

GEMINUS AND THE ISIA

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THE Greek scientific writer Geminus wrote several works of historical interest, including a lost treatise on the foundations of mathematics and an extant book on astronomy known as the *Isagoge* ("Introduction to the Phenomena"). The *Isagoge* is important to us as a witness to a stage of Greek astronomy that was both less advanced and less homogeneous in method than Ptolemy's. Approximate knowledge of when its author lived would be useful in several respects, for example in tracing the diffusion of elements originating in Babylonian lunar theory and in Hipparchus' work. Recent scholarship frequently cites Neugebauer's dating of Geminus to about A.D. 50, which has largely superseded the dating to the first half of the first century B.C. that used to be widely accepted.¹ Both dates derive, oddly enough, from analysis of the same passage in the *Isagoge*. The purpose of this note is to elucidate the chronological issues, and to present documentary evidence that decisively establishes the earlier dating.

The limits established by ancient citations are not very narrow. *Isagoge* 4 mentions Hipparchus as an authority concerning constellations, and though Geminus does not say so, the lengths of the astronomical seasons listed in *Isagoge* 1 are the values that Hipparchus had used in deriving a model for the sun's motion. These passages cannot have been written before the 140s B.C. Moreover, Alexander of Aphrodisias (*In Arist. Meteor.*, CAG 3.2.152 line 10) cites a lost work by Geminus concerning the optical cause of rainbows, and according to Simplicius (*In Arist. Phys.*, CAG 6.291 line 21), reporting a lost passage of Alexander, this work was entitled *Concise Exposition of Posidonius' Meteorology*. Hence Geminus lived either concurrently with Posidonius or after him, and it is well established that Posidonius' philosophical

¹ O. Neugebauer, *A History of Ancient Mathematical Astronomy* (Berlin 1975) 2.579–581.

and literary career coincides approximately with the first half of the first century B.C. On the other hand, Geminus cannot have written later than Alexander, one of whose works, the *De fato ad imperatores*, was completed between A.D. 198 and 209.

The seventeenth-century chronographer Petavius (Denis Petau) seems to have been the first to recognize that a paragraph in *Isagoge* ch. 8 concerning calendars contains information that would only have been valid for a few years around the time that Geminus wrote, and hence has the potential to narrow the bounds considerably.² The passage, in which Geminus discusses the shifting relationship between the solstices and an Egyptian religious festival dedicated to Isis, is the following:

This reason [i.e. the discrepancy between the Egyptian calendar year of 365 days and the solar year] also accounts for the widespread error, which has obtained a tradition of long standing and is believed to our day among the Greeks. Most of the Greeks suppose that the Isia of the Egyptians and the winter solstice according to Eudoxus occur at the same time, which is absolutely false: the Isia are shifted a whole month relative to the winter solstice. The error has flowed from the cause described above. 120 years ago the observance of the Isia exactly coincided with the winter solstice. A shift of one day arose in four years, which did not amount to a perceptible shift relative to the annual seasons. In 40 years, there resulted a shift of 10 days; even so, the shift did not prove to be perceptible. But now when a shift of a month has arisen in 120 years, those who assume that the winter solstice according

² The text of the *Isagoge* (Greek and Latin) was first printed, without notes, by Edo Hildericus von Varel at Altdorf in 1590. Geminus makes no appearance in the 1583 or 1593 editions of Scaliger's *De Emendatione Temporum*. In the 1598 edition (Book II, chapter "de octaeteride Eudoxi," pages 67–68) Scaliger interpreted the passage as implying that Geminus wrote 120 years after Eudoxus, which, as he noted, would lead to the impossibility of having Geminus precede Hipparchus. (The discussion is unchanged in the posthumous 1629 edition, pages 69–71). Petavius corrected Scaliger's interpretation in his 1627 *De Doctrina Temporum* (Book II vii), and deduced a date for Geminus c. 93 B.C. By slightly varying the chronological assumptions, Petavius subsequently shifted the date further forward to 77 B.C. (*Uranologion*, 410–411 in the 1630 edition). Most subsequent attempts to date Geminus, with the exception of Neugebauer's, are refinements of Petavius; a partial list is given by Manitius in the Teubner ed. of Geminus, 238. Aujac (in the Budé ed., xix–xxiv) stands out by refusing to consider the data in chapter 8 sufficiently determinate to narrow Geminus' date at all.

