The Antikythera Mechanism, Rhodes, and Epeiros

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Introduction

I am particularly honored to be asked to contribute to this Festschrift in honor of James Evans. For the last nine years I have been engaged in studying the Games Dial and the calendar on the Metonic Spiral of the Antikythera Mechanism,[1] and in that time I have come to admire James's willingness to look at all sides of the evidence, and the way in which he conducts his research in an atmosphere of collaborative and curious inquiry combined with mutual respect.

It has long been suggested that the Antikythera Mechanism may have been built on the island of Rhodes,[2] one of the few locations attested in ancient literary sources associated with the production of such celestial devices. This paper will strengthen the thesis of a Rhodian origin for the Mechanism by demonstrating that the as-of-2008-undeciphered set of games in Year 4 on the Games Dial were the Halieia of Rhodes, a relatively minor set of games that were, appropriately for the Mechanism, in honor of the sun-god, Helios (spelled Halios by the Doric Greeks). This paper will also summarize an argument that the calendar on the Metonic Spiral cannot be that of Syracuse, and that it is, contrary to the assertions of a prominent scholar in Epirote studies, consistent with the Epirote calendar. This, coupled with the appearance of the extremely minor Naan games on the Games Dial, suggests that the Mechanism also had some connection with Epeiros.

The Games Dial and the Halieia of Rhodes

The application in the fall of 2005 of micro-focus X-ray computed tomography on the 82 surviving fragments of the Antikythera Mechanism led to the exciting discovery and subsequent publication in 2008 of a dial on the Antikythera Mechanism listing various athletic games now known as the Olympiad Dial (but which I will call the Games or Halieiad Dial—more on that below), as well as a hitherto unknown Greek civil calendar on what is now called the Metonic Spiral.[3]

I begin with my own composite drawing of the Games Dial (Fig. 1). As one can see from the composite drawing, the Games Dial on the Antikythera Mechanism is divided into four quadrants labeled as in Table 1.[4] The new reading of ΑΛΙΕΙΑ in the final position of year 4 is published

1 The core of this paper was delivered at a conference at the Lorentz Center in Leiden in June of 2013. I especially want to thank my collaborator John D. Morgan, whose perceptive comments have been invaluable. I also wish to thank the Department of Classics at Case Western Reserve University, the Dean of the College of Arts and Sciences, Cyrus Taylor, the Freedman Center for Digital Scholarship, and the Baker Nord Center for the Humanities for their moral and financial support.

2 Price 1974, pp. 13, 57-62.

3 Freeth, Jones, Steele and Bitsakis 2008.

4 The ∟ is the common abbreviation symbol for ἔτος (year), and the letters Α, Β, Γ, Δ stand for the ordinals 1st, 2nd, 3rd, and 4th.

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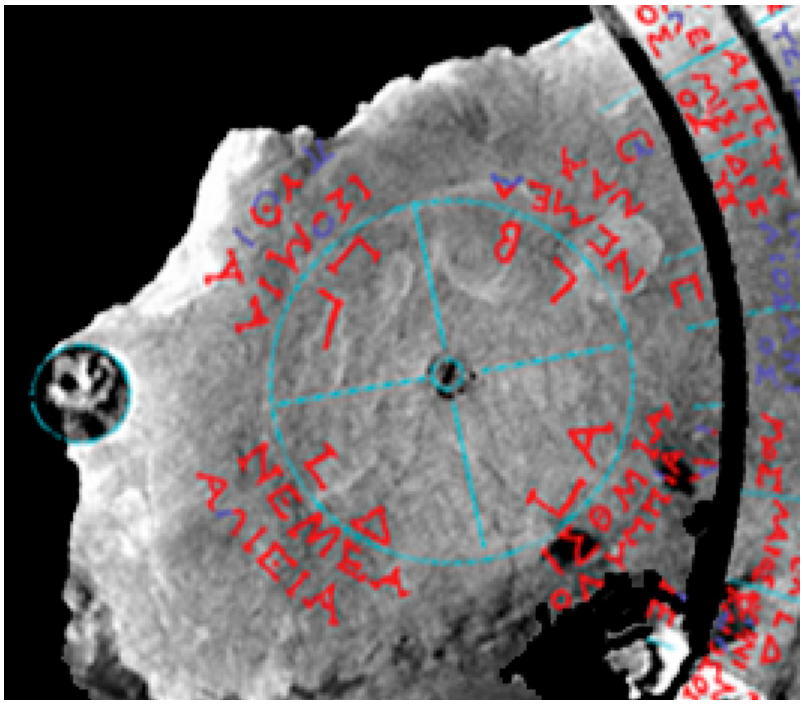

