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Postscript: The Athenian Calendars

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POSTSCRIPT: THE ATHENIAN CALENDARS

In the Preface to his *Athens from Alexander to Antony* (Harvard 1997), Christian Habicht writes of his collaboration with J. D. Morgan resulting in numerous changes in the dates of Athenian archon-years, "In accordance with the rule mentioned by Plato, *Laws* 767C, that the new year began with the new moon after the summer solstice, there was a nineteen-year cycle of twelve ordinary and seven intercalary years, following each other in fixed order. If rigorously observed (as seems to have been the case), the character of every single year, whether ordinary or intercalary, is determined a priori. This, in turn, requires a shift of a number of accepted archon dates." Habicht is unquestionably our most eminent authority on the history of Hellenistic Athens, and his endorsement of a nineteen-year "Metonic cycle" for Athens carries great weight. Plato placed the beginning of the calendar of his ideal state after the solstice. Aristotle (*Hist. Anim.* 543B) says the tunny-fish bears in Hekatombaion (I) at the time of the solstice: θέρους δὲ περὶ τὸν Ἑκατομβαιῶνα θυννίς, περὶ τροπὰς θερινάς. Theophrastos (*De Caus. Plant.* 3.4) begins his four divisions of the year with the summer solstice.[1] The calendar of Habicht and Morgan will present a radical change. In B. D. Meritt's table of Athenian archons (*Athenian Year* 174–177), he presented two successive cycles in the middle of the third century showing the following character of years:

Cycle 10 (261/0–243/2) 0 0 I 0 0 I 0 I 0 I 0 0 0 I 0 I 0 0 I
Cycle 11 (242/1–224/3) 0 I 0 I 0 0 I 0 0 0 I 0 I 0 I 0 I 0 0

Of the nineteen years, fourteen did not correspond.

In addition to Poseideon (VI), inscriptions record that Hekatombaion (I), Metageitnion (II), and Anthesterion (VIII) were used as intercalary months, which suggested to me that there was not a cyclic pattern of intercalation: "The Intercalary Month at Athens", *CP* 63 (1968) 53; *The Choiseul Marble* (1970) 63.[2]

For numismatic evidence relating to the Athenian calendar, see *Phoenix* 30 (1976) 351. Of the controversy between Margaret Thompson and David Lewis, W. E. Metcalf, *AJA* 96 (1992) 547, has recently written:

> There seemed no real middle ground, and there was no substantive advance until Otto Mørkholm's posthumously published discussion ("The Chronology of the New Style Coinage of Athens", *ANSMN* 29 [1984] 29–42). The Thompson *arrangement* is vindicated entirely, even as her chronology is modified to accord with extending the series over the period ca. 185/80–45/40 B.C.

He quotes Thompson as saying, "The author's conclusions seem to me so valid that I hope the controversy can now be considered at an end." A critical factor is the position of the nu (intercalary) years. B. D. Meritt and J. S. Traill, *The Athenian Agora* 15 (1974) 17, reviewed the early evidence and endorsed Thompson's arrangement that there were two N years in a row, 171/0 and 170/69. See also *Calendars of Athens* (1947) 109–110.

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[1] Cf. A. E. Samuel, *Greek and Roman Chronology* (Munich 1972) 64 n. 1.

[2] A. G. Woodhead, *Hesperia* 58 (1989) 299, developed the unique argument that the phrase - - - ιῶνος ὑστέρου in a prescript of the year 304/3 is a "re-use of an earlier month-name at a later stage of the year which in all other respects continued on its way as an ordinary year". He believes that Anthesterion (VIII) II was substituted for Mounichion (X) of a normal calendar in 304/3 B.C.; see *SEG* 39.101. This position is based on his belief that two intercalary years could not fall in successive years in his "Metonic" cycle, which in any case for him followed no fixed order of years. See note 5 below. This means that the state festivals in Mounichion would be cancelled. Meritt, who advanced the same theory, allowed two intercalary years in succession for 171/0 and 170/69. J. W. Müller, *ZPE* 103 (1994) 128–138, offers correlations between the Babylonian and Athenian calendars for 120 B.C. to 180 A.D. to support his earlier suggestion of a nineteen-year cycle at Athens, which differed from that of Euktemon in Geminos.

Morgan has presented several papers at meetings of the AIA (e.g. *AJA* 100 [1996] 395), but has yet to publish his completed work, which must take account of several hundred calendar equations in the prescripts of inscriptions. This comment is not made in criticism, for changes in the dates of archons are proposed almost annually, several by S. Tracy in his study of scripts, and the study of the date of archons is a full-time occupation. One test of any table will result when new prescripts come to light. In the old days of Agora excavations, every new archon often required a new table. The name of the archon is secondary to that of the secretary; for, since Ferguson's discovery of the secretary-cycle, the cycle of secretaries is often the determining factor.[3] Thus arises the question of "breaks" in the secretary-cycle, their number and historical reasons for same. The subject is very complicated.

In the calendar published by Dinsmoor in his *Archons of Athens in the Hellenistic Age* (1971), he found (p. 420) that the new year dates in the period 432 to 90 B.C. ranged over 50 days (June 13–August 2). In Meritt's 1971 table, New Year's Day might occur between June 16 and August 28.[4] A priori, it would seem that the Athenians would keep their festivals, many of an agricultural nature, in accord with the seasons, and the calendar of Habicht and Morgan would accomplish this feat, a major achievement. Their calendar will be awaited with great interest.[5] For Meton, see, for example, Toomer, *Dictionary of Scientific Biography* 9 (1974) 333–340. A. C. Bowen and B. R. Goldstein, "Meton of Athens and Astronomy in the Late Fifth Century B.C.", *A Scientific Humanist: Studies in Memory of Abraham Sachs* (1988) 39–80, argue persuasively that the Metonic cycle was not to serve for an astronomical or civil calendar.

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In "Tampering with the Calendar", *ZPE* 123 (1998) 213–231, Francis M. Dunn, using my name scores of times as a sort of paragon of misunderstanding of calendric problems, has raised fulsome objections to my use of the word "tampering" as applied to the Athenian calendar. In my calendric studies, I have applied the word to modifications of a calendar using the terminology of lunar months (νουμηνία, ἱσταμένου, φθίνοντος, ἀνομένου, ἀπιόντος, etc.) for 29- and 30-day segments. Reminiscent of recent debates in Congress over the President's use of the words "is", "alone", "sex", in his impeachment trial, F. M. Dunn now plays a war of words over my terminology, opting for the word "adjustment". In his first paragraph, he annotates my word "tampering" as "harmful interference or rash meddling". He frequently uses such phrases as that I have attributed "unworthy motives to the archon", as if there were some sort of conspiracy in altering the dates in the festival calendar. One might use the words retardation and compensation. It is clear what is meant, and no rhetoric is necessary. It has been my position that compensatory (= subtracted) dates were preceded by retarded (= embolimoi) dates in a festival lunar calendar of 354± or 384± days. Actually, there is much more evidence for tampering than when I last treated the subject, as I hope to demonstrate.

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[3] The theory of a priestly cycle is now discredited by Sara Aleshire, *The Athenian Asklepieion* (1989) 75–81.

[4] Cf. *War* 3.164.

[5] My debate with Meritt and his circle included his postulate that the Athenians adopted a Metonic 19-year cycle in which the Athenians watched for every 19-year anniversary of Meton's alleged announcement of his cycle without a rigid fixed order throughout the cycle. Such a position is apparently followed by G. Woodhead in *The Athenian Agora* 16 (1997) pp. 156–157 (although the first year of his cycle), 301–302, 313, 327, 360, 365, 369, 375, 394, although he does not argue the problem. Any arbitrary and irregular system of intercalation will reveal an average of 7 intercalary years within 19 years. As noted in *War* 3.164, a 1971 table of Meritt showed eight ordinary years within nine and four intercalary years within five for his "Metonic" cycle; cf. *Thucydides' Pentekontaetia* 184–185. The important announcement of Habicht is that a "fixed order" of years with a new archon table can now be established.