to Eudoxus is at the Isia of the Egyptians implicate themselves in excessive ignorance. One can make allowance for a difference of a day or two, but a shift of a month cannot go unnoticed; it is demonstrable from the length of the days, since they have a large divergence with respect to the winter solstice, and also the curves traced by sundials make it evident when the true solstices occur, and especially among the Egyptians, who are experienced observers.

The point Geminus wishes to make is clear enough: because the interval between winter solstices is $365 \frac{1}{4}$ days, while the interval between fixed dates of festivals in the Egyptian calendar is 365 days, a coincidence that once existed between the solstice and a particular festival has, after 120 years, become an interval of one month (30 days) between the festival and the solstice. The chronological details are less obvious. What does Geminus mean by the "winter solstice according to Eudoxus," and in what context was it stated that the Isia fell on this date? And when Geminus says that one month now separates the Isia and the solstice, does he mean the "solstice according to Eudoxus," and how precise a figure should we take the "one month" to be?

The "solstice according to Eudoxus" was an event recorded in *parapegmata*, that is, Greek stellar weather calendars. A *parapegma* was a list of predictions of risings and settings of fixed stars and constellations, solstices and equinoxes, and weather phenomena such as winds, rains, and storms. A common format of the *parapegmata* followed a schematic solar calendar, starting the year with the summer solstice and dividing it into twelve fixed but unequal parts identified with the zodiacal signs traversed by the sun. There was also a tendency for *parapegmata* to become *variorum* texts, attributing dates of weather, stellar, and solar phenomena to older authorities of whom Eudoxus was one. Thus in a *parapegma* appended to Geminus' *Isagoge* in the extant manuscripts (known for this reason as the "Geminus" *parapegma*, although it is almost certainly not by him) there are numerous citations of phenomena "according to Eudoxus," including the "winter solstice according to Eudoxus" on the fourth day of Capricorn. By way of contrast, the first day of Capricorn is stated in this *parapegma* to be the solstice according to Euctemon and Callippus. In general the calendar of the "Geminus" *parapegma* seems to be based on that of Callippus, at least to the extent that Callippus' solstices and equinoxes always fall on day one of the signs Cancer, Libra, Capricorn, and Aries. The method

by which the Eudoxian data were synchronized with this framework is not known; one possibility is that all authorities' summer solstices were assumed to be the same.

How, then, could a date fixed in a *parapegma*'s solar calendar be tied to a date in a civil or cult calendar? After the reforms of the late first century B.C. the Roman and Egyptian civil calendars used a cycle of three years of 365 days followed by one of 366 days, so that the summer solstice, and any phenomenon assumed to be a constant number of days after the solstice, could be associated with either a specific civil date or, at worst, two consecutive dates.³ Thus when Ptolemy produced a *variorum parapegma* in his *Phaseis*, he dispensed with the artificial solar calendar, and gave all dates according to the reformed Egyptian calendar. In the Hellenistic period, on the other hand, the local calendars of Greek cities such as Athens were lunisolar, so that the summer solstice could fall anywhere within a range of a calendar month or more, and conversely a festival date could coincide with any of a range of thirty or more consecutive *parapegma* dates. It seems plausible that one of the functions of the calendrical cycles of Meton and Callippus was to establish rules for the year-to-year correlation between *parapegma* dates and lunar dates; but even so, a *parapegma* could not meaningfully intersperse references to festivals tied to a lunar calendar among the weather and astronomical phenomena.