Figure 1. The Games/Halieiad Dial.

here in full for the first time and rests upon the following evidence from the micro-focus X-ray computed tomography.[5]

∟Α΄	∟Β΄	∟Γ΄	∟Δ΄
Ἴσθμια Ὀλύμπια	Νέμεᾳ Νᾶα	Ἴσθμια [Π]ύθ[ι]α	Νέμεα Ἁλίεια
Year 1	Year 2	Year 3	Year 4
Isthmia Olympia	Nemea Naa	Isthmia [P]yth[i]a	Nemea Halieia

Table 1. Inscriptions of the Games/Halieiad Dial.

It should first be noted that each CT-generated photo is a slice of the Mechanism at a particular angle, direction and depth (and these slices can be combined into an accurate 3D X-ray volume and viewed with CT viewing software). On each slice only parts of some letters are visible, some more sharply than others. One must, therefore, stack up several image slices (in Adobe *Photoshop*) with the same absolute placement and read the images in a sequence. As the angle, direction and depth of each X-ray changes slightly, some letters or letter strokes that were blur-

5 This article is partly based on data processed, with permission, from the archive of experimental investigations by the Antikythera Mechanism Research Project in collaboration with the National Archaeological Museum of Athens (see T. Freeth, Y. Bitsakis, et al. 2006. In particular, I want to thank Mike Edmunds for releasing some of these data to me, and Tony Freeth and Alexander Jones for responding to my numerous queries. The mention of the possible reading ΑΛΙΕΙΑ by Zafeiropoulou (2012, p. 247) was based on a communication of my reading to her by other members of the AMRP.

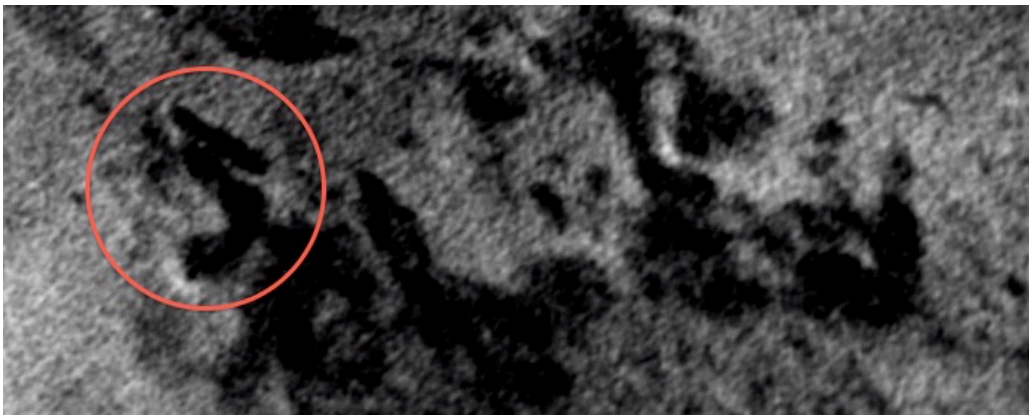

Figure 2. Area of damage above the initial ΑΛ of ΑΛΙΕΙΑ.

ry or invisible in one image come into view or even into focus in another, some more sharp than others, while others become blurrier or disappear altogether. Thus one must make a composite drawing on a graphics tablet by tracing what one sees as one moves through the images, each image adding more strokes to complete the picture. There are sometimes stray shadows or marks of damage (some of this a result of the image slice being at a slightly different angle or level) and often the letters themselves change appearance from looking like deep black grooves to letters in relief, so the technique of reading these images is not foolproof and is subject to interpretation. Nevertheless, the following analysis will demonstrate that the correct reading is ΑΛΙΕΙΑ.