Writing oblivious of recent studies of the calendar by Paul Roesch, S. Follet, A. C. Bowen, B. R. Goldstein, Catherine Trümpy,[6] P. Ducrey, J. Pouilloux, M. J. Osborne, and others, F. M. Dunn advances one original thesis: calendars were regularly maintained in highly disorderly fashion without regard to the lunar movement (i.e. without tampering) until, occasionally, they adjusted the calendar to what he calls (p. 224) "the traditional calendar in which the beginning of the month approximated the appearance of the new lunar crescent". If a calendar equation or literary source proved that Day 5 fell on a full-moon day (15±), there had been no "tampering"; this was normal progression. The year had apparently started out of whack with the moon, or a lot of days had been intercalated. What happened in the days preceding Day 5 is never divulged. Previous scholars have deduced that if the calendar had lagged behind the progression of days in calendars with terminology of 29- and 30-day months, the archon had inserted days (embolimoi), or "tampered" with the calendar. Dunn's thesis is normal disorder sans tampering. In reading F. M. Dunn's paper, one thinks of the character in Disraeli's *Sybil*, "distinguished for ignorance; for he had only one idea and that was wrong".

Historically, in my collaboration with Otto Neugebauer, I first used the word "tampering" as applied in modifications in a calendar using the terminology of lunar months, in which days were intercalated (embolimoi) and then dates suppressed. For example, on pp. 20–21 of *Calendars of Athens* (1947), we cited a law of the Euboian Confederacy concerning the contracting of Dionysiac artists, published as *IG* XII.9.207 and *IG* XII. Suppl. p. 178.[7] The law prescribed that the Dionysiac troupes were to appear on specified dates, first at Karystos, then, moving northwards, at Eretria, Chalkis, and Oreos. In connection with the appearance of the troupes in the four cities on the dates designated for the Dionysia, the prescription was given that the "lunar" calendars might be adjusted by intercalations of up to three days (lines 28–29). I assume that later by the end of the year dates were suppressed. These modifications in the calendar illustrate an important principle about ancient practice. Whereas in modern times, if a performance or festival is postponed, we assign a new calendar day for the postponed performance. By contrast, festivals of the ancient Greeks were celebrated on the original calendar date, regardless of the length of the postponement. Certain dates were sacred to certain gods. If the seventh day was sacred to Apollo, his festival had to fall on that calendric date, regardless of the phase of the moon. The ancient Greek festival dates were fixed, with festivals falling on assigned days in terms of a "lunar" month.

On his page 219, F. M. Dunn cites an example where he postulates that the full moon at Athens "fell at the latest on the evening of the fifth" of Boedromion (III) at the time of the battle of Marathon. In a calendar which follows normal lunar terminology, this would be the 64th day (30 + 29 + 5). Thus, the Athenian calendar was lagging behind a normal lunar one by ten days (30 + 29 + 15±). F. M. Dunn continues by emphatically denying that the Marathon example is "tampering", but "days were being added to prevent interruption of the Eleusinian Mysteries". Now, the Eleusinian came after the middle of the month Boedromion, so it would be absurd to claim that the Athenians adjusted their calendar before they marched out to Marathon in anticipation of the festival. Rather the position of F. M. Dunn seems to be that the Athenians maintained their calendar in a highly disordered fashion in relation to their lunar terminology before Boedromion 5, having no "tampered" days. Thus, the beginning of the year would fall about Skirophorion (XII) 20 of the previous year in an "untampered" calendar. After

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6 Catherine Trümpy, *Untersuchungen zu den altgriechischen Monatsnamen und Monatsfolgen* (Heidelberg 1997), collects a more up-to-date list of the names of months and their etymologies than found in Samuel. The names found in Mycenaean Greek are collected on p. 2 with bibliography. The names of months identical with festivals imply early observation of the lunar phenomenon. Her study has nothing to do with other calendar problems such as the progression of days within the month. She does not note that D. Maulliez, *BCH* 108 (1984) 383–389, presents a survey of the correspondence of months and their Delphic equivalents in the Phokian Koinon. A numerical calendar was introduced in the second century B.C. to remedy the coexistence of several nominal months. A mass of new material on "Months" will be found in the indices of *SEG* s.v.

7 About 290 B.C. See now *SEG* 30.1095 and *SEG* 34.896 for many new readings.

returning to Athens, they observed the moon and decided that the Eleusinian should be observed on its proper lunar days, so, for Dunn, "adjusted" the calendar. It is noteworthy that F. M. Dunn offers no chart of the progression of days from Hekatombaion (I) Noumenia to his full moon on Boedromion (III) 5 without the calendar being "tampered".

F. M. Dunn's acceptance of Plutarch's Boedromion 6 as the date for the battle of Marathon I now believe is a mistake, as explained in *War* 3 (1979) 174–175, in agreement with H. W. Parke, *Festivals of the Athenians* (Ithaca 1977) 54–55. The day, as Parke explains, had been established as the festival day of Artemis. Before the battle, the Athenians made a vow to sacrifice to Artemis a she-goat for every Persian killed. The rest of the story is well known. The festival of Artemis was celebrated on Boedromion 6 (see J. D. Mikalson, *The Sacred and Civil Calendar of the Athenian Year* [Princeton 1975] 18 and 50). In *War* 3.174–175, I observed that the ephebes conducted a procession under arms to the sanctuary of Artemis. But they also marched to the polyandreion at Marathon where they offered sacrifices "to those who had died in behalf of freedom". The date of this latter celebration is not given, but the march to Athens consumed a full day which was clearly not that of the Artemis festival. It is reasonable to assume that the celebration on the battlefield commemorated the day of the battle. I follow Parke and others in assuming that the day of the vow to Artemis on Boedromion 6, which was an important festival commemorating the battle, led to the mistaken belief that it was the anniversary. R. W. Macan, in his commentary on Herodotos 6.120, in referring to the Plutarch passage, writes, "Boeckh (*Mondcyklen der Hellenen*, 15) has shown that the day of the annual Commemoration is substituted in this passage for the actual day of the battle". Plutarch refers to a procession (πομπή) to Agrai which was still celebrated on the sixth as a festival of thanksgiving (χαριστήρια). As I have said, the pompe to Agrai could not be on the same day as the pompe to Marathon. Jacoby (*JHS* 64 [1944] 62) opined, "The anniversary of the dead of Marathon had been assigned to the sixth of Boedromion, and not to the calendar date of the battle in order to connect it with the general State festival of the dead." Isokrates 4 *Panegyrikos* 86–87, gives a different account and has the Spartans set out in haste, covering the distance in three days and nights. Plato (*Laws* 698E, *Men.* 24C) says the Spartans arrived too late by one single day. Boedromion 5 was not a full-moon night at Marathon, as F. M. Dunn has it.

To continue with Marathon, F. M. Dunn says that "adjustment" had taken place in the Athenian calendar (with the 5th or earlier being the day of the full moon), but "not in the Spartan calendar" (p. 219). Herodotos (6.106.3; cf. Plutarch *Mor.* 861F) says Pheidippides reached Sparta on the ninth day of the month, but they could not march out, the moon not being full. Since F. M. Dunn's Spartan calendar was not "adjusted", he has it that the full moon in the Spartan calendar did not fall until day 15±. F. M. Dunn continues by examining passages which I had collected in *Ancient Athenian Calendars on Stone* (1963) 326–328, as exemplifying divergencies among Greek calendars, including the well-known passage in Aristoxenos *Harm.* 2.37 that the same day might be the tenth at Corinth, the fifth at Athens, or the eighth elsewhere. An explanation offered by F. M. Dunn (p. 220) is that the observers in various cities were "observing different crescents". Now the moon does not make different orbits on the same night, one for Sparta, another for Athens. Even amateur observers or schematic calculators are not going to look at the same full moon and concoct "unadjusted" calendars of 29 and 30 days which have it fall on the 5th at Athens and the 15th at Sparta. Nor are the same observers or calculators going to have the crescent on the first at Athens and the tenth at Corinth, whatever the elevation of the observers. None in sunny Greece in June/July at the time of the crescent for the first month are going to observe the same crescent ten days apart. The difference in latitude between the two cities, only 26 kilometers removed, is slight. When the moon is closest to the earth (perigee), it is 221,463 miles away. The difference in the angle of viewers separated by 100 kilometers or so is slight. If moon-watchers took a position at Athens and Sparta, or at San Francisco, Berkeley, and Santa Barbara in California, or at Oxford and Cambridge in England, I venture to affirm that they are not going to see the crescent five days apart. Allowing for the position of the observer and the effect of weather, it is extremely doubtful that the difference would be more than one day. F. M. Dunn devotes several pages to the difficulties in observing the lunar position, but the same strictures would apply to all calendars, yet we know that the Egyptians and Babylonians had lunar calendars with untampered full and hollow months. To explain the differences in calendar dates of different Greek cities, as attested for example by Aristoxenos and Plutarch, some other factor than faulty observation is required.