In Egypt, festivals could have their dates established in either the civil calendar, which had constant years of 365 days, or in a lunar cult calendar that was bound cyclically to the civil calendar. Festivals of the former kind would *in the short term* appear to have a fixed relation to the phenomena recorded in *parapegmata* because of the small discrepancy between the civil calendar year and the solar year; and conversely the phenomena could in the short term be assigned specific dates in the Egyptian calendar. This is of course what Geminus is saying in the passage quoted above. But we know that this was not a mere possibility: we actually possess in the early third century B.C. papyrus *P. Hib. I 27* fragments of a *parapegma* laid out according to the Egyptian civil cal-

³ The Julian reform of the Roman calendar had its epoch in 45 B.C., although the regular cycle of intercalations every four years only began in A.D. 4. Whether the Egyptian calendar reform's epoch was 30 B.C., with intercalations synchronized with those of the Roman calendar, or 26 B.C., with a regular four-year cycle from the beginning, is disputed; see D. Hagedorn, "Zum ägyptischen Kalender unter Augustus," *ZPE* 100 (1994) 211–222.

endar, not a solar calendar, and in it festival dates appear along with the expected parapegma material. Two excerpts from this text will serve to illustrate the way in which phenomena tied to the solar year and festivals tied to the civil year are coordinated. The first (fr. b, lines 58–64) covers the last days of the fourth month, Choeac, and part of the fifth month, Tybi:

(Day) 26. The Crown has its acronychal rising, and the “bird” north winds blow. The night is $12 \frac{1}{2} \frac{1}{30}$ hours, and the day $11 \frac{1}{3} \frac{1}{10} \frac{1}{30}$. Osiris makes his circumnavigation, and the golden boat is brought forth. Tybi (*date missing*) in Aries. (Day) 20. Spring equinox. The night is 12 hours and the day 12, and the festival of Phitorois.

The second passage (fr. m, lines 200–206) covers the five “epagomenal” days (supplementary days at the end of the year, belonging to no month):

In the five epagomenal days, (day) 4. Arcturus has its acronychal setting. The night is $12 \frac{1}{2} \frac{1}{5} \frac{1}{30} \frac{1}{90}$ hours, the day $11 \frac{1}{15} \frac{1}{45}$, and it has the birthday of Isis.

P. Hib. I 27 does not cite any authorities for the astronomical and meteorological phenomena it contains, although it is probable that some of them derived from the same tradition that is ascribed to Eudoxus in the “Geminus” parapegma. For example, this parapegma has for the twenty-first day of Pisces, “according to Eudoxus the Crown has its acronychal rising; the ‘bird’ winds begin to blow,” which exactly corresponds to the statement for Choeac 26 in the papyrus. It seems to me quite likely that when Geminus asserts that the Greeks have a belief that the Isia coincide with Eudoxus’ winter solstice, he is referring to a traditional text structured like *P. Hib. I 27*. When the text was composed, I suggest that its author determined—we do not know how—that the summer solstice fell on a certain Egyptian calendar date in the year in which he was writing, then projected forward to the autumnal equinox and the winter solstice by adding intervals of days for the lengths of the seasons associated with Eudoxus, and found that the winter solstice fell during the Isia.

This would help to explain why Geminus speaks expressly of the “solstice according to Eudoxus”: it was so named in the calendar he

had before him. On the other hand, when he describes the one month interval between the Isia and the solstice in his own time, he evidently has in mind the actual, observable solstice, and he quite legitimately avoids dealing with the question of whether the Eudoxian solstice coincides with the actual solstice or falls a few days earlier or later. Hence in trying to date Geminus on the basis of this passage, we should not lose time seeking to determine the Eudoxian solstice date (which may in any case not have had a determinate equivalent in the Julian calendar), but simply work from the true winter solstice, allowing for a possible error of, say, three days either way in Geminus' determination of its date.