The final two letters, IA, are clear in several photos, so I believe all would agree these are not in dispute (see Figs. 3, 4 and 5). The interpretation of the first 4 letters, however, is more difficult. Their decipherment begins about ¼ millimeter above them on the surface of the Mechanism, where there are accretions and damage. Here one sees that an area of damage sits above the first two letters, which I have circled in red (see fig. 2).[6] As will become clear, some of this area of damage runs down into the level of letters to interfere with their reading, and it is important to distinguish this damage from the letters themselves.

Going to a slice a little below, one can see that the outlines of 6 letters appear, along with some of this area of damage circled in red (Fig. 3). Here it is especially important to note that to

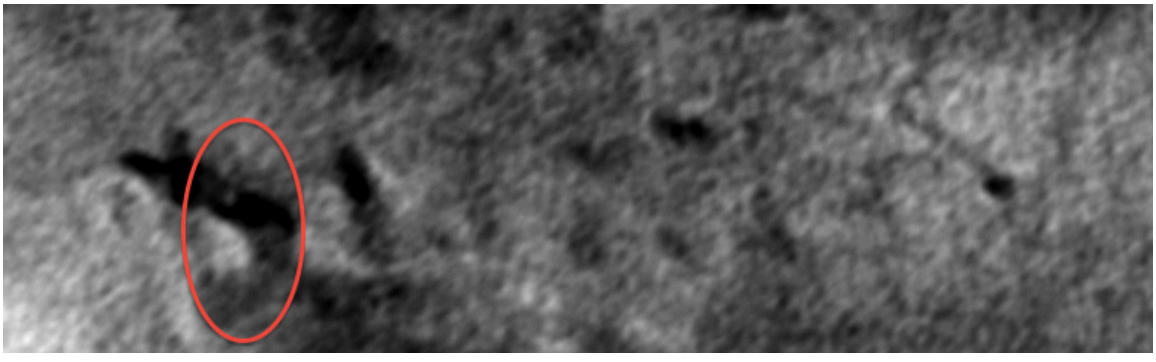

Figure 3. Damage at the level of the letters.

6 Special thanks to the late John Seiradakis and to Magdalini Anastasiou, who sat down with me in Thessaloniki and using the Studio Max VG software snapped these pictures. I also wish to thank Magdalini for sharing the beautiful Antikythera Mechanism font that she created.

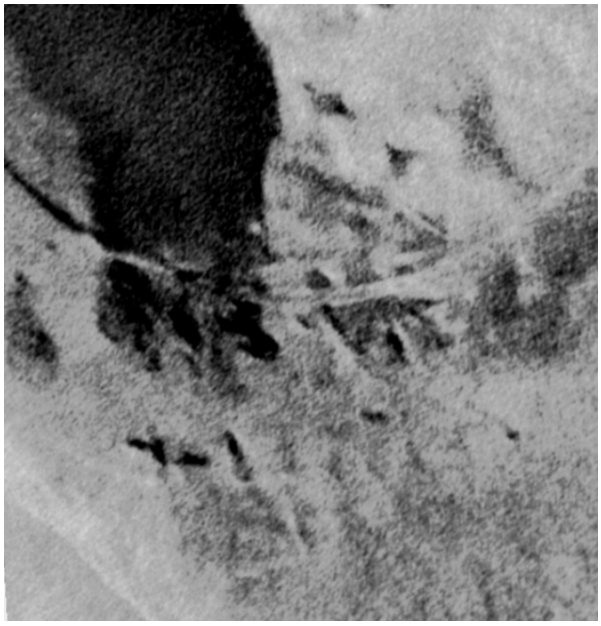

Figure 4. The six letters of the games in year 4.

the left of the red oval, some new strokes are visible (an apex along with a diagonal) that were not visible in Fig. 2 in this same area. This suggests that these are, in fact, letter strokes. In any case, as is clear from all relevant image slices, there are six letters, no more and no less. Stepping back a bit, all six letters are visible (Fig. 4).

That these are the only six letters is made even more likely by the fact that the inscriber was careful to center names of the games around the Games Dial (with the exception of the Olympia in year one because he ran out of space next to the Metonic Spiral). Adding another letter to the left, the only place where an extra letter could have possibly gone and escaped the notice of the micro-focus X-rays, would have spoiled the appearance.

