contenting himself thereafter
with an ἄλλως).[42] In explanation of these variants, he refers to a
passage in Apollonius' own dedicatory letter to Eudemus,
which deserves to be quoted in full:

> I dare say you have not forgotten my telling you that I under-
> took the investigation of this subject at the request of Naucrates
> the geometer at the time when he came to Alexandria and stayed
> with me, and that, after working it out in eight books, I com-

---

[39] Heiberg (*supra* n.2: 375) once conjectured καταγραφαί, "diagrams," for
the MSS. παραγραφαί , which he rightly kept in his edition (interpreting "breves
illas notas, quibus in codd. mathematicorum propositiones usurpatae vel ipsius
operis vel Euclidis citantur," 355 n.1). This would have implied that diagrams
were not common in texts of the period, which is hardly credible (diagrams
were certainly used in early mathematical texts, as papyri and some other evi-
dence clearly prove: K. Weitzman, *Illustrations in Roll and Codex*[2] [Princeton
1970] 47ff).

[40] ἔστι δὲ χαρίεν καὶ σαφὲς τοῖς ἐντυγχάνουσι καὶ μάλιστα ἀπὸ τῆς ἡμετέ-
ρας ἐκδόσεως, καὶ οὐδὲ σχολίων δεῖται· τὸ γὰρ ἐνδέον αἱ παραγραφαὶ πλη-
ροῦσιν.

[41] Both quotations are from their long and informative preface as translated
by G. J. Toomer, *Apollonius, Conics Books V to VII: the Arabic Translation
of the Lost Greek Original in the Version of the Banū Mūsa* II (New York
1990) 620–28.

[42] Passages collected by Heiberg (*supra* n.3) 361f.

municated them to him at once, somewhat too hurriedly, with-
out a thorough revision (as he was on the point of sailing), but
putting down all that occurred to me, with the intention of re-
turning to them later. Wherefore I now take the opportunity of
publishing each portion from time to time, as it is gradually
corrected. But, since it has chanced that some other persons also
who have been with me have got the first and second books
before they were corrected, so do not be surprised if you find
them in a different shape.[43]

Eutocius inferred, perhaps over-optimistically,[44] that his
variants derived from these various versions by Apollonius:[45]

Since there were several editions, as Apollonius himself says in
the preface, I thought it better to put them together from what-
ever source came to hand and place the clearer version in the text
to help the understanding of beginners; and to indicate the varia-
tions on the proofs outside [*sc.* in the margin].[46]

Here he is describing the principles on which he constructed
his text as well as his commentary. He even enunciates his
critical principles: he has put the "clearer" version in the text.
That is to say, he used his judgement, not manuscript evidence,
to decide between variants. As the Banū Mūsa put it, "he
employed his intelligence in what he could not correct ... until
he discovered the proof for it." Rejected variants he placed
"outside," by which he evidently means in the margin.[47] There

---

[43] Tr. T. L. Heath, *Apollonius of Perga: Treatise on Conic Sections* (Cam-
bridge 1896) lxix.

[44] II lvii Heiberg: "sive, quod veri similius est, magistris debetur, qui libro
Apollonii in docendo utebantur, quo modo in codicibus reliquorum
mathematicorum ortae sunt demonstrationes alterae."

[45] Modern writers often make the anachronistic assumption that revised
editions drive their predecessors off the market. The truth is that authors had
no way of controlling the dissemination of a work once it had left their
hands. The best known case is Cicero's *Academica*, where (non-overlapping)
parts of both editions have survived: see Philippson in M. Gelzer, W. Kroll, R.
Philippson, and K. Büchner, "M. Tullius Cicero," *RE* 7A (1939) 1128-35.

[46] πλειόνων δὲ οὐσῶν ἐκδόσεων, ὡς καὶ αὐτός φησιν ἐν τῇ ἐπιστολῇ, ἄμεινον
ἡγησάμην συναγαγεῖν αὐτὰς ἐκ τῶν ἐμπιπτόντων, τὰ σαφέστερα παρα-
τιθέμενος ἐν τῷ ῥητῷ διὰ τὴν τῶν εἰσαγομένων εὐμάρειαν, ἔξωθεν δὲ ἐν τοῖς
συντεταγμένοις σχολίοις ἐπισημαίνεσθαι τοὺς διαφόρους (ὡς εἰκὸς) τρόπους τῶν
ἀποδείξεων.