Geminus' "whole month" is of course also a round figure, although for the sake of argument he gives it a precise interpretation as equivalent to thirty days. It would be safer, therefore, to allow a further tolerance of a few days, say six in all, in the assumed solstice date. Since a change of one day in the interval between the solstice and a festival date in the Egyptian calendar arises in four years, we will have to allow a margin of about a quarter century either way around the ideal date when the Isia was thirty days before the winter solstice. The Julian calendar date of the winter solstice in years about 100 B.C. is roughly noon of December 23 to noon of December 24; about A.D. 200 the solstice falls roughly between noon of December 21 and noon of December 22. In 100 B.C. the Egyptian date falling thirty days before the solstice was therefore Hathyr (month III) 8, while in A.D. 200 it had advanced to Tybi (month V) 21.

The question, then, is whether a festival of Isis, identifiable with Geminus' Isia, can be found within the months Hathyr, Choeac, and Tybi. From Petavius on, the starting point for this investigation has always been Plutarch's *De Iside et Osiride*, an extensive interpretation of the Egyptian myths relating to Isis and Osiris written probably in the first quarter of the second century of our era. That Plutarch had authentic information about the Egyptian festival calendar is certain. For example, in chapter 12 (355E–F) Plutarch relates that the Egyptians considered the five epagomenal days of their calendar to be, respectively, the birthdays of Osiris, Horus, Typhon (Seth), Isis, and Nephthys. Precisely the same series of birthdays is attributed to the epagomenals in several pharaonic texts, for example one of the extant copies (*P. Cairo* 86637) of the New Kingdom hemerology (calendar of

auspicious and inauspicious days);⁴ and the birthday of Isis also appears by itself in the second passage of *P. Hib. I 27* quoted above.

In three passages (ch. 13, 356C; ch. 39, 366C–F; ch. 42, 367E–F) Plutarch associates the four days Hathyr 17–20 with the central events in the myth of Isis and Osiris: the death of Osiris and the shutting up of his body in a chest; the launching of the chest into the sea; and Isis' recovery of it. Two questions have to be considered about these dates. First, do they pertain to the unreformed Egyptian calendar about which Geminus writes? Petavius and most of his successors more or less took it for granted that they did, whereas Neugebauer gave a reasoned argument that Plutarch was using the reformed calendar. And secondly, is this the festival that Geminus calls the Isia? The consensus has been that they were one and the same festival, although the only good evidence with bearing on the question has never been brought into consideration.

Plutarch seems to answer the first question in chapter 13, where he refers to “the seventeenth day of Hathyr, in which (month) the sun traverses the Scorpion.” In the reformed (Alexandrian) Egyptian calendar the sun passes through the zodiacal sign Scorpio from about ten days before the beginning of Hathyr to about the twentieth of that month. In the unreformed calendar, on the other hand, Hathyr had fallen back relative to the solar year sufficiently by A.D. 100 so that the sun entered Scorpio only in the very last days of Hathyr. For this reason, Neugebauer concluded, first, that Plutarch's dates belonged to the reformed calendar, and secondly, that the dates of the Isia intended by Geminus should be obtained by finding what dates in the unreformed calendar were equivalent to reformed Hathyr 17–20 about the time Plutarch wrote. These were (approximately) Choeac 22–25. As confirmation, Neugebauer pointed to a description of a long Osiris festival lasting from Choeac 12–30 in a late Ptolemaic Egyptian text in a temple at Dendera, and also to the mention of Osiris' voyage and the bringing forth of the golden boat on Choeac 26 in the first passage of *P. Hib. I 27* quoted above.⁵ Since the duration of the festival seemed to be in doubt,

⁴ C. Leitz, *Tagewählerei: Das Buch ḥꜣt nḥḥ pḥwy ḏt und verwandte Texte* (Wiesbaden 1994 [Ägyptologische Abhandlungen 55]) 1.419–424; Abd el-Mohsen Bakir, *The Cairo Calendar No. 86637* (Cairo 1966) 55. For other texts see S. Schott, *Altägyptische Festdaten* (Mainz 1950 [Akademie der Wissenschaften und der Literatur, Abhandlungen der Geistes- und Sozialwissenschaftlichen Klasse, Jahrgang 1950, Nr. 10]) 992–993.

