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## DID CONON OF SAMOS TRANSMIT BABYLONIAN OBSERVATIONS?

By Gerald L. Geison\*

It is now well established that the astronomy of ancient Greece contains numerous elements of indisputably Babylonian origin — the Babylonian eclipse records which appear in Ptolemy's *Almagest* represent only one especially noteworthy example.<sup>1</sup> But the exact pathway by which Babylonian astronomy was transmitted to the Hellenistic world has not yet been discovered. A number of attempts have been made to identify a transmitter, but Neugebauer has rejected as highly conjectural the seemingly promising candidates Callisthenes, Kidenas (or Kidinnu), Naburianos (or Naburianu), and Berossos.<sup>2</sup> Indeed, it is Neugebauer's position that the sources allow no answer to the question of transmission.<sup>3</sup>

What we would really need in order to understand the details of transmission is a Greek commentary to Babylonian ephemerides and procedure texts. Somewhere the great step from year-by-year ephemerides to tables based on mean motions, as we know them from the *Almagest*, must have been made. That we cannot answer such a question even approximately demonstrates how little we know about the earlier period of Hellenistic astronomy outside Mesopotamia.

\*Yale University. I wish to thank Dr. Bernard Goldstein for his generous assistance in the preparation of this article.

<sup>1</sup> For a discussion of some of the specific elements in Greek astronomy which can be traced to Babylonian influence, see J. K. Fotheringham, "The Indebtedness of Greek to Chaldean Astronomy," *Quellen und Studien zur Geschichte der Mathematik*, 1933, B 2:28-44; Otto Neugebauer, *The Exact Sciences in Antiquity* (New York: 1st Harper Torchbook ed., 1962, reprinted from the 2nd ed. of 1957 [1st ed. 1952]), esp. "Origin and Transmission of Hellenistic Science," pp. 145-190; and A. Aaboe, "On the Babylonian Origin of Some Hipparchian Parameters," *Centaurus*, 1955, 4:122-125.

<sup>2</sup> Neugebauer, *op. cit.*, pp. 137, 151, 157.

<sup>3</sup> *Ibid.*, p. 157:

In view of this, it is interesting that in 1891 Paul Tannery claimed that Conon of Samos, a well-known Greek geometer and astronomer of the third century B.C., "composed seven books on astronomy . . . in which he collected the early observations of eclipses by the Chaldeans, and which subsequently became the point of departure for the works of Hipparchus on the matter."<sup>4</sup> If Conon did in fact write a work which contained Chaldean (Babylonian) eclipse records, and which was subsequently used by Hipparchus, this would seem to qualify him as an especially important figure along the pathway of transmission from Babylon to the Hellenistic world.

Furthermore, Tannery is not alone in making this claim for Conon. George Sarton repeated the claim by saying that Conon's work contained "Chaldaean observations of eclipses, thus paving the way for Hipparchos,"<sup>5</sup> and more recently, Dijksterhuis wrote: "Conon of Samos . . . wrote a work on astronomy, in which he collected the ancient observations of the Chaldeans."<sup>6</sup>

In point of fact, however, it is reasonably certain that Sarton drew his information directly from Tannery's article<sup>7</sup> and highly probable that Dijksterhuis did too.<sup>8</sup> Consequently, responsibility

<sup>4</sup> Paul Tannery, "Conon," *La Grande Encyclopédie*, Vol. XII (Paris: Lamirault, 1890-1891), pp. 451-452.

<sup>5</sup> George Sarton, "Conon," *Introduction to the History of Science*, Vol. I (Baltimore: Williams and Wilkins, for Carnegie Institution of Washington, 1927), p. 173.

<sup>6</sup> E. J. Dijksterhuis, *Archimedes* (Copenhagen: E. Munksgaard, 1956), p. 12, n. 1.

<sup>7</sup> In fact, at the end of his article, Sarton (*op. cit.*) cites only Tannery's article.

<sup>8</sup> Dijksterhuis' statement about Conon appears only in a brief descriptive footnote, and he gives no indication of his source. However,

for the notion that Conon's astronomical work contained Babylonian observations must rest ultimately with Tannery. But, unfortunately, the evidence for Tannery's assertion is not presented in his article. To be sure, Tannery does provide a reference—"Probus, *De Astrologia*." But the passage to which Tannery alludes, found in Probus' commentary on Vergil's *Bucolica* (3,40), tells us only that "Conon, mathematician of the Egyptian nation, left seven books *De Astrologia*, dedicated to Ptolemy [Evergetes III, king of Egypt]." <sup>9</sup>

Nonetheless, Tannery's claim for Conon as transmitter deserves careful attention for at least three reasons: (1) Conon was a highly competent mathematician <sup>10</sup> and astronomer and must therefore be taken seriously, (2) he is known to have spent a large part of his life in Egypt (i.e., in a place easily accessible to Babylonian influences), and (3) his candidacy has not been investigated. Rehm's valuable article on Conon <sup>11</sup> provides us with a list of the ancient references to Conon (a complete list, as far as I can judge), and this primary source material may be used to answer the question: did Conon in fact transmit Babylonian observations or eclipse records? More generally, the question is this: just what does the an-

cient literature tell us about Conon as an astronomer?