[47] Heiberg (*supra* n.3: lviii) also argues that some of the lacunae in Eutocius
point to the text having been written in the margins and so particularly
vulnerable to physical damage.

has been some debate in recent years about when scholia came to be written in the margins of classical texts rather than in separate monographs. It has usually been assumed that the practice developed in late antiquity; others have preferred to postpone it until the development of minuscule script in the eighth and ninth centuries.[48] The debate centres less on the purely technical aspect (the location of explanatory notes on the same page as the text) than on the abridgement for the purpose. Here in the case of Eutocius we seem to have an indisputable example; his commentaries clearly represent an abridgment of the work of innumerable predecessors.[49]

We should not overrate Eutocius' editorial skills. His edition was no doubt modelled on those of Theon, aimed at students rather than scholars. His frequent citation of variants does not in itself prove that he collated MSS. systematically. It is likely that the more important variants were already indicated with an ἄλλως in the margins of scholarly MSS. The Aristotelian commentators frequently discuss variant readings, and though they occasionally collated MSS., it is clear that the texts they used often carried variants.[50] Nonetheless, whatever his method and sources, there can be no question that Eutocius produced his own text of Books I–IV of Apollonius' *Conica*.

So in all four examples of the ἐκδόσεως formula from Eutocius' Apollonius commentary and in all three from Theon's commentary on the *Almagest* the reference is to a text. The same is surely true of the three more examples from Eutocius' commentaries on Archimedes. So Heiberg's first thoughts were best. Isidore did not revise Eutocius' commentaries, he edited the text on which his commentaries were based.

[48] See Wilson (*supra* n.24) 244–56, and "The Relation of Text and Commentary in Greek Books," in *Atti del Convegno internazionale «Il libro e il testo»*, *Urbino, 20–23 settembre 1982*, edd. C. Questa and R. Rafaelli (Urbino 1984) 105–10.

[49] For a list of the earlier texts read and cited by Eutocius see Heiberg (*supra* n.2: 363–71), concluding that he was "ein sehr fleißiger Sammler von weit ausgedehnter Belesenheit" (363); Bulmer-Thomas (*supra* n.6) IV 489ff. But his Apollonius commentary is less substantial, providing much less of historical value than the Archimedes commentary: *cf.* Toomer (*supra* n.41) xvi.

[50] See the evidence for *De caelo* alone assembled by P. Moraux, "Notes sur la tradition indirecte du 'de caelo' d'Aristote," *Hermes* 82 (1954) 145–82, and in his edition, *Aristote du ciel* (Paris 1965) clx–clxvi.

Once more, however, we should not overestimate this edition. We need not believe, with E. Stein, that Isidore "distinguished himself" as editor of Archimedes; or with C. Fabricius that it is Isidore we have to thank for the "rescue" of the principal MSS. of Archimedes.[51]

Large claims have been made for the "School of Isidore." According to H. Hunger, he played an important rôle in the transmission of the text of both Archimedes and Euclid.[52] It is worth taking a closer look at the only piece of evidence that links him to Euclid. The author of the so-called fifteenth book of Euclid's *Elements* demonstrates how to inscribe certain regular solids inside certain others (for example, a cube in an octahedron) and how to determine the angle of inclination between faces meeting in an edge of these solids. The method was to construct various isosceles triangles, and the rules for drawing them are attributed to "Isidore our great teacher."[53] There is no reason to doubt the usual assumption that this is Isidore of Miletus and that the author of the treatise was a pupil of his, writing in the early sixth century.[54] After briefly quoting Isidore's formulation of his rules, the anonymous proceeds to explain them in more detail, on the grounds that "the distinguished man" was content once they seemed self-evident to himself (54.1f Heiberg). The implication is that Isidore had not published his own discovery. He may well have given brilliant and popular classes on the ancient mathematicians. He may even have played a part in the revival of interest in their writings, which may in turn have led to a demand for copies, both in Constantinople and Alexandria. But Heiberg's further

[51] E. Stein, *Histoire du Bas-Empire* II (Paris 1949) 457; C. Fabricius, *RE* 9 (1916) 2081; much the same in K. Ziegler, *Kl. Pauly* 2 (1975) 1462.