In spite of the literary evidence about the divergencies in the calendars of different states, we have the neglected, but firm, evidence in the form of an oath taken by emissaries of three far-removed states (Athens, Ambrakia [in the north], and Akarnania [in the west]) that the calendars of these states about 166 B.C. differed by only one day (XI 26 or 27 [Akarnania]), of which I give the opening lines (*IG* II[2] 951 add.):

> ἐπὶ Νικοσθένου ἄρχον[τος μηνὸς Θαργηλιῶνος]
> πέμπτει ἀπιόντος ὡ[ς Ἀθηναῖοι, ὡς δὲ Ἀμ]–
> βρακιῶται ἐπὶ γραμ[ματέως . . . .⁹. . . . . μ]ηνὸς [Φοι]–
> νικαίου πέμπτει ἀ[πιόντος, ὡς δὲ Ἀκα]ρνᾶνε[ς]
> ἐπὶ στρατηγοῦ Χρεμᾶ [μηνὸς Ἑσπερι]νου? τετρά[δι]
> ἀπιόντος, ὅρκος . . .

The uniformity strongly suggests that these states were using a lunar calendar and, if these three, presumably all of Greece. Turning to the evidence of *SEG* 34.95 (lines 2, 26, and 44) we find that a few years later the Athenian kat' archonta calendar was out of step with the kata theon one throughout a period of several months (III–VI). Thus, the first and last days of these months, as mentioned in Aristoxenos and Plutarch, were out of step with the lunar calendar and surely with the calendars of other Greek states for a period of several months. Paul Roesch, *Études Béotiennes* (Paris 1982) 63–67, has shown that the Boeotian calendar exhibits the same phenomenon with the civil dates lagging behind the lunar dates. Finally, we have the example of the Euboian calendar cited above. The practice of the noumenias within the year being out of step among different states was so widespread that it drew the comments of Aristoxenos, Plutarch, and others.

Kata Theon Dates

In accordance with his theory objecting to 'tampered' dates and maintaining that a true observation calendar was impractical, F. M. Dunn, writing of the calendar to which according to him the Athenians adjusted his untampered dates, says on p. 224, "Dates κατὰ θεόν follow the traditional calendar in which the beginning of the month approximated the appearance of the new lunar crescent." On p. 217, he writes, "The month could contain only 29 or 30 days, and it seems plausible to assume that these fell in rough alternation." Thus, in Dunn's "adjusted" calendar there were 354 days (6 X 30, 6 X 29) in an ordinary year and 384 in an intercalary one. Mindful that the thrust of Dunn's paper is his objection to the theory of 'tampered' dates, we turn to the table of seventeen kat' archonta – kata theon equations published by Neugebauer and me in *Calendars of Athens* (1947) p. 15,[8] to which add *Hesperia* 33 (1964) 183 (Month XI 11 = Month XI 18) and second and third equations (lines 2, 26, and 44) in my No. 8, then unpublished, but now published with new fragments as *SEG* 34 (1984) 95. Also add *Hesperia* 17 (1948) 25 (Month [V.9] k.th. = Prytany 5.9 = Month [V.7] k.a. in 95/4 B.C.); *Hesperia* 17 (1948) 26 (Month V[8] k.th. = Prytany 5.8 = Month [V?] k.a. in 95/4); *Hesperia* 26 (1957) 72–73 (Month IX.19 k.a. = Month IX.21 k.th. = Prytany 9.22 in 164/3 B.C.). Stamires, *Hesperia* 17 (1948) 39, has restored two very fragmentary non-stoichedon prescripts with kata theon, but not kat' archonta, dates

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[8] No. 3 in the table should be deleted, since Meritt (*Hesperia* 32 [1963] 16) has shown that a better reading should be ὀγδ[όει ἐμβολίμωι]. No. 1 was included following Koehler's and Kircher's conclusions that double-dating was required to fill a long lacuna, but Meritt, *The Athenian Year* (1961) 165–166, has shown that the reading should be τ[ετάρτει ἐμβολίμωι]. Not all of the dates in the table are correct. See, for example, S. Tracy, *Horos* 7 (1989) 41–43.

for the same day in the year 173/2, but his texts are almost entirely restoration, including even the phrase kata theon. The total is 22, not 7 as Dunn has it (p. 225). All are dated from the beginning of the third to the beginning of the first century. The interesting feature of the fragmentary *SEG* 34.95 inscription is that we have three different equations in the same year. The first and third equations are restored or read with months Boedromion (III.16, in the third prytany) and Posideon (VI.24), proving that the kat' archonta calendar was not adjusted for a period of approximately 98 days and probably much more (or that they had modified and adjusted three different times; the difference in the third equation is only two days, reading ἐ[νάτει]), and certainly not for a single festival, as Dunn frequently postulates for his 'adjustments.' The question arises, what are these kat' archonta dates if not tampered dates, or modifications in the kata theon calendar?

Paul Roesch, *Études Béotiennes* (Paris 1982) 60–68, an epigraphist of the L. Robert school, presents four examples of kata theon in the Boeotian calendar, the earliest dated in 229 B.C., referring to the calendar kata theon as "le calendrier lunaire". Roesch points out that the kata theon dates were in inscriptions of interstate relations, designating lunar dates applicable to several states, clearly true lunar dates, not ones in "traditional" calendars of each separate state.

Whereas in the Boiotian calendar, Roesch suggested that dates kata theon were used in inscriptions of interstate relations, this was not always true of the Athenian one. *IG* II² 946, 947, and 949 are decrees in honor of foreigners, but *IG* II² 1006 and *Hesperia* 15.207 are in honor of Athenian ephebes, and *IG* II² 967 and 1004 in honor of the prytaneis of one phyle which had been in office. *SEG* 34.95 is an inventory of the dedications in one Athenian sanctuary. Roesch's observation, however, is well taken. In *The Athenian Tax Law of 374/3* published by R. Stroud (1998), which relates to the grain from Lemnos, Imbros, and Skyros, the supervision of the grain was dated in terms of lunar months Maimakterion (V) and Anthesterion (VIII), not in terms of the prytany calendar, which seems to have been rare on the Greek mainland except for Athens, but possibly used in Erythrai, Chios, Teos, and other Ionian cities which had a boule made up of prytaneis, although I know of no firm evidence; see J. A. O. Larsen, *Representative Government in Greek and Roman History* (Berkeley 1955) 12; G. Busolt, *Griechische Staatskunde* 476–477, 1581.