⁵ Neugebauer (above, n. 1) 2.579–580.

Neugebauer simply assumed that the date Geminus had in mind might have been anywhere in Choëac, and showed that the winter solstice fell in that month roughly from 120 B.C. to 20 B.C., so that Geminus himself would have been writing at some time in the first century A.D., or, as he restates it, “a date around 50 A.D.”

The evidence that there was a festival in Choëac related to the myth of Osiris’ death and resurrection during the Hellenistic period is uncontroversial, and in fact there is much more of it than Neugebauer seems to have been aware of. Egyptian-language festival calendars of the late Hellenistic period at Dendera, Esna, and Edfu (all in Upper Egypt) specify such a festival, although the specific days in Choëac assigned to it are not consistent from text to text.⁶ Two Ptolemaic hieratic papyri, the Bremner-Rhind papyrus (B.M. 10188) and *P. Berlin* 3008, contain versions of “lamentations of Isis and Nephthys” (for the lost Osiris) that are to be recited respectively on Choëac 22–26 and Choëac 25.⁷ As early as the first half of the seventh century B.C., we find a reference in an inscription in the temple of Taharka at the “Sacred Lake” at Karnak to a “beautiful festival” of Choëac 25, for which Taharka had a wooden boat constructed for Osiris to sail in.⁸ According to all these sources, the festival proper took place in the last third of the month; at Dendera this was preceded by a longer period devoted to more esoteric rituals. (Hence Neugebauer’s reasoning actually should lead to a date for Geminus within thirty years or so of about A.D. 90.)

⁶ A. Grimm, *Die altägyptischen Festkalender in den Tempeln der Griechisch-Römischen Epoche* (Wiesbaden 1994 [Ägypten und altes Testament 15]) 388. I am in full agreement with Grimm (443–444) that the dates in these calendars belong to the civil calendar, not to an ideal “Sothic” calendar in which the year begins with the rising of Sirius about July 19. R. Merkelbach, *Isisfeste in griechisch-römischer Zeit. Daten und Riten* (Meisenheim am Glan 1963 [Beiträge zur klassischen Philologie 5]) 33–36 supposes that the dates are Sothic, and that Plutarch’s dates are their counterparts in the reformed civil calendar (Geminus does not enter his discussion). As it turns out, the unreformed Egyptian year about the time of Plutarch’s writing began only a few days after Sirius’ rising. The criticism of Merkelbach in Leitz (above, n. 4) 1.128–129 is not accurate.

⁷ R. O. Faulkner, “The Lamentations of Isis and Nephthys,” *Mélanges Maspero I. Orient anciens*. Fasc. 1. (Cairo 1934 [Mémoires publiés par les membres de l’institut français d’archéologie orientale du Caire 66]) 337–348, esp. 338, and R. O. Faulkner, “The Bremner-Rhind Papyrus,” *Journal of Egyptian Archeology* 22 (1936) 121–140, esp. 122. *P. Berlin* 3008 is the text discussed in A. Boeckh, *Über die vierjährigen Sonnenkreise der Alten, vorzüglich den Eudoxischen* (Berlin 1863) 431–434 and H. Brugsch, *Die Adonisklage und das Linoslied* (Berlin 1852) 21.

⁸ Schott (above, n. 4) 971.