[52] Heiberg (*supra* n.31) 156; H. Hunger, *Die hochsprachliche profane Literatur der Byzantiner* II (Munich 1978) 230.

[53] Heiberg (*supra* n.32) 50.21 with 67 n.1.; a clear summary of Isidore's rules in Heath (*supra* n.31) III² 519f.

[54] Heiberg (*supra* n.31) 156. To Heiberg's case against the alternative possibility, that Book XV is by Damascius and that the teacher is the Athenian scholarch Isidorus, may be added Damascius' malicious remark (*Vita Isidori* 218, ed. C. Zintzen [Hildesheim 1967]=*Epit. Phot.* 164) that Isidorus excelled Hypatia not only as a man does a woman but also as a true philosopher does a geometrician. The implication is surely that this Isidorus was not a geometrician.

suggestion[55] that Isidore was also responsible for the formation of a corpus of Archimedes' writings probably goes too far. After all, as the same Heiberg conceded, Eutocius seems to have known only the three works of Archimedes on which he wrote commentaries—and Isidore perhaps only the first two.[56] Since another six have survived,[57] it does not look as if the School of Isidore conducted a very thorough search. There is certainly no evidence that he did anything for the text of Euclid. Nor, after Theon and Proclus, can he be credited with a revival of interest in Euclid.

Even the often repeated claim that "it was in the school of Isidorus that [Archimedes'] treatises were turned from their original Doric into the ordinary language" is not borne out by the evidence.[58] On the one hand, the way Eutocius draws attention to the antiquated terminology and the "partial preservation of Archimedes' own Doric" in an "old book" he found (p. 130.29f) suggests that both dialect and terminology had already been largely modernized before Isidore's day. On the other hand, he quotes a handful of Doric forms in his commentary on *De sphaera et cylindro* that are no longer to be found in our MSS.[59] Evidently the *systematic* suppression of Dorisms was later than Eutocius' day.

The only work attributed to Isidore is a commentary, on one of the most practical works of the eminently practical Hero of Alexandria, his Καμαρικά ("On Vaulting"). Isidore was a highly successful builder, and in an age when so many churches were being built, we can hardly doubt that this commentary owed more to Isidore's own experience in building vaults than to study of the MSS. of Hero.[60] All we know of it comes from

[55] *Archimedis opera* III[2] xcv: "eius temporis studiis debetur, quod opera Archimedis, quae singulatim ferebantur aut in bibliothecis latebant, undique conquirebantur. nonnulla in corpusculum mechanicorum recepta sunt."

[56] Heiberg (*supra* n.2) 359, and see 123 *infra*.

[57] Not to mention fragments and another that survived long enough to be translated into Arabic.

[58] Heath (*supra* n.6) 25; *cf.* Bulmer-Thomas (*supra* n.6 [1981]) 482.

[59] J. L. Heiberg, "Ueber den Dialekt des Archimedes," *NJbb* Suppl. 13 (1884) 543.

[60] "The relevance to Haghia Sophia is obvious," according to Warren (*supra* n.6: 8), but the work in which Eutocius refers to it cannot have been written later than *ca* 520. Vaults had been the staple of Roman architecture since Trajan, *e.g.* W. L. MacDonald, *The Architecture of the Roman Empire*[2] I (New Haven 1982) 180f. Isidore had doubtless been building them all his life.

another of his pupils, Eutocius, who in Book II of his Archimedes commentary refers to it for the description of a special compass Isidore had invented for drawing parabolas (p.84.8). It does not survive, and we cannot even be certain that it was a published work. At this period, the word ὑπόμνημα often denotes nothing more than lecture notes taken down by a student,[61] and Eutocius was certainly Isidore's student.