Fig. 5 is a close-up of what one sees when one removes the layer of noise above the level of the letters. First it is important to note that with the area of noise above removed, all that is visible in this photo is on the same level of the letters. Thus any visible marks that were not visible in fig. 2 are likely to be letter strokes; conversely, any strokes in Fig. 2 that are still visible in Fig. 5 are likely to be damage. Hence the neat and crisp joining-up of the diagonal and cross-bar of the first letter *on the same level as the rest of the letters and not visible in Fig. 2* strongly implies these are purposeful letter strokes, not damage. In addition, in some slices an apex and a left diagonal of this first letter are visible (see Figs. 3, 4 and 7, for example). Finally, these strokes are on an orientation that is slightly rotated, which is exactly what they should be to follow the arc of the

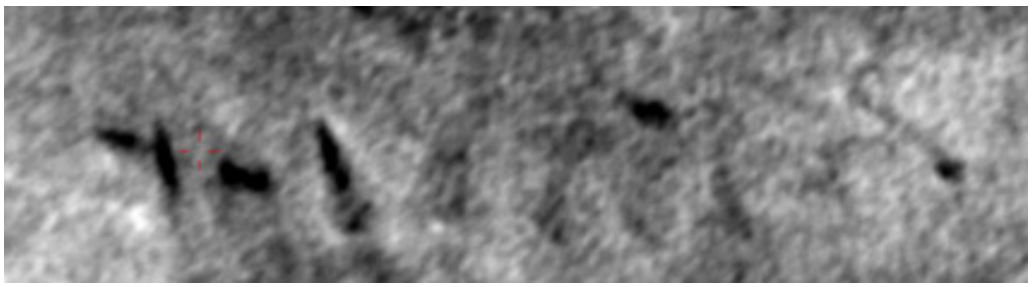

Figure 5. Close-up of 6 letters, with about ¼ millimeter noise above removed.

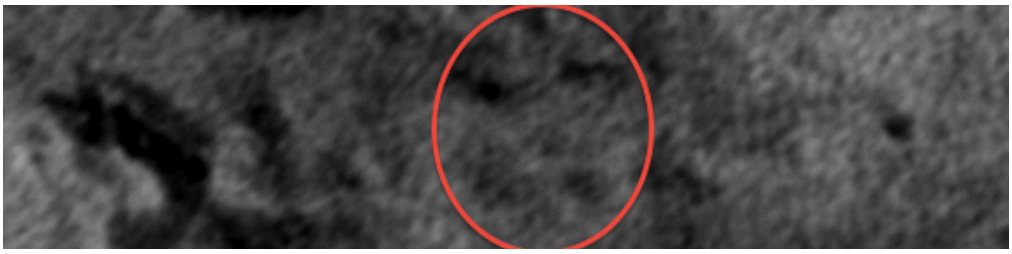

Figure 6. Close up of E.

circle around the Games Dial as the letters of the other games do. Thus the reading of A for the initial letter is extremely likely, if not assured.

To the right of the initial A there is a thick, dark groove. This groove is on an orientation that is the same with respect to the damage above seen in Fig. 2. This is, therefore, very likely to be a part of the area of damage that starts above and continues down into the level of the letters. To the right of this thick, dark groove, one can see the second letter with a right diagonal as well as an apex. Enough of this second letter is preserved in several different slices (see Figs. 3, 4 and 5) to see it cannot be A, Δ, M or N, but only Λ. It too is in the correct orientation for a letter on the arc around the Games Dial.

The third letter consists of one faint vertical hasta that fits between two wider letters, and while a deep groove is not visible in any photo, the outline of an iota, including serifs, is visible in a few slices (see Figs. 3, 4 and 5). Based on spacing (i.e., the need to be a narrow letter) and the outline of a single vertical stroke in some photo slices, I believe the reading of an I is assured.