The word θεός presents a philological problem; it is not a matter of semantics. In *Calendars of Athens* (Harvard 1947) 16, Neugebauer cited references to several examples of the phrase κατὰ θεὸν νουμηνία in the astronomical literature to support our translation of the phrase as "according to the moon". In some non-Athenian inscriptions the phrase κατὰ σελήνην was used with calendar dates, and we regarded the phrases as synonymous. Aristotle (*Ath. Pol.* 43.2) wrote, κατὰ σελήνην ἄγουσιν τὸν ἐνιαυτόν. Plutarch (*Mor.* 349F) says, ἐπέλαμψεν ἡ θεὸς πανσέληνος, which the Loeb translates, "the goddess shone with full moon". In Aristophanes *Clouds* 615–626, Selene asks the chorus to convey to Athens her displeasure at its conduct of the festival calendar. Her strong statement is that the Athenians should observe the feast days according to the moon. E. G. Turner and O. Neugebauer, commenting on the phrase κατὰ σελήνην in a papyrus (*Bulletin of the John Rylands Library* 32, No. 1 [1949] 9), write, "The addition of *kata selenen* obviously means that we are dealing here with phenomena of the real lunar calendar." In Josephus (*AJ* 2.318; 3.248) dates were given by lunar reckoning (κατὰ σελήνην). Pouilloux demonstrated that kata theon and kata selenen were synonymous in Philo: *REA* 66 (1964) 211–213. J. and L. Robert, in commenting on Pouilloux' article, added *IG* VII.4135 line 11, where the phrase kata theon is used in referring to the same date in the calendars of Boiotia and Delphi. This Boiotian inscription is studied by Paul Roesch, *Études Béotiennes* (Paris 1982) 60. I noted above that in *IG* II² 951 add. lunar dates were used for Athens, Ambrakia, and Akarnania. In addition, we have three different states that were recognizing kata theon dates, which must have been true lunar dates. Earlier, in the accounts of Delian temples 434–432 B.C., *IG* I³ 402, published in Athens, gives the months (lines 14, 15, 17, 22) in terms of both the Athenian and the Delian calendars. Accordingly, we interpreted phrases with κατὰ θεόν as lunar dates. Dates given as κατ' ἄρχοντα, always lower in number, we interpreted as modifications of the kata theon calendar.

Hollow Months

Of special interest is the Rhodian ἡμερολόγιον, or calendar, in which each day of a succession of months is entered by numerals, followed by the names of people, who are conjectured to be the contributors of oil to the gymnasium: C. T. Newton, *Ancient Greek Inscriptions in the British Museum* 2 (1883) No. 344; *IG* XII.1.4. W. R. Paton and E. L. Hicks, *Inscriptions of Cos* ((1891) 328, examined the stone and say that the marble contained the Calendar for thirteen months, or 384 days. The intercalary month was Panemos B placed at the end of the year, although Panemos was the tenth month. The last day of the month was indicated by the monograph for τριακάς. Months of thirty days had the monogram for προτριακάς for the 29th. In the last decade, after ΚΑ (21), the order of numerals was reversed, ΚΓ being the 28th day and ΚΘ the 22nd. Cf. *ZPE* 41 (1981) 145–151. The Athenian calendar was similar with δευτέρα φθίνοντος, latest occurrence 306/5 (or μετ' εἰκάδας, earliest example 334/3) being used for a full month (day 29) and ἕνη καὶ νέα for the last day of all months. In Greek calendars studied in A. E. Samuel, *Greek and Roman Chronology* (Munich 1972), the omitted day in a hollow month is regularly δευτέρα φθίνοντος, δευτέρα ἀπιόντος, or προτριακάς (common). Proklos in the scholia to Hesiod *Op*. 765 and 817 twice tells us that the 29th day (δευτέρα φθίνοντος) was omitted at Athens in a hollow month, and Moschophoulos, who had the works of Proklos in a more complete state than we do, reports the same statement. Proklos is thought to have used Philochoros or Plutarch's Περὶ ἡμερῶν. The problem of the omitted day was discussed in *ZPE* 49 (1982) 243–265. Since the omitted date was determined before the last day of the month, which in turn was followed by Day Noumenia of the next month, how did the Greeks determine a hollow month in a lunar calendar?

The problem of the omitted day is tied to that of the epoch of the day. Van der Waerden, *JHS* 80 (1960) 176, accepted a definition of Geminus, chap. 6 (p. 68 of Manitius) that day is the time from sunrise to sunrise. G. Bilfinger, in his lengthy monograph, *Der Bürgerliche Tag* (Stuttgart 1888), collected the ancient testimonia and argued vigorously that the Athenians reckoned the day from sunrise, a conclusion endorsed by Sontheimer, *RE* s.v. Tageszeiten (1932) 2014. Hesiod began his day in the morning: *Op*. 810, "the ninth of the midmonth improves towards evening": see T. A. Sinclair page 81.

To continue with the subject of the hollow month, Hesiod (line 766) began his calendar with the τριακάς. Homer reckoned time by the use of ἠώς, e.g., "This is the twelfth dawn since I came to Ilion" (*Iliad* 21.80). It seems incontrovertible that any calendar with a fixed order of months must be the regularization of a lunar calendar depending originally on observation. It must, therefore, at its introduction, have been based on the concrete phenomenon either of crescent invisibility or of crescent visibility as the starting point of the month.[9] Our sources tell us that the Athenians called the last day of the month the "old and new" (ἕνη καὶ νέα). One explanation might be suggested that with a morning epoch, the νέα was the night of the visibility of the crescent. As explained in "The Pannychis of the Panathenaia", *Philia Epe* (Festschrift for George Mylonas) 2 (1986) 179–188, the celebration of the pannychis of this festival was held on the night of Hekatombaion 28, not in the first part of Hekatombaion 29. I discussed the problem in greater detail in *ZPE* 49 (1982) 262. The calendar for the Greater Mysteries at Eleusis has sometimes been cited also with regard to a pannychis as supporting an evening epoch, which I believe is incorrect. The most detailed treatment is that of A. Mommsen, *Feste der Stadt Athen* (1898) 204–277. For the calendar, see also S. Dow, *HSCP* 48 (1937) 111–120; G. Mylonas, *Eleusis and the Eleusinian Mysteries* (1961) 243–285; J. D. Mikalson, *The Sacred and Civil Calendar* (1975) 58–59; H. W. Parke, *Festivals of the Athenians* (1977) 55–72; N. D. Robertson, *AJP* 119 (1998) 547–575, who, however, is unaware of the dispute over the calendar problem ("it is now granted by all authorities" [p. 549]). The evidence spans many centuries (*Homeric Hymn to Demeter* and Herodotos 8.65 to *IG* II^2

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[9] Cf. R. A. Parker, *The Calendars of Egypt* 17.

1078/9 [c. 220 A.D.] and the polemics of the Christian Fathers). Aristophanes in the *Frogs* gives a continuous presentation of the early stages of the procession to Eleusis, from the moment they call Iakchos from a temple in Athens (324 ff.) down to the time the chorus dances around the Kallichoron, the sacred spring of Eleusis (451; Pausanias 1.38.6). Cf. p. xv of B. B. Rogers edition, although it is to be noted, as L. Radermacher observes in his second edition (1954) of the play (pp. 184–185), Tucker and Jane Harrison (*CR* 18 [1904] 416–418) argue that the reference is to the small Mysteries ἐν Ἄγραις. The scholium on Aristophanes *Frogs* 326; Plutarch *Cam.* 19.6 and *Phokion* 28.1 (both references to the same event in the fourth century) all place the bringing out of Iakchos on Boedromion 20 (τὸν Ἴακχον ἐξάγουσιν). The marble agalma (Pausanias 1.2.4; Cicero *Verr.* 4.60.135; Clement Alex. *Protr.* 62) of Iakchos by Praxiteles is brought out before the procession starts. Euripides *Ion* 1076, speaks of Dionysos (or Ion) watching the torch-dances on the 20th (εἰκάδων = εἰκάδος), a pannychis on the evening of the arrival of the procession in Eleusis. Cf. N. J. Richardson, *Homeric Hymn to Demeter* (1974) 165, 215. All of this accords with a theory of morning epoch. However, an inscription, published as *IG* II^2 1078 (= *SIG*^{3} 885) and dated to c. 220 A.D., has been cited for a procession on the 19th. The inscription, as Kirchner's title suggests (De Eleusiniorum sacris in pristinum splendorem restituendis), has to do with the κόσμος of the sacred objects (τὰ ἱερά), giving three dates in Boedromion and referring to the ephebes, who had nothing to do with the classical festivities. On the 13th, the kosmetes is to lead the ephebes to Eleusis in a customary formation (μετὰ τοῦ εἰθισμένου σχηματος τῆς ἅμα ἱεροῖς πομπῆς). On the 14th, the ἱερά are to be taken to the Eleusinion in Athens ὡς ἂν κόσμος τε πλείων καὶ φρουρὰ μείζων περὶ τὰ ἱερὰ ὑπάρχοι. The inscription mentions a cleanser (φαιδυντής). Then on the 19th, the ephebes return to Eleusis μετὰ τοῦ αὐτοῦ σχήματος παραπέμποντας τὰ ἱερά. For the relation between the two cult centers, see M. Nillson, *GR*^{2} 1.712. It does not follow that any of the three designated ephebic πομπαί to and from the Eleusinion in Athens, including that on the 19th, is the same as the classical procession which escorts Iakchos from the temple in Athens on the 20th. Dow (p. 114) suggests that the ephebes went on ahead to make main preparations for the main πομπή. All conflict would be resolved if we assume that the calendar was altered when the ephebic processions were introduced long after classical times. In *IG* II^2 847, four hundred years earlier than *IG* II^2 1078, the epimeletai were praised for the κομιδὴ τῶν ἱερῶν. Over the centuries many modifications in the festivities took place, and this included the care of τὰ ἱερά. Perhaps the post-pompai activities had been expanded, requiring another day at Eleusis, when the Mysteries became the greatest festival in Athens, attracting many foreigners, including potentates, for initiation. Mommsen demonstrated that the festivities at the Panathenaia were expanded in Roman times. *IG* II^2 1078/9 introduced a new, or expanded, procedure and hence was to be set up in three places, none of which was a temple connected with Iakchos. It was to add new luster to the Eleusinian festival, as is expressly stated in lines 30–31. Philostratos (*VS* 2.20.602) refers to the procession to Athens (on the 14th) when he writes (Loeb tr.), "The suburb is called the 'Sacred Fig-tree', and when the sacred emblems from Eleusis are carried in procession to the city they halt here to rest." Incidentally, I do not believe that the phrase προέπεμψαν τὰ ἱερὰ καὶ τὸν Ἴακχον ὡσαύτως supports a theory, as construed by N. Robertson (p. 552), that the ephebes with a countless throng of worshippers marched 14 miles from the Eleusinion in Athens to Eleusis with τὰ ἱερά and then hurried back to Athens to escort Iakchos the next day over the same distance, a total of 42 miles in 30-odd hours, and then observed an elaborate pannychis. Rather, a procession started at the Eleusinion with τὰ ἱερά and picked up Iakchos on the way. ὡσαύτως often means 'likewise' (see Powell for Herodotos and *TGL*), just as αὔτως means 'just as before' (LSJ). Robertson's interpretation ('they escorted two processions') is incorrect. The idea that the Eleusis road was so "unsafe", presumably from marauders, at the time of one of the greatest religious occasion in the Greco-Roman world, that an armed guard was required to traverse it is a figment of Robertson's imagination (p. 553).