Anthemius too has come in for extravagant praise over the years. According to an architectural historian (Warren [*supra* n.6] 12), "Isidorus the elder and his nephew stood with Anthemius on the ultimate peak of Greek mathematics. Their efforts raised it a little higher." A more qualified critic wrote recently of his "bombastic style and mathematical ineptitude."[62] The claims for originality and even brilliance once made for his discussion of burning-mirrors in *On Remarkable Mechanical Devices*[63] (of which only a fragment survives in the original) have suffered a sharp blow from Toomer's publication of the classic Greek treatment of the subject, Diocles' *On Burning Mirrors.* Not only are Anthemius' demonstrations clumsy by comparison; he appears not even to have known Diocles' book, despite Eutocius' knowledge of it.[64] For an architect he was no doubt a competent mathematician, and he certainly knew how to apply his knowledge to subjects great and small. A complete Arabic translation (unpublished) of *On Remarkable Mechanical Devices* continues with methods for constructing fairground distorting mirrors.[65] And Agathias lists a series of mechanical jokes he played on his unfortunate neighbour in Constantinople, including dazzling him with mirrors and a simulated earthquake caused by steam-power.[66] Hunger's claim (*supra* n.52: 230) that he "commented on Nicomachus" seems to be a

---

[61] For example, almost none of the numerous extant commentaries by Ammonius and Olympiodorus were published; what we have are copies made from their lectures (ἀπὸ φωνῆς) by students: Richard (*supra* n.13) 191–222.

[62] Toomer (*supra* n.8) 20.

[63] Text and commentary in Huxley (*supra* n.10).

[64] Toomer (*supra* n.8) 18, 187–201.

[65] Toomer (*supra* n.8) 20, supplemented by private information. The discovery of the Arabic version puts out of court the much discussed issue (Huxley [*supra* n.10] 20–33) whether the so-called *Fragmentum mathematicum Bobiense* was part of Anthemius' book.

[66] *Hist.* 5.7f; E. Darmstaedter, "Anthemios und sein „künstliches Erdbeben" in Byzanz," *Philologus* 88 (1933) 477–82.

confusion with Anthemius' contemporary and fellow-citizen Asclepius of Tralles. There is no evidence that he took pupils or edited texts.

There is a widespread view that Isidore and Anthemius were "more scientists than architects." According to Krautheimer, for example, "Experienced master builders of 537 must have stood aghast at the disregard of sound building practices by those two non-professionals to whom the Emperor had entrusted his greatest building."[67] There is no basis whatever for this opinion. A passage of Pappus to which G. Downey drew attention bears out for late antiquity Vitruvius' famous claim[68] that architects were expected to have a sound theoretical training: "the man who has been trained from his youth in the aforesaid sciences [geometry, mathematics, astronomy] as well as practised in the aforesaid arts [metalwork, carpentry, painting], and in addition has a versatile mind, will be, they say, the best inventor of practical devices and the best builder."[69] Pappus conceded that very few reached this ideal; those that did were known by the honorable title *mechanicus* (μηχανικός). The inscription from Chalcis sub Belo (*IGLS* II 348) celebrates Isidore's homonymous nephew as μεγαλοπρεπέστατος ἰλλούστριος καὶ μηχανικός.

Procopius (*Aed.* 1.1.24) makes it clear that Justinian put Anthemius in charge of the new S. Sophia because he was "the most learned in the art of building" (μηχανική), and Agathias (*Hist.* 5.8.3 [p.171.7 Keydell]) describes him as a builder *by profession* (τέχνη). It should be noted that Isidore is already described as μηχανικός in the explicits to Eutocius' *De sphaera et cylindro*, a first publication of his youth (p.2.13), that is to say *ca* 510/515, when Isidore cannot have been more than 35.[70] There is no reason to doubt that Isidore was a practicing, pro-

---

[67] R. Krautheimer, *Early Christian and Byzantine Architecture*³ (New York 1979) 215, 220.

[68] *De Arch.* 1.1.3, not always taken seriously: see MacDonald (*supra* n.60) 138.

[69] F. Hultsch (*supra* n.11) III 1022–24=I. Thomas, *Selections Illustrating the History of Greek Mathematics* II (Loeb ed., London 1941) 614–17, with G. Downey, "Pappus of Alexandria on Architectural Studies," *Isis* 38 (1948) 197–200, and "Byzantine Architects: Their Training and Methods," *Byzantion* 18 (1946–48) 99–118.

[70] On the question of ages and dates see *supra* 2.

fessional architect all his life, teaching pupils in the intervals between commissions.