As for the fourth letter, in a few photo slices, what looks to be the shadowy outline of a N appears. These were the first photo slices I was shown, so this was my first impression (and before I was given the data I spent several weeks of fruitless searching for games that matched the other traces and ended in NIA), but when one looks at all the photo slices, it is clear that this fourth letter is an E, with parts of all strokes visible in some photos, especially the bottom horizontal and lower left corner (see Figs. 6 and 7), and that the seeming diagonal of a N in some photos is

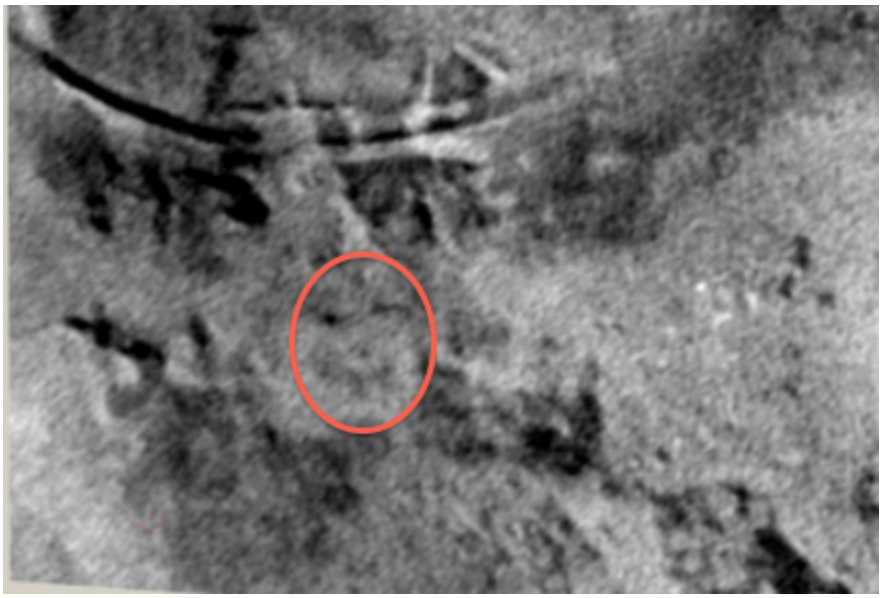

Figure 7. E from another angle.

actually a result of mistaking pieces of the upper left corner, the middle horizontal, and right side of the lower horizontal of the E for the diagonal of a N.

This fourth letter was the key to reading the games, and if I have correctly identified the letter strokes and the damage, epigraphically speaking the reading ΑΛΙΕΙΑ may be given with no dotted letters (see composite drawing, Fig. 1).[7]

In addition to the epigraphical considerations, this reading is strengthened further by the fact that no other games of six letters consistent with the visible traces and ending in EIA are attested in Greek or Roman sources.[8] Finally, the AMRP team sensibly argued that these games were listed in chronological order,[9] since otherwise it would make no sense that the Isthmian games were listed before the Olympia and Pythia.[10] This hypothesis finds strong corroboration by the identification of the Rhodian Halieia, which the Scholiasts to Pindar say ended six days after the Nemean games had finished.[11] Apart from the Scholiasts' testimony that the Halieia were in the same year of the Nemea and shortly after them, from inscriptions we know that the Great Halieia were held every four years (the Greeks referred to this as pentaeteric, or every five years,

7 Based upon my composite drawing of letter traces, I am obligated not to dot any letters (the art of the epigrapher is to distinguish between real letter strokes and damage, make a drawing of the actual letter strokes, and then give a text *according to the drawing*). There is, of course, always the possibility that all the photo slices deceive in their totality, but this seems very unlikely.

8 The only other two attested possibilities that come even close are the Ἰλίεια of Ilion (see Hesychius: Ἰ λ ί ε ι α · ἑορτὴ ἐν Ἰλίῳ Ἀθηνᾶς Ἰλιάδος καὶ πομπὴ καὶ ἀγών). These are attested epigraphically one time (*IG* II^2 3138, end of 4th/beg. of 3rd BC, but see Frisch 1975, p. 130, n. 52 for other references). These, however, appear to have been called the Panathanaia after 306 BC. There are also the Δίεια in honor of Zeus at Tralleis in Karia, which are also attested epigraphically only one time (*SEG* 22.350, l. 28). These, however, have only 5 letters, plus a delta in a position on the Mechanism for which there is no evidence of a lower horizontal where there should be, if this were the correct reading.