It is not so clear, however, that this is the festival that Plutarch describes. In fact, the mention of the sun's crossing through the Scorpion is only one of several indications that he gives that bear upon the festival's calendrical situation, and these are inconsistent. In chapter 39 he writes that the occurrence of the festival in Hathyr signifies allegorically the annual cessation of the Etesian winds, the end of the Nile flood, and the nights becoming longer than the days—events suggestive of the time about the autumnal equinox, whereas Hathyr 17–20 in the reformed calendar correspond to November 12–15.⁹ This has suggested to at least one scholar that the calendar Plutarch has in mind is an idealized “Sothic” calendar with the year beginning at the rising of Sirius in July (which would put Hathyr 17–20 in early October).¹⁰ But it is also the case that about A.D. 110 Hathyr 17–20 in the unreformed calendar corresponded to October 11–14. Finally, in chapter 42 Plutarch explains the choice of the 17th of the month for the date of Osiris' death by the circumstance that on that day the full moon can be seen to be ended, and this is only meaningful if he is thinking of lunar months. It is clear that for the sake of his multilayered interpretations Plutarch is ready to play fast and loose with the nature of the calendar, and we have no *a priori* reason to place our reliance solely on the reference to the sun's zodiacal position. But even if it turns out that the dates Hathyr 17–20 are in the reformed Egyptian calendar, we cannot presume that they should be translated into the unreformed calendar according to the relative alignment of the calendars in Plutarch's time. This amounts to assuming that the festival continued to be fixed according to the unreformed calendar well into the Roman period, which is indeed a possibility. On the other hand, it may be that the festival was associated with Hathyr 17–20 both before and after the calendar reform. The fact is that we know little in general about the way that festival dates were determined after the reform.

By referring to *P. Hib.* I 27, Neugebauer seems to have been the first to bring Greek-language papyri to bear on the problem of the Isis festival. As it turns out, however, there are also many references in Greek

⁹ The parapegma tradition put the cessation of the Etesian winds about the beginning of September (“Geminus” parapegma: Virgo day 5, 26 days before the autumnal equinox; “Egyptians” in Ptolemy *Phaseis*: Thoth 3 = September 2/3). The recession of the Nile flood in lower Egypt usually begins in early October, and is completed in December.

¹⁰ Leitz (above, n. 4) 1.127–129.

papyri of the Hellenistic and Roman periods to a festival expressly called the Isia (spelled variously Iseia or Isieia). F. Perpillou-Thomas's recent and thorough study of the Greek papyrological evidence for Egyptian festivals lists nineteen papyri that mention the Isia by name, in addition to four that probably refer to it without using the word.¹¹ The majority of these documents do not provide calendrical information, but enough of them do so that we can draw the following conclusions:

- (1) The word Isia is consistently used without further qualification as the name of a festival. Like Geminus, the writers of the papyri seem to anticipate no ambiguity, such as would arise if there existed more than one festival that could be identified by this name.
- (2) In the Hellenistic period (i.e., before the reform of the Egyptian calendar) the Isia fell in Hathyr. Thus in 256 B.C. the landowner Apollonius wrote a letter from Alexandria on Phaophi (month II) 23 to his agent Zenon at Philadelphia to send dry logs for the Isia (*P. Cair. Zen.* II 59154). The letter is endorsed with a date in Hathyr, apparently the 18th. The next year, in Phaophi, Apollonius made the same request of logs "for the festival" (not named this time, *P. Cair. Zen.* II 59191). In 254 B.C. Apollonius again wrote requesting gifts for presentation to the king on the occasion of the Isia (*P. Cair. Zen.* IV 59560); the letter is dated Hathyr 2 and mentions in connection with the request a date between Hathyr 10 and 19 (the numeral is broken). A further papyrus from third century B.C. Philadelphia (*BGU VII 1552*) lists expenses for the month Hathyr associated with the Isia. From 159/158 B.C. we have an account of temple supplies from Memphis (*UPZ I 94*, line 16) containing an entry on a date in Hathyr that may be the 20th "for the Isia."¹²

¹¹ F. Perpillou-Thomas, *Fêtes d'Égypte ptolémaïque et romaine d'après la documentation papyrologique grecque* (Leuven 1993 [Studia Hellenistica 31]) 94–96. Perpillou-Thomas draws the same inferences as I concerning the date of the Isia, but the underlying arguments are only partially presented, and she makes no reference to Geminus. It is curious that in an earlier treatment of the same questions (and with access to less papyrological evidence), H. C. Youtie, "The Heidelberg Festival Papyrus: A Reinterpretation," in P. R. Coleman-Norton ed., *Studies in Roman Economic and Social History in Honor of Allan Chester Johnson* (Princeton 1951) 178–208, esp. 194 used the assumption that Geminus wrote in the first century B.C. to help establish that the Isia fell in Hathyr, not realizing that his date for Geminus derived from the very hypothesis he was arguing for.