R. A. Parker, *The Calendars of Ancient Egypt* (*Studies in Ancient Oriental Civilization* No. 28 [1950]) 10, has shown that the Egyptian day was reckoned from dawn to dawn,[10] and that people who began their day with a morning epoch used a calendar based on old crescent invisibility in the eastern sky and those who began their day in the evening based their month on the visibility of the new crescents or on full moons.

In *Physis* 31 (1994) Nuova Serie. Fasc. 3.689–729, A. C. Bowen and B. R. Goldstein, who have written extensively on Greek astronomy and Greek calendric problems,[11] and possess a knowledge of Greek astronomy which I lack, have devoted an article, "Aristarchus, Thales, and Heraclitus on Solar Eclipses: An Astronomical Commentary on P. Oxy. 53.3710. cols. 2.33–3.19", a commentary on *Od.* 20.156 about a festival identified as that of the νουμηνία, to a study of the Greek calendar. The authors, rejecting Geminos, posit that the epoch of the Greek day was sunset. They offer a study of the period of the interlunium with parallels between the Greek and Egyptian calendars at the end and beginning of months. Simultaneously, two studies of the papyrus and the noumenia have now appeared in *Illinois Classical Studies*: W. Burkert, 18 (1993) 49–55, and D. Sider, 19 (1994) 11–18. Both assume that the epoch of the Greek day was sunset. I note that A. E. Samuel, "Ptolemaic Chronology", *Münchener Beiträge zur Papyrusforschung* 45 (1962) 41–51, raises objections to Bilfinger's arguments about the morning epoch for the day in the Makedonian calendar.

O. Neugebauer, *The Exact Sciences in Antiquity*[2] (Providence 1957) 106, wrote with regard to a "lunar month", "No two consecutive reappearances of the new crescent after a short period of invisibility of the moon are [n]ever separated by more than 30 days or by less than 29 days." A. E. Samuel, *Greek and Roman Chronology* (Munich 1972) wrote at length about the lunar month of which I extract the following:

> A lunar month *can never* be shorter than 29 days nor longer than 30 days, so that the fluctuation will be over a very limited range. . . . If on the evening which ends the 29th day the moon is not seen, either because in fact it is not visible for astronomical reasons or because visibility is obscured by atmospheric conditions, that month can without difficulty be given another day to become a 30 day month. But if atmospheric conditions obscure the moon on the evening of the 30th day, experience will dictate that the month should begin anyway. The maximum dislocation causable by poor visibility would thus be one day; that is if the moon were actually in first crescent on the evening of the 29th day, but was not seen due to atmospheric conditions so that the month was not begun until the next day, the calendar month would be one day longer, and the next month one day behind the true observation month. Etc.

By contrast, F. M. Dunn says (p. 217) that by computer he had determined that in the period from 438 to 431 B.C. at Athens "the full moon would fall on the ninth to sixteenth day of the month, rarely on the eighth". Parenthetically, if we apply this determination to all calendars, it would seem that a true observational calendar was impossible, although we are told by specialists that the Egyptian festival calendar and the Babylonian one were indeed observational. Tables for the full moon, in contrast to those for the end of the month, are of relatively little significance for Greek calendars.[12] The Egyptians, with a lunar calendar based on morning invisibility of the moon in the eastern sky, "counted the 15th day as that of full moon, without regard to astronomical exactness". (R. A. Parker, *The Calendars of Ancient Egypt* p. 9). There is no reason to doubt that the Greeks did the same. Some Greek calendars used the "15th", others διχομηνία.

The problem of the omitted day in the Greek lunar month is more complicated, since the 29th day was omitted, thus requiring determination of the omission by the end of the 28th day. There is little lite-

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[10] The morning epoch was used also in the Ethiopic and Coptic calendars; see *ZPE* 49 (1982) 263 n. 61.

[11] See *Thucydides' Pentekontaetia* (1995) 190.

[12] In the tables of F. K. Ginzel, *Handbuch der mathematischen und technischen Chronologie* I and II (Leipzig 1906, 1911), new moons are given for the period 605 B.C. through 308 A.D. and full moons from 500 B.C. through 100 A.D. In addition to R. A. Parker and W. H. Dubberstein, *Babylonian Chronology* (Providence 1956), H. H. Goldstine, *New and Full Moons 1001 B.C. to A.D. 1651* (Philadelphia 1973), supported by O. Neugebauer, provides data for Babylon. Following Ginzel, E. J. Bickerman, *Chronology of the Ancient World* (London 1968) 110–142, provides tables for new moons, giving the date of conjunction in mean Greenwich time. Oddly, these tables were omitted in the second 1980 edition. Ginzel (2.374–375) says that at Athens Mount Lykabettos was used for observations.

rature on the subject by our astronomical authorities. Following Parker's calculations in which Day 2 in the Egyptian calendar was called "New Crescent Day", I suggested in *ZPE* 49 (1982) 263–264 that the day called νουμηνία corresponded to Egyptian Day 2, and that observation took place by the morning of Day 28, permitting the determination of a full or hollow month, thus correcting my earlier study in *CP* 54 (1959) 151–154 and *Choiseul Marble* 72–73, based on a theory of a day of evening visibility. Although not directed at the problem of the omitted day, Bowen and Goldstein also offer, with charts, a comparison of the Egyptian festival and Greek calendars at the end of the month on the basis of evening visibility.