Inasmuch as it may be essentially Isidore's text of Archimedes we read today, he may be said to have played a central rôle in the transmission of the text. But, like Theon's Ptolemy and Eutocius' Apollonius, it was surely a text that rested on Isidore's own judgment rather than collation of MSS. Since this was the text that had formed the basis of Eutocius' study of Archimedes in Isidore's school, it is hardly surprising that he should have used it as the basis for his own commentary. But this does not mean that he saw it as the last word on the text of Archimedes. At p.130.29f he announces a spectacular discovery of his own: that "old book" containing theorems which, despite some corruptions, seemed to correspond to a promise of Archimedes unfulfilled in extant editions and explained quite otherwise by previous commentators. The terminology and traces of Doric convinced him (as they have convinced modern students[71]) that he had actually found a missing fragment of Archimedes.[72]

This brings us at last to the meaning of παραναγιγνώσκειν. A search of the computer files of the Thesaurus Linguae Graecae allows this rare word to be traced from fourth-century Athens down to the age of Theon and Eutocius. Its standard, well documented meaning is 'read aloud for the purpose of checking or comparing one document against another'.

Particularly revealing is a passage in Ps.-Plutarch (*Lives of the Ten Orators* 841F): Lycurgus enacted a law that the tragedies of Aeschylus, Sophocles, and Euripides should be written out and kept in the public archives (τὰς τραγῳδίας αὐτῶν ἐν κοινῷ γραψαμένους φυλάττειν); and that the city clerk read them out to the actors to compare their texts; and that it be unlawful to depart from the authorized text in acting (καὶ τὸν τῆς πόλεως γραμματέα παραναγιγνώσκειν τοῖς ὑποκρινουμένοις· οὐκ ἐξεῖναι γὰρ ⟨παρ'⟩ αὐτὰς ὑποκρίνεσθαι). Bernardakis' supplement seems to be the neatest way to obtain the required sense: Lycurgus' law was evidently intended to stop "the growing cor-

---

[71] Heath (*supra* n.6) 540f; P. M. Fraser, *Ptolemaic Alexandria* (Oxford 1972) II 578.

[72] Nor is this the only occasion on which Eutocius collated MSS. He goes on to quote Dionysodorus' solution of this same problem (153.15f), noting that the corruptions of the text were present in every MS. he had inspected.

ruption of the tragic texts by actors' interpolations."[73] What the clerk did was read out the authorized text so that actors could check their versions against it. Then there is Porphyry's quotation of a letter from Longinus to himself complaining that his copies of Plotinus' writings are full of errors: "I should be very glad if you could send me accurately written copies, simply to read for the purpose of comparison (τοῦ παραναγνῶναι μόνον) and then return" (*Plot.* 19.29, tr. Armstrong). This sense is common in the Attic orators: *e.g.* Aeschin. *In Ctes.* 201, τοὺς νόμους τῷ ψηφίσματι παραναγνῶναι ("read by way of comparison"[74]); 250, τὰς ἐπιστολὰς ἀλλήλοις παραναγιγνώκουσιν ("read and compare with each other"). So often of reading documents (usually laws) aloud: Dem. *De Cor.* 267, μαρτυρίας ... παρ' ἃς παρανάγνωθι καὶ σύ μοι τὰς ῥήσεις; Aeschin. *In Ctes.* 187, παρανάγνωθι δὴ καὶ ὃ γέγραφε Κτησιφῶν; *De fals. leg.* 60, παρανάγνωθι δή μοι καὶ τὸ Δημοσθένους ψήφισμα; 91; Isoc. *Paneg.* 17; Polyb. 2.12.4, τὰ πεπραγμένα διεξῆλθον καὶ τὰς συνθήκας παρανέγνωσαν; *cf.* 3.21.5, 15.25.5; III Macc. 1.12, τοῦ δὲ νόμου παραναγνωσθέντος; Diod. 1.70.9, 73.4; 15.3.6; Philo *In Flacc.* 100; Jos. *Vit.* 260, *AJ* 10.58; Apollod. *Bibl.* 2.64; Euseb. *Praep.Evang.* 8.5.1; Athanasius *PG* 28.912, 944; Basil *PG* 31.1437; Joh. Chrys. *PG* 55.611, 614. In many of these passages there is a clear implication that the text is beng read publicly so that everyone can check what it says: for example, Libanius *Decl.* 16.1.49: οἷον, εἰ παρανόμων γραφὴ τὸ κρινόμενόν ἐστι, παρανεγνώσθησαν οἱ νόμοι. τὰ τοῦ ψηφίσματος ῥήματα εἰ διαφωνίαν τινὰ ἔχει, μεμαθήκατε. Compare also *Letter to Aristeas* 299, an account of how everything Ptolemy said and did during his audiences was written down and "read out" (παραναγινώσεται) the following day, "and if any procedure is found incorrect it receives rectification" (tr. Hadas).