¹² The editor, Wilcken, read the damaged day number as kappa (20), but remarked that

- (3) The specific dates Hathyr 17–20 derived from Plutarch can be confirmed. An account of issues of lamp oil from the estate of Apollonius (*P. Corn.* 1, lines 29–37) has entries for regnal year 28 of Ptolemy II Philadelphus, Macedonian month Apellaios days 6–9 pertaining to a festival, which is named for Apellaios 9 the Isia. The Macedonian calendar dates can be converted to their Egyptian counterparts with an uncertainty of one day, and prove to be either Hathyr 17–20 or, less probably, 18–21.¹³ And although the date Hathyr 20 in *UPZ* I 94 is uncertain, another temple account from Memphis, dated 160/159 B.C., lists expenses incurred during an unnamed festival on Hathyr 16–20 (*UPZ* I 89, lines 11–16).¹⁴
- (4) The calendrical situation of the Isia in the Roman period is established by *P. Fay.* 118, a letter from the landowner Lucius Bellenus Gemellus to his agent in Euhemeria dated Trajan year 14 (A.D. 110) Hathyr 10. Among other requests, Gemellus asks to have presents bought for certain of his friends for the Isia. In correspondence of this nature and date, there can be no doubt that the calendar employed is the reformed civil calendar.¹⁵ Hence it is clear that when the civil calendar was reformed in the late first century B.C., the Isia continued to be observed on Hathyr 17–20 according to the

the very unclear traces were not actually suggestive of that letter, and that he was only confident that there was only a single letter-numeral; see *UPZ* I 420 and 452.

¹³ Cf. the table in E. Grzybek, *Du calendrier macédonien au calendrier ptolémaïque. Problèmes de chronologie hellénistique* (Basel 1990 [Schweizerische Beiträge zur Altertumswissenschaft 20]) 188. I do not consider the reconstruction of the Macedonian lunar calendar underlying Grzybek's tables to be historically correct, but they have a very good rate of agreement with attested date equations in papyri; see A. Jones, "On the Reconstructed Macedonian and Egyptian Lunar Calendars," *ZPE* 119 (1997) 157–166.

¹⁴ See Wilcken's comments in *UPZ* I 401–402. *P. Tebt.* I 118 (second century B.C., from Tubtunis) lists accounts of expenses incurred for a "funeral feast" (*perideipnos*) on Hathyr 17 and a celebratory dinner on Hathyr 20. These were identified with some plausibility as observances of the first and last days of the Isia by I. Lévy, "Sur une inscription de Priène," *Revue épigraphique* n.s. 1 (1913) 251–253, esp. 252 n. 5. The New Kingdom hemerology remarks for Hathyr 17 (in one of the manuscripts also for Hathyr 16) "great weeping and loud lamentations by Isis and Nephthys" (Leitz [above, n. 4] 1.127), which Boeckh (above, n. 7) 203–204 identified as an allusion to the Isia. This may be correct, but the obscure manner of expression in this calendar makes it an insecure basis for drawing inferences about Egyptian calendrics and astronomy. The interpretations in Leitz's otherwise useful edition appear to me to be exceedingly shaky.