In addition to the passage by Probus discussed above, a number of ancient authors refer to Conon's astronomical activity. Several of them <sup>12</sup> have to do with Conon's part in a dramatic episode whose heroine is Berenice, wife of Ptolemy Evergetes (reigned c. 247–222 B.C.). In brief, Berenice had vowed that she would clip off her hair if her husband were allowed to return victorious from a military campaign in Asia. He did, and she kept her vow, placing a lock of her hair in a temple. But by the next day the lock had disappeared. This seemed strange, but Conon (perhaps the court astronomer <sup>13</sup>) claimed that he could account for the lock, saying that he had seen it among the constellations. He then pointed out seven stars which he imagined were the lock and which he (and subsequent astronomers) called *Coma Berenices* (Lock of Berenice). This episode inspired Callimachus' full-length elegy *Coma Berenices*, which, except for scattered fragments, survives only in an imitation in Latin by Catullus (composed c. 55 B.C.). The first four lines of Catullus' version attest to the astronomical skill and achievements of Conon and indicate that he had observed the risings and settings of the stars, the planetary periods, and perhaps solar eclipses:

All the lights of the mighty world  
he [Conon] knew;

a comparison of Dijksterhuis' full footnote (only a part is quoted above) with Tannery's article reveals remarkably similar phraseology.

<sup>9</sup> M. Valerius Probus, *In Vergilii Bucolica et Georgica commentarius*, ed. H. Keil (Halis, 1848), pp. 8–9.

<sup>10</sup> For Conon's mathematical accomplishments, see Pappus of Alexandria, *La collection mathématique*, trans. P. ver Eecke (Paris: Desclée de Brouwer, 1933), p. 177; Apollonius, *Treatise on Conic Sections*, trans. T. L. Heath (Cambridge, Eng.: Cambridge Univ. Press, 1896), pp. lxxii–lxxiv; and esp. Archimedes, *Works*, trans. T. L. Heath (Cambridge, Eng.: Cambridge Univ. Press, 1897), pp. 1–2, 56, 151, 233.

<sup>11</sup> Albert Rehm, "Conon," *Pauly's Realencyclopädie der classischen Altertumwissenschaft*, new revision, ed. G. Wissowa (Stuttgart: J. B. Metzler, 1922), Vol. II<sup>2</sup>, pp. 1338–1339.

<sup>12</sup> Cf. Hyginus, *The Myths of Hyginus*, trans. and ed. Mary Grant (Lawrence: Univ. Kansas Press, 1960), *Poetica astronomica*, p. 214; *Patrologia cursus completus, Series graeca*, ed. Jacques Paul Migne, Vol. XXXVI (Paris: Garnier, 1858), p. 1037A; *Callimachus and Lycrophan*, trans. A. W. Mair (London: Heinemann, 1921), p. 227; and Gaius Valerius Catullus, *The Complete Poetry*, trans. Frank O. Copley (Ann Arbor: Univ. Michigan Press, 1957), pp. 83–86.

<sup>13</sup> Rehm, *op. cit.*, suggests that if Conon was not exactly in the official position of a "court astronomer," he was nonetheless closely associated with King Ptolemy Evergetes and his wife Berenice.

Where rise the stars he learned, and  
 where they set;  
 How flames the sun, how runs, and  
 disappears;  
 How pass the planets in their  
 seasons fixed. . . .<sup>14</sup>

But, interesting as that may be, the Callimachus-Catullus elegy, like other references to Conon's part in the Lock of Berenice episode, makes no mention of Babylonian observations or eclipse records, and for present purposes the episode is therefore of only minor importance.

Turning, then, to other sources, it may at first seem highly promising that Ptolemy, in his *Apparitiones* (or *Phaenomena*), refers to Conon nineteen times.<sup>15</sup> Indeed, in one instance, Ptolemy tells us that Conon made observations in Italy and Sicily,<sup>16</sup> but the other eighteen references are in the category of "predictions of storms," and are noninformative for present purposes. Again there is nowhere any mention of Conon vis-à-vis Babylonian observations. The same can be said for the one reference to Conon by Pliny who merely includes Conon incidentally in a list of parapegmatis.<sup>17</sup>

This leaves unexamined just one other ancient reference to Conon as an astronomer—a passage which appears in Seneca's *Natural Questions* and which deserves to be quoted in full:

Democritus, the most acute of all the ancient philosophers, says he suspects there are several stars whose orbits are erratic. But he has given neither their number nor their names, as the motions of the five planets were not in his time understood. Eudoxus was, in fact, the first to import from Egypt into Greece the knowledge of these motions, though he says nothing about comets. From this it becomes plain that, even among the Egyptians, the people that bestowed

most care on observation of the sky, the portion of astronomy that relates to comets had not been worked out. Subsequently Conon, who was himself a careful investigator, made a record of the sun's eclipses that had been observed by the Egyptians; but he made no mention of comets, though he would certainly not have omitted anything definite on the subject that he had learned in Egypt. So much is certain; two authors, Epigenes and Apollonius of Myndus, the latter highly skilled in casting horoscopes, who say that they studied among the Chaldeans, are at variance in their accounts. The latter asserts that comets are placed by the Chaldeans among the number of the wandering stars (i.e., planets), and that their orbits have been determined. Epigenes, on the contrary, asserts that the Chaldeans have ascertained nothing regarding comets, which are thought by them to be fires produced by a kind of eddy of violently rotating air.<sup>18</sup>