There are also several examples in late writers[75] of the gerundive παραναγνωστικός, where the reference is to a document required to be formally read aloud: *e.g.* Palladius *Dial. de vita Ioan. Chrysos.* p.47.20 Coleman-Norton, παραναγνωστικὸν ἔχομεν μόνον· ποιήσατε αὐτὸ ἀναγνωσθῆναι; and Photius *Bibl.* cod. 162 (105a.20 Bekker, II 129 Henry)), ἔγραψεν ἐπιστολὴν

---

[73] R. Pfeiffer, *A History of Classical Scholarship* (Oxford 1968) 82; Ptolemy III is later said to have borrowed this authorized text and never returned it.

[74] So T. Gwatkin and E. S. Shuckburgh in their still useful commentary of 1890.

[75] See Lampe, *PGL s.v.* (p.1022).

Εὐσεβίῳ (παραναγνωστικὸν δὲ καλεῖ τὴν ἐπιστολήν), ὅρκοις αὐτὸν εἰς τὴν ταύτης ἀνάγνωσιν ἐκκαλούμενος. Evidently the letters are to be read aloud so that there should be no misunderstanding; in the second case the writer actually binds the recipient with an oath to do so.

So from first to last the word seems to imply reading with care and accuracy. If a single English word has to be picked to translate it, 'check' or 'revise' might be best, so long as a caveat is added. There does not seem to be a single text that suggests revision in the sense of addition or expansion,[76] the sense required if either Hypatia or Isidore had added new material to the commentaries of Theon and Eutocius respectively in the way envisaged (for example) by W. Knorr. Indeed, in the case of the laws and Christian texts specified in virtually all the texts listed above, the purpose of the reading is precisely to establish that *nothing* has been added or altered. But it would be a perfectly satisfactory word to characterize the careful reading and checking that went to produce the sort of editions here under discussion. It corresponds to the primary meaning of Latin *recognoscere*, "to examine, check (a document), in order to establish authenticity, accuracy, *etc.*"[77]

The linking of two names in all the headings and explicits under discussion might bring to mind the numerous *subscriptiones* in Latin MSS. dating from this period where the owner names the man who has collated the text with him; he is often a professor, and is named as a sort of guarantee of the purity of the text. For example *Vettius Agorius Basilius Mavortius ... legi et ut potui emendavi conferente mihi magistro Felice oratore urbis Romae* (Hor. *Epodes*); *Felix ... emendabam contra legente Deuterio scholastico* (Martianus Capella).[78] But the parallel is not exact. The *subscriptores* in these MSS. are not the authors, but (often aristocratic) owners, anxious to ensure that their calligraphic copies had an accurate text. The only way to

---

[76] Theon's supplements to Euclid do not count as additions of substance.

[77] *OLD s.v.* 1b (p.1583). So already the first thoughts of Heiberg (*supra* n.2: 359). While acknowledging that the basic meaning of παραναγιγνώσκειν was "nebenbei lesen, d.h. conferiren," he reckoned that "hiervon is aber kein weiter Schritt zu der Bedeutung: eine Ausgabe mit andern vergleichen, eine Text recension besorgen." In his edition (*supra* n.1: III² xciii n.1) he glossed the word "recognoscere vel recensere."