¹⁵ In *P. Fay.* 119 from the same dossier, Gemellus commissions a purchase of cocks for the Saturnalia (December 17) on Choeac 12 (December 8 in the reformed calendar, but near the beginning of November in the unreformed calendar c. A.D. 100).

reformed calendar. Hence Plutarch's dates turn out to belong to the reformed calendar after all, but they should not be translated into their contemporary equivalents in the unreformed calendar to obtain the dates that Geminus knew. The Osiris festival that was held in Choëac was not called the Isia, although the events in the Isis-Osiris myth that it celebrated were essentially the same. No manipulations of calendars can turn the Isia in Hathyr and the Osiris festival in Choëac into a single event without contradicting part of the documentation cited in the foregoing pages.¹⁶

Now that we have determined that Isia was the name of a festival occurring on Hathyr 17–20 of the Egyptian civil calendar, i.e., the unreformed calendar in the Hellenistic period and the reformed calendar in the Roman period, we can see at once that Geminus is describing a situation that ceased to exist after 22 B.C., the year when reformed dates began to diverge from their unreformed equivalents. More precisely, if we take December 23 to be the date of the winter solstice, then the solstice began to be thirty days later than the first day of the Isia (Hathyr 17) in 66 B.C., and was for the last time in this relation to the final day of the festival (Hathyr 20) in 50 B.C. Allowing for a reasonable margin of uncertainty about the date of the solstice and the one month interval, we can say that it is very probable that Geminus wrote the *Isagoge* between 90 and 25 B.C., and definitely not during the first century of our era. He was therefore closer in time to Hipparchus than to Ptolemy, and quite possibly a contemporary of Posidonius.

In closing, we may remark that there are two other traces besides Geminus of the traditional association of the Isia with the winter solstice. One of these is remarkably late, perhaps four hundred years after Geminus. Achilles, an elementary writer on astronomy who lived between the late second and the early fourth centuries of our era (he cites Ptolemy and is cited by Firmicus Maternus), affirms that the Egyptians instituted the mournful rites of the Isia as a reflection of the

¹⁶ F. Dunand, *Le culte d'Isis dans le bassin oriental de la Méditerranée* (Leiden 1973 [Études préliminaires aux religions orientales dans l'empire romain 26]) 1.227–228 illustrates the contortions that follow from refusing to accept the existence of two distinct festivals—in this instance exacerbated by her rejection of the wandering years of the unreformed civil calendar as the vehicle for the festival dates in favor of a “Sothic” calendar. My impression is that, so far as the observance of religious festivals in Egypt is concerned, the Sothic calendar is a fiction of modern scholarship.

southward descent of the sun from Cancer into Capricorn, that is, from the zodiacal sign of the summer solstice to the sign of the winter solstice. The second document, on the other hand, is early enough so that it seems to catch the tradition in the making. The well known “Eudoxus” papyrus (*P. Paris* 1) can be dated securely to the years preceding 165/164 B.C., since its vacant margins were subsequently used for transcripts of letters written in those years.¹⁷ Towards the end of the astronomical text in the papyrus (col. xxii lines 21–23), within a digest of parapegmatic data, it is written that “according to Eudoxus (and) Democritus the winter solstice is sometimes Hathyr 20, sometimes (Hathyr) 19.” That Hathyr 19 and 20 were the two culminating days of the Isia, so that the “Eudoxus” papyrus turns out to make the very assertion in concealed form that Geminus complains about, is not likely to be an accident. But about 170 B.C. the correlation would still have been valid, or nearly so.¹⁸

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¹⁷ The best available text of *P. Paris* 1 is F. Blass, “Eudoxi Ars Astronomica qualis in charta aegyptiaca superest,” *Kieler Universitätsprogramm*, Sommersemester 1887 [Reprinted, *ZPE* 115 (1997) 79–101].

¹⁸ Boeckh (above, n. 7) 196–200 found that the statement in the papyrus was valid in 197–190 B.C. on the hypothesis that the winter solstice was supposed to fall on December 28. The precise date is uncertain, but there are reasons for believing that the “Eudoxian” winter solstice was three or four days later than the true solstice.