This is a most important passage, for Seneca does mention that Conon made a record of solar eclipses; but the eclipses had been observed by the *Egyptians, not the Chaldeans* (it is in the next sentence that Seneca speaks of "the Chaldeans"). This seems to be the passage that comes closest to giving the information included in Tannery's article, and one has little alternative but to conclude that Tannery substituted "Chaldeans" for "Egyptians" in the sentence about eclipse records.

It is interesting to note that more recent scholarship offers some indirect support for this substitution. In reporting that Conon collected records of eclipses, Seneca says that the eclipses were observed by the Egyptians. However, since Neugebauer has pointed out that the Egyptians did not record solar eclipses,<sup>19</sup> it is now possible to suggest that Seneca may have been in error and that "Chaldeans" actually *should* be substituted for "Egyptians" in the sen-

<sup>14</sup> Catullus, *op. cit.*, p. 83.

<sup>15</sup> Claudius Ptolemaeus, *Opera quae exstant omnia*, Vol. II, *Opera astronomica minora*, ed. J. L. Heiberg (Leipzig: Teubner, 1907).

<sup>16</sup> *Ibid.*, p. 67.

<sup>17</sup> Pliny the Younger, *Natural History*, trans. H. Rackham, Vol. V (London, 1950), p. 385.

<sup>18</sup> *Physical Science in the Time of Nero, being a translation of Seneca's Naturales quaestiones*, trans. John Clarke (London: Macmillan, 1910), pp. 274-275.

<sup>19</sup> Neugebauer, *op. cit.*, p. 95: "From the enormous wealth of written documents from ancient Egypt we have only one doubtful reference to a partial solar eclipse of 610 B.C. . . ."

tence about eclipse records. In fact, this would be the only possible basis for the claim that Conon transmitted Babylonian observations. But even then, it would be necessary to qualify the claim further by pointing out that Seneca is not a particularly reliable source for this kind of information, and his concern in this passage is with comets rather than eclipses.

That Conon collected eclipse records of any sort depends, therefore, upon a

source of questionable reliability, and that he collected *Babylonian* observations requires an emendation of the ancient text. Clearly, then, the available evidence does not prove that Conon transmitted, or even collected, Babylonian observations, and thus there is no justification for elevating him to the office of transmitter, as Tannery did. It is to be hoped that, in the absence of new evidence, this claim will be perpetuated no longer.

## A SEVENTEENTH-CENTURY MALTHUSIAN

*By Stillman Drake\**

Giovanni Battista Baliani (1582–1666) is best known as a friend and correspondent of Galileo who published two books on the motion of heavy bodies. In 1647 he also published a treatise on the plague,<sup>1</sup> which occasioned favorable comment at the time and was reprinted in 1653 but is now neglected and very scarce. Baliani was not a doctor, as he remarked in his preface to the book; hence he made no attempt to discuss any cure for the plague but speculated only on its cause and on its contagious character. As its cause, he postulated a condition of the air for which he attempted a physical explanation that is not without interest for its implied theory of the structure of matter. With respect to contagion, Baliani was content to catalogue the reported phenomena of experience; as he remarked in the preface, “. . . it is more interesting to seek the nature of things in things themselves than in the writings of others,” declaring that he would set forth his own thoughts on the subject including ideas perhaps repressed by others but none the less curious.

The first section of Baliani's treatise, dealing with the cause of the plague,

concluded with a passage which appears to me to be of considerable interest as an anticipation of the fundamental idea now universally associated with the name of Thomas Malthus. The history of population theory lies well outside my field, and Baliani may have been already duly credited, though a cursory glance at the literature has not revealed to me any reference to his name in this connection. The rarity of his book and the current interest in population theory warrant translation of the passage in order that others may assess its historical value. Baliani wrote:

Finally, I consider how little hope may be reposed in the goods [*beni*] of this world, where our condition is so miserable; for, besides our being subjected to so many other misfortunes, pestilence and war, which fill the world with horror, cannot be escaped without our ultimately running into famine, which is perhaps still worse than the others; at least, not without changing and upsetting the order of nature, which requires that more people be born than die naturally. If that were not so, the human race, which took its rise from one man alone, would be perpetually occupied by little more than one man; but that could not be, for the world is made for men, and to be filled with them, as we have seen in no great period of time to have happened twice.<sup>2</sup> But it is impos-

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<sup>1</sup> Giovanni Battista Baliani, *Trattato della Pestilenza* (Savona, 1647).

<sup>2</sup> A puzzling clause of which the reference is not clear: “. . . che'l mondo è fatto per gli huomini, e per doversi di loro riempire, come habbiam veduto, in non molto lungo tempo