In Athens, the Areopagos tried certain homicide cases out of doors in the dark of night in the period called interlunium, a period of 2 or 3 nights: Lucian *De domo* 18 (Loeb 1.195); *Hermotimos* 64 (Loeb 6.379). Pollux (8.117) gives the calendar dates as τετάρτη φθίνοντος, τρίτη, δευτέρᾳ. Cf. scholion to Aischines *Against Timarchos* 188. The *Etym. Magnum* 131.13 and *Etym. Gud.* 70.4 refer to these days (or nights) as ἀποφράδες. See *War* 3.209–212; R. W. Wallace, *The Areopagos Council to 307 B.C.* (Baltimore 1989) 122 and 257 n. 105; Albert Henrichs, *Illinois Classical Studies* 19 (1994) 40; J. H. Lipsius, *Das Attische Recht* (1915 [rep. 1966]) 161; G. Radke, *Die Bedeutung der weissen und der schwarzen Farbe* (Jena 1936) 71. If the lunar calendar was normal, these dark nights fell on the dates given by Pollux. If there had been any retardation of the calendar, the Athenians nonetheless held their courts on the two or three nights of the interlunium. By observing these nights, the Athenians show an awareness of the lunar movement at the end of the month and were in a position to determine when a lunar hollow month would occur. I believe that the parallel with the Egyptian calendar is sound. At the least, the facts that the Greeks were observers of the interlunium and had hollow months of 29 days are sufficient to show that for a society which had no artificial light it was a close observer of the lunar movement. Parker (p. 10) wrote of Egypt what would explain the omission of the 29th day if applied to Athens:

> If the beginning of the Egyptian day is connected with the lunar month, then we must seek a lunar phenomenon associated with the morning. This can only be the gradual waning of the moon in the eastern sky until it is just visible before sunrise on one morning (old crescent), while on the following morning it is invisible.

It is fitting to close the subject by citing a passage from Polybios 9.15 (see Walbank's commentary 2.140–141), which tells us that anyone with a knowledge of the zodiacal constellations can calculate how much of the night has passed (tr. Shuckburgh):

> In all human undertakings opportuneness is the most important thing, but especially in operations of war. Therefore a general must have at his fingers' ends the season of the summer and winter solstice, the equinoxes, and the periods between them in which the days and nights increase and diminish. For it is by this knowledge alone that he can compute the distance that can be done whether by sea or land. Again, he must necessarily understand the subdivisions both of the day and the night, in order to know at what hour to order the reveillé, or the march out; for the end cannot be attained unless the beginning be rightly taken. As for the periods of the day, they may be observed by the shadows or by the sun's course, and the quarter of the heaven in which it has arrived, but it is difficult to do the same for the night, unless a man is familiar with the phenomenon of the twelve signs of the Zodiac, and their law and order: and this is easy to those who have studied astronomy. For since, though the nights are unequal in length, at least six of the signs of the Zodiac are nevertheless above the horizon every night, it is plain that in the same portions of every night equal portions of the twelve signs of the Zodiac rise. Now as it is known what portion of the sphere is occupied by the sun during the day, it is evident that when he has set the arc subtended by the diameter of his arc must rise. Therefore the length of the night is exactly commensurate with the portion of the Zodiac which appears above the horizon after sunset. And, given that we know the number and size of the signs of the Zodiac, the corresponding divisions of the night are also known. If however the nights be cloudy, the moon must be watched, since owing to its size its light as a general rule is always visible, at whatsoever point in the heaven it may be. The hour may be guessed sometimes by observing the time and place of its rising, or again of its setting, if you only have sufficient acquaintance with this phenomenon to be familiar with the daily variation of its rising. And the law which it too follows admits of being easily observed; for its revolution is limited by the period of one month, which serves as a model to which all subsequent revolutions conform. And here one may mention with admiration that Homer represents Ulysses, that truest type of a leader of men, taking observations of the stars, not only to direct his voyages, but his operations on land also.

For the Homeric passage, see *Od.* 5.272–277, and various commentaries, including that of Heubeck, West, and Hainsworth. The parapegmata of the astronomers (Euktemon, etc.) charted the solar zodiacal year. The parapegma of *IG* II[2] 2782 and another found in the Pompeion marked the days of the Athenian month and were lunar: *ZPE* 49 (1982) 256 n. 36.

Prytany Year

Rejecting a rigid application of Aristotle's rule for the prytany calendar without any documentation, F. M. Dunn writes (p. 225), "A date in the council's calendar may vary by several days." On the same page, Dunn says, "Neither the festival calendar nor the prytany calendar can be firmly reconstructed." Typically, Dunn does not review the evidence. What with a prytany calendar of variable length and a highly disordered, but "untampered", festival calendar, it would seem that for Dunn the Athenians had no satisfactory method of specifying a specific date. Dunn's position may explain why he ignores hundreds of calendar equations in Athenian inscriptions, although he says (p. 222) that Morgan supplied him with his list of equations, which Habicht in turn says stipulates a nineteen-year cycle.

Neugebauer and I quoted Aristotle's rule (*Ath. Pol.* 43.2) for the sequence of prytanies in an ordinary year. He makes no mention of an intercalary year, but we assumed a similar rigid pattern. *IG* I[2] 374 (= *IG* I[3] 476) indicated a 37-day prytany as number six of the year 408/7, while the eighth prytany had 36 days; far more important, an argument in favor of known lengths for prytanies is the fact that the terminology for giving dates in the prytanies, i.e., "x days were left in the prytany", implying predetermined lengths. There were no embolimoi days in the prytany calendar. The treatment of the so-called calendar inscription is central to the problem: *IG* I[2] 324; *IG* I[3] 369. It cannot be contested that where restoration is not a factor, the prytany year confirms the Aristotelian pattern. There is agreement that in a four-year period (426/5–423/2) the prytany calendar had 1464 days (4 x 366), approximating a solar year. In *Calendars of Athens* 95–105, I offered a study of the calculations of the abacus operator. Subsequently, in *Hesperia* 24 (1965) 131–147 and *AJP* 85 (1964) 40–50 (with photograph), I rejected a reconstruction of the text, which was followed by Dover (*HCT* 4.267), Lewis (*CAH* V[2] 521), *IG* I[3] 369, and Meritt and Lang, that theorized that the stele had been damaged at the right margin before inscribing, thus reducing the number of letters to be restored in the stoichedon text for eleven lines. I also rejected computations that assumed that the abacus operator placed pebbles in the wrong column, subtracted instead of adding, neglected to place pebbles in the proper column, and forgot to calculate the interest on some part of the sum.

The reverse side of the Choiseul Marble (*IG* I[2] 304B), not mentioned by Dunn, contains a far larger number of equations in terms of the prytany and festival calendars than any other stone. There are 29 equations, spanning five prytanies and six months. Tables for this calendar were published in *The Choiseul Marble* (1970) 25–26 and, with one modification, in *BCH* 101 (1977) 24, both with photographs. The tables show intercalated and subsequent suppressed dates in the festival calendar. Since the Pritchett/Neugebauer theories were anathema to the Princeton School, my initial publication was followed by a series of articles, culminating in *IG* I[3] 377, by Meritt and Lewis. Each transcription, made not from the stone, but from my photographs without epigraphical commentaries, offered different texts. Previous to my transcription, it had been posited that the text of lines 27 and above could not be of the same year as the lower text (lines 28 ff.). The text is badly weathered with vertical fissures, lines 12–27 being incised by a different mason with the letters of this non-stoichedon part extremely crowded together. I observed that the original letters had etched a patina on the defaced stone which could be brought up in sunlight when the stone was moistened and offered a photograph in color of some passages. No epigraphist has the last word on any inscription, but any text not based upon a study of the stone under similar conditions can be final. My text showed intercalation in four cases with subtractions in three cases over a period of six months. Hopefully, there will be improvements in the text, which has not been completely deciphered.