[78] I have discussed these two cases in *CP* 81 (1986) 320ff; for other examples see J. E. G. Zetzel, *Latin Textual Criticism in Antiquity* (New York 1981) Ch. X.

do this was to hire a competent person to collate every word against another copy certified as reliable. And the *subscriptiones* almost invariably use one or both of the words *emendare* or *conferre*, making it clear that correction and collation is the point of the activity. Neither Theon nor Eutocius uses either of the two standard Greek equivalents, διορθοῦν and ἀντιβάλλειν.[79]

Hypatia and Isidore did more than proofread somebody else's text. They constituted their own, an activity for which παραναγιγνώσκειν became the technical term. It was evidently a new term. Its absence from the voluminous Homer scholia[80] is proof enough of this. It is not a term ever applied to what Zenodotus, Aristophanes, or Aristarchus did to the text of Homer. This is perhaps because it was a different sort of activity. The text of Homer was judged by the criteria of 'fittingness', MS. attestation, or linguistic usage; variants in Aristotle likewise by the last two criteria in addition to philosophical considerations. Both groups of scholars were trying to establish what their author wrote and what it meant. In the writings of the mathematicians an altogether different criterion was paramount: mathematical correctness. Was the proof right? The mathematicians were read quite simply to learn mathematics. To this end mistakes were naturally corrected. If a demonstration could be improved, it was. Not even the language was sacrosanct; as Eutocius' discussion of his new Archimedes fragment shows him well aware, both dialect and even terminology were modernised. The point was to produce a text that the professor's students could read and understand. The purpose of their studies was utilitarian. Some of them would go on to become architects. Practical considerations were understandably predominant. There was no reason why διορθοῦν should not have served for this sort of editing as well, but it is not surprising that a different term came to be used.

Of course, Hypatia may have contributed more to her father's enterprise than a corrected text. Since she never married, she may (as in Kingsley's novel *Hypatia*) have continued to live in his house. They had no doubt discussed the problems

---

[79] R. Devreesse, *Introduction à l'étude des manuscrits grecs* (Paris 1954) 83ff, 123f; LSJ *s.vv.*; E. G. Turner, *Greek Manuscripts of the Ancient World*[2], ed. P. J. Parsons (=*BICS* Suppl. 46 [London 1987]) 15f.

[80] It is not registered, at any rate, in J. Baar, *Index zu den Ilias-Scholien* (Baden-Baden 1961).

of the *Almagest* over many years, and Theon may have included many of her ideas. But that is a possibility based on general considerations of probability; it is not implied by what Theon says in the heading to Book III.

As for Isidore's contributions to Eutocius, that is a different matter. On the one hand, Eutocius did study Archimedes with Isidore and perhaps copied his text from Isidore's personal exemplar. Obviously we should expect to find some of Isidore's ideas in Eutocius' commentary. On the other hand, to judge from his one reference to Isidore in his commentary (p.84.8) and the scrupulous account of an original contribution of Isidore by the anonymous author of Euclid XV, we should not expect to find Eutocius presenting original ideas of Isidore as his own. Furthermore, nothing Eutocius says suggests that Isidore was directing the work that resulted in his commentary, was present while he did it, or criticised it before publication. On the contrary, it was not to Isidore that Eutocius dedicated his *De sphaera et cylindro*, but to Ammonius (p.2.15 Heiberg), whom he praises as no less a mathematician than a philosopher. There is good evidence for Ammonius' mathematical expertise, and another of his pupils, Olympiodorus, writes competently on astronomy.[81] All four books of the later commentary on the *Conica* of Apollonius are dedicated in the warmest terms to Anthemius. The commentary on *In dimensionem circuli*, based on Isidore's text, has no dedication at all. The commentary on *De planorum aequilibriis* is dedicated to an unidentifiable "most noble Peter" and the explicits in the same Florentine MS. that in the other three works mention Isidore's edition here say only "Commentary of Eutocius of Ascalon...." Apparently Isidore's edition did not include this work. The available evidence does not suggest that he was the "onlie begetter" of Eutocius' studies on Archimedes.[82]

COLUMBIA UNIVERSITY
September, 1990

---

[81] Neugebauer (*supra* n.10) 1037, 1043ff.

[82] I am grateful to Jacqueline Long, Henry Mendell, Dirk Obbink, Anne Tihon, Gerald Toomer, and Alex Tulin for comments on an earlier draft; and above all to Wilbur Knorr for generously showing me the relevant parts of his *Textual Studies in Ancient and Medieval Geometry* before publicaton.