As an explanation of differences between prytany and festival dates in a calendar which in the fourth and following centuries had Prytany 1 = Hekatombaion (I) 1, Neugebauer and I posited that we need not assume irregularities in the length of the prytanies when single dates of the festival calendar could be interpreted as dates possibly subject to modification, i.e. κατ' ἄρχοντα.[13] Thus, in *Hesperia* 32 (1963) 16–17, we have Hekatombaion (I) 25 ὀγδόη ἐμβόλιμος = Prytany II.3 in an ordinary year in the period of twelve tribes. The prytany calendar was regular, whereas the festival calendar had nine days called Hekatombaion (I 25). The text is not listed by F. M. Dunn. The text of *Hesperia* 23 (1954) 299 reads Ἐλαφηβολιῶνο[ς ἐ]νάτει ἱσταμένου τετάρτει ἐμβολίμωι, which I regard as a modified or 'tampered' date. By contrast, Dunn (p. 221) specifically objects to this date as resulting from "tampering by the archon", calling it rather an 'adjusted' date in the calendar he attributes to the Athenians, i.e. non-lunar and disorganized. Whereas on one page, Dunn tells us that the Athenians observed a traditional regulatory, but non-observational, festival calendar of alternate 29- and 30-day months, most of the article is devoted to the thesis that his calendar had no 'tampered' dates. It is noteworthy that Dunn does not tell us what happened to this calendar between Hekatombaion (I) 1 and his 'adjusted' dates for any year that required adjustment without tampering.

We have, I would estimate, well over 300 equations, many fragmentary and requiring restorations and sometimes the assumption of error, for the Athenian calendars. In no case is a prytany date on the stone higher than that required by an application of the Aristotelian rule. When we have one or more equations for any given year, one may offer tables showing differences in the length of prytanies from the Aristotelian rule, but only by assuming that the days on the other side of the equation progressed in such order as to permit this. For example, A. G. Woodhead, *The Athenian Agora* 16 (1997), often follows Meritt, offering variations in the prytany and festival calendars which would result in minimum disorder in both calendars, thus abandoning the Aristotelian rule. He even follows Meritt (e.g. p. 149) in the strange position that suppression of dates never occurs in Skirophorion (XII). *Hesperia* 23 (1954) 287–296, records on the stone a fourth intercalated Elaphebolion (IX) 9 (τετάρτει ἐμβολίμωι) = Prytany IX 27 in an intercalary year 271/0, but the discovery of other inscriptions of the year showed, as Woodhead (*The Athenian Agora* 16 [1997] p. 268) has worked out the calendar, "four days already intercalated". Thus with only three plus months to go the archon had to subtract eight dates. Dunn treats only the first equation and calls it an 'adjusted' date. In *Phoenix* 30 (1976) 350, I presented a table containing an impressive list of intercalated days in the festival calendar which Meritt posited in his study of calendar equations from the time that dating in terms of the two calendars was adopted in the prescript of decrees. For example, Meritt wrote in *Hesperia* 38 (1969) 108, "Elaphebolion 9, the 274th day of the year, is thus equated with Prytany IX 25, the 281st day of the year, and seven extra days (ἐμβόλιμοι) have to be assumed in the festival calendar before Elaphebolion 9 to make a true equation for the 281st day." We cannot ignore such equations, as F. M. Dunn does, or adopt his thesis that the Athenians lived with disorganized (i.e. "untampered") calendars which only allowed adjustments.

In the light of the attested irregular progression of days in the Athenian festival calendar, we have parallels for assuming a high measure of irregularity for any given year in contrast with the prytany calendar. 1. As noted above, one date in the festival calendar was repeated by adding eight days of the same name before moving on to the next day. 2. An unadjusted festival calendar may be maintained for several months. In the case of *SEG* 34.95, an irregularity was maintained at least for 98 days from

[13] Before 407/6 B.C., we know that the prytany and festival calendars were not co-terminous, i.e. that the equation Hekatombaion (I) 1 - Prytany I 1 did not apply; see *Choiseul Marble* 25–26; *Thucydides' Pentekontaetia* 185 ff. The prytany year was dated by the phrase ἐπὶ τῆς βουλῆς ᾗ . . . πρῶτος ἐγραμμάτευε which occurs last in 408/7. It is at this time that I would date the archon-list of *IG* I^3 1031: *Thucydides' Pentekontaetia* 186–187. The restoration of the democracy brought many changes (*IG* I^3 105), some imposed gradually: J. A. O. Larsen, *Representative Government* 197. In the two-volume corpus of *IG* I^3, the names of months in inscriptions earlier than the Choiseul Marble are found in sacred or religious documents: *IG* I^3 6 (Eleusinian mysteries); 7 (Praxiergidai); 36 (Athena Nike); 78.53 (Eleusis); 234 (Fasti sacri); 246 (sacred law); 402 (Delos); 1382 (private religious association). Two inscriptions refer to foreign states: *IG* I^3 21 lines 32, 33 (Miletos) and *IG* I^3 42.15 (Kolophon). Two refer to the tribute: *IG* I^3 34.68 and *IG* I^3 71.6, 18, 19 (Assessment of 425). In the records of the expenditures of the Treasurers of Athena, we have *IG* I^3 373.15 (during rule of Four Hundred) and *IG* I^3 369.58, 79 (names incorrectly restored). Finally one of the Attic Stelai (X) gives four dates: *IG* I^3 430.6, 8, 10, 13.

Month III into Month VI. Comparing *IG* II^2 946 with 947, we find an irregularity in Month IX of 28 days persisted into Month XI without adjustments. 3. Whereas in *Hesperia* 15.206–207, the days of the month and the prytany are in accord, nineteen days later in the second decree the festival calendar has dropped behind the prytany calendar by two days in the same month. To assume that the Athenians had not tampered with their festival calendar in the interval is absurd. Chronologists often work on the assumption that the character of a year is obtained by computations comparing the possibilities for years of twelve and thirteen months and choosing the one which results in fewer irregularities in the distribution of months and prytanies; cf. *Phoenix* 30 (1976) 349–350. Similarly, they compare the days in festival months and prytanies for distribution of the lengths of these months and prytanies without considering the possibility of embolimoi and subtracted days in the festival calendar.

The rationale for an even distribution in the lengths of prytanies is obvious. This calendar regulated the economic and administrative life of the city. Pay was given to prytaneis and ekklesiasts who were in office according to the prytany calendar; see W. T. Loomis, *Wages, Welfare Costs and Inflation in Classical Athens* (Ann Arbor 1998) Chap. 1. The subject was discussed at length in *Ancient Athenian Calendars on Stone* (1963) 355–360; *ZPE* 49 (1982) 257, etc. When the authorities wanted to postpone a meeting, they did not stop the clock, but changed the date after the manner of today. According to A. S. Henry, *The Prescript of Athenian Decrees* (1977) 37, it was not until ca. 341/0 B.C. that "for the first time we find mention of the lunar month and/or the day within the month". Earlier, the "detail of date was achieved by adding the ordinal numeral to the name of the prytanising tribe and by specifying the day of the prytany". Precision was given by the prytany calendar before the introduction of lunar dates.

Solstices

Although the calendars of Dinsmoor and Meritt are not in agreement, Habicht and Morgan now posit that Hekatombaion (I) Noumenia in the Athenian calendar was the first New Moon after the solstice, as noted in the beginning of the article. Students of Greek scientific astronomy are agreed, I believe, that the observation of equinoxes belongs to a comparatively late period (e.g. Toomer, *Gnomon* 44 [1972] 128). On the other hand, Diogenes L. (2.1) reports Favorinus as saying the gnomon was invented by Anaximander and set up in Lakedaimon to mark the solstices and equinoxes (= C. Mueller, *FHG* 3 p. 581 frg. 27; H. Diels, *Frg. Vorsokr.*[9] 1 p. 81). Pliny (*NH* 2.187) says the same of his pupil Anaximenes. There was a sacred well in upper Egypt at the equator in whose water the sun was reflected like a lid at noon on the day of the summer solstice. There are many references to this well as being used as a means to determine the solstice: Strabo 17.1.48.817; Arrian *Indika* 25.7; Aristeides *Or*. 48.347 (= vol. 2 p. 462 ed. Dindorf). In his note Dindorf quotes the text of Eustathios on Dionysios Periegetes 220. Pliny *NH* 2.183 refers to this well where it is shown that the sun is virtually above that place at the time. He then catalogues other similar places. Homer *Od.* 15.404 has the phrase ὅθι τροπαὶ ἠελίοιο, "there is an isle called Syria, west of Ortygia (lit. 'Quail island'. Delos ?) where are the turnings of the sun".[14] Eustathius remarks, ἕτεροι δέ φασι σπήλαιον εἶναι ἐκεῖ, δι' οὗ τὰς ἡλίου, ὡς εἰκός, ἐσημειοῦντο τροπάς, ὃ καὶ ἡλίου διὰ τοῦτο σπήλαιον ἔλεγον. In the early excavations at the top of Mount Kynthos at Delos, A. J. A. Lebége, *Recherches sur Délos* (Paris 1876) 136, found part of a ἡλιοτρόπαιον (viz. two supports and a piece of the dial). Philochoros says that Meton set up a sundial at Athens in 433/2 B.C., and H. Thompson originally offered a candidate for the site: *Hesperia* 1 (1932) 207–211. However, Thompson later withdrew his candidate, and A. C. Bowen and B. R. Goldstein, "Meton of Athens and Astronomy in the late Fifth Century", in *A Scientific Humanist: Studies in Memory of Abraham Sachs* (Philadelphia 1988), esp. pp. 72–73, have now given us a detailed treatment of Philochoros' report. The subject is treated by Rehm, *RE* s.v. Horologium (1913) 2417–2428. Ardaillon's article on

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[14] J. Schmidt, *RE* s.v. Ortygia (1942) 1523–1526, discusses at length three candidates for the site. Cf. Hiller, *Der Kleine Pauly* 4 p. 366. See also Heubeck and Hoekstra in their commentary on the *Odyssey* line (p. 257).

Horologium in DS, *Dictionnaire* 3:1 (1900) 256–264, is more detailed for ancient sources. Polybios (5.99.8) refers to a Heliotropion at Thebes. Pliny *NH* 36.72–73, describes at length an obelisk at Rome used by Augustus to mark the lengths of days and nights. Herodotos (2.109) says the sundial came to Greece from Babylon. He mentions the πόλος and γνώμων as two distinct instruments. A. W. Lawrence, in his commentary on Herodotos, says an early example of a gnomon comes from Palestine. Solstitial dials or gnomons were known from an early age in Greece. Hesiod used the phrase τροπὰς ἠελίοιο (*Op*. 564, 663) for the summer and winter solstices and numbered his days according to a lunar month.[15] Aristophanes *Eccl.* 652 has slaves go to δεῖπνον at the time when the shadow on the στοιχεῖον, apparently an early name for a γνώμων, is ten feet. See B. B. Rogers and R. G. Ussher, who cite several parallel passages in their commentaries on the line. In *IG* XII.5.647 line 16, the ten feet is time for a public feast: ἀποδιδόναι δὲ τὸ δεῖπνον δεκὰ ποδῶν. In Aristophanes frg. 675K, the deipnon is at the time of a seven-foot shadow. Euboulos (frg. 119K), in jest, tells a story of a parasite, a very tall man, who, being asked to supper when the shadow was twenty feet long, took the measurement in the morning instead of the evening and made his appearance at sunrise. See also Menander frg. 364K where the measurement was twelve feet by the dial. Cf. Plutarch *Mor.* 50E. O. Neugebauer, *The Exact Sciences in Antiquity*[2] (Providence 1957) 86, writes, "One of the inscriptions of the cenotaph of Seti I (about 1300 B.C.) shows a simple sun-dial and gives a description of its use." Bowen and Goldstein conclude (p. 73), "We prefer the hypothesis that the *heliotropion* was a device aligned to a solstitial rising-point such that a part of it was illuminated only on the day of the solstice."

In a masterly work, Sharon Gibbs, *Greek and Roman Sundials* (New Haven 1976), has given us a work of over four hundred pages on the subject, cataloguing 256 sundials. It is reviewed by P. Pattenden in *CR* 92 (28) 1978. 336–339, who has devoted an article to a sundial at Aphrodisias: *JHS* 10-1 (1981) 101–112. The discovery of some sundials shows that they were intended as a practical means to determine time for men in the fields. Inscribed sundials turn up frequently: *SEG* 26.1346; 30.585; 31.456, 931, 1061 bis; 34.1069; 35.1483.30; 36.1035, 1153 (an expert in sundials); 37.1355; 40.866; 41.477, 711; 42.908, 1435; 45.677, 864, 1448. Most are late. Some receive detailed commentary. Vitruvius, preceding his lengthy discussion of the movements of the planets, writes (9.1 Loeb):

> The shadow of the gnomon at the equinox is of one magnitude at Athens, another at Alexandria, another at Rome, is different at Piacenza and in other parts of the world. Therefore the designs of dials vary widely with change of place. For the length of the shadows at the equinox determines the design of the *analemma* by which the hours are marked in accordance with the locality and the shadow of the gnomon.

For the gnomon and analemma, see the entries in *Der Neue Pauly*. Sharon Gibbs treats the analemmas of Vitruvius and Ptolemy in an appendix (pp. 105–117).

Sacred Calendars

Calendars in terms of lunar months and days make no allowances for embolimoi and kat' archonta dates. They clearly gave dates in terms of an untampered lunar or kata theon calendar. When officials modified the calendar by intercalating and subtracting dates over a period of several months in a single year, we do not know how this confusion was resolved, but it seems unlikely that the sacrifices would be omitted on the prescribed dates. The citizen body was certainly aware of the distinction between the two festival calendars. I think that all would agree that the major state festivals were carried out according to the kat' archonta calendar.

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[15] M. L. West in his 1978 edition has noted that in the *Works* time is largely measured by the movement of the sun and the constellations (286–617). In the *Days*, the arrangement is according to the lunar month. Reference is made to one lunar month, Lenaion (504). West (p. 346) noted the same inconsistency in Roman agricultural writers. West gives a summary of days on pp. 57 ff. The 1st, 4th, 7th, 8th, and 9th were holy days. For recent bibliography on the *Works and Days*, see A. Lardinois, *AJP* 119 (1998) 333–336, to which add the important article of Paul Roesch, "Le calendrier d'Hésiode", *Stele, Mélanges N. Kontoléon* (Athens 1977) 26–32.

Several laws regulating sacrifices in terms of lunar dates through the year are not uncommon. Many fragments of the Athenian State Calendar of Nikomachos, known from Lysias 30 (*Against Nikomachos*) and dated around the end of the fifth century,[16] are studied by Oliver, *Hesperia* 4 (1935) 21 ff. and S. Dow, *Historia* 9 (1960) 270–293. Another was for the Tetrapolis of Marathon: *IG* II^2 1350, 400–350 B.C. J. J. Pollitt, *Hesperia* 30 (1961) 293–297, published a sacrificial calendar of the deme Teithras. A calendar of the deme of Eleusis has been studied at length by S. Dow and R. F. Healy, *HThS* 21 (1965) 1–58 (= F. Sokolowski, *LSCG* no. 7). The most interesting is a large stele found at Spata in Attika and published by G. Daux, *BCH* 87 (1963) 603–634 (*SEG* 21.541), which has received a large bibliography. This was a sacrificial calendar for the deme Erchia, listing in five columns 59 sacrifices spread throughout the year, with each sacrifice being dated by lunar month and day. It dates to the second quarter of the fourth century. Others will be found in the three volumes of F. Sokolowski. J. Mikalson studies the relationship between the sacrificial calendars of the state and of the Attic demes: *AJP* 94 (1977) 424–435. In *SEG* 26 (1976/7) no. 138, the editors conveniently catalogue five sacrificial calendars of Attic demes, all of which are receiving continuing bibliography. See also G. Daux, “Le Calendrier de Thorikos au Musée J. Paul Getty”, *AC* 52 (1983) 150–174 (= *SEG* 33.147).

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[16] Nikomachos produced a new code of state religion which was not completed after many years until 399/8 B.C., when he was prosecuted. In the speech, Nikomachos is charged with accusing the speaker with impiety for protesting against some new sacrifices required by Nikomachos’ revisions of the laws of Solon. As Gernet explains in the Budé edition, objections were raised by the conservative element of the populace, particularly about the expenses involved. This Nikomachos calendar continues to receive bibliography: *SEG* 40 (1990) 146. The speech illustrates the great popular interest in the subject of the sacrificial calendar. F. Jacoby, *Atthis* (1949) 65, wrote, “What we know is that the code of Solon settled the festivals and sacrifices of the State on certain days and months, and that in the fifth century intercalation, which more than anything else decides the course of the calendar, was in the hands of the archon.”