9 Freeth, Jones, Steele and Bitsakis 2008, p. 20.

10 The only other likely system for the arrangement is that of having the trieteric games on the inner circle, and the pentaeteric games on the outer circle, but given the Scholiast's information (see note 10), it appears the maker had the games arranged trieterically/pentaeterically and chronologically.

11 The Scholiast to Pindar *Olympian* 7 147c, who was probably relying upon Istros' lost work περὶ τῶν Ἡλίου ἀγώνων (*On the Games of Helios*), says of the Halieia τελεῖται δὲ μηνὸς Γορπιαίου εἰκοστῇ τετάρτῃ ἡμέρᾳ. ἀπέχει δὲ τῶν Νεμέων ἡμέρας ἕξ ("they finished on the 24th day of the month of Gorpiaios, six days from/after the Nemea."). The *Hypothesis to the Nemea* d,e also says of the Nemea: καὶ ἔστι τριετὴς, τελούμενος μηνὶ Πανέμῳ ιη΄ ("they are trieteric, and they finish on the 18th of the month of Panemos"). Most scholars have accepted the authority of these two scholia that the the Halieia finished on the 24th six days after the Nemea had finished on the 18th, but Perlman (1989, pp. 57-60) argued that the word ἀπέχει means "before" rather than its most natural meaning "after", so that the Nemean games finished after the Halieia around the new moon (last day) of Argive Panamos rather than on the 18th of the month, six days before the end of the Halieia. She also ignored another Pindaric scholion that equated Argive Panamos with Julian *Iulius* (Mommsen 1867 *Nem. Hyp.* schol. 1, l. 38: ἤγετο δὲ μηνὶ Πανέμῳ $\overline{\text{ιη}}$, ὅς ἐστιν Ἰούλιος), the month that normally most closely corresponded to Athenian Hekatombaion, and argued instead for late August or even early September (i.e., the season that normally most closely corresponded to the end of Athenian Metageitnion). Perlman's heterodox view is now virtually excluded by the evidence of the Antikythera Mechanism. As for Perlman's contention that the Gorpiaios mentioned here is from the Seleucid calendar, it is more likely it refers to Alexandrian Gorpiaios, since Istros is known to have worked with Kallimachos in Alexandria in the mid third century BC. In the time of the Roman Empire, which is the time when the Scholiast was probably working, Alexandrian Gorpiaios ran from June 25 to July 24, and thus corresponded most closely to Athenian Hekatombaion and Julian *Iulius* (see Samuel 1972, p. 177). My own thorough review of the evidence of the Nemea has concluded that they normally fell in the lunar month coincident with Athenian Hekatombaion (July/August), although there may have been times when they were in the lunar month normally coincident with Athenian Skirophorion (June/July).

because lacking the concept of zero they counted inclusively).[12] In sum, when all this powerful and interlocking evidence is taken together, I believe the reading of Halieia is assured; thus the Games Dial is complete.

Games Dial/Halieiad Dial vs. Olympiad Dial

Naturally, a dial on a Greek time-reckoning device listing athletic games including the Olympia in a four-year period makes one immediately think of Olympiads, the four-year period between Olympic festivals that was a standard means to reckon time in Magna Graecia, but year 1 of an Olympiad in ancient Greek literary sources began with the celebration of the Olympia in even years BC divisible by 4 (200, 196, 192 etc.) and ran until the same time of year in the next year when year 2 of an Olympiad began,[13] whereas on this dial year 1 is beginning sometime between the Halieia of Rhodes (in roughly July of odd years one year before the Olympia such as 201, 197, 193..., if the testimony that they finished six days after the Nemea is reliable, which now seems confirmed by the Mechanism) and the Isthmia at Corinth (in the spring of even years BC) and it is ending with the Olympia, not beginning with them. To put this another way, the Isthmia definitely fell in years 2 and 4 of a traditional Olympiad, not in years 1 and 3,[14] hence the years on this dial cannot refer to the four individual years of an Olympiad.

It therefore appears that this dial does not reference individual Olympiad years in the traditional sense, which is why I prefer to call it the Games Dial, although one could rightly also call it the Halieiad Dial, since it does accurately represent Halieiad years. What other function this four-year period on the Mechanism had is not clear, but it may be that it was somehow used in combination with the 365 holes for the days of a solar year on the front of the Mechanism to achieve a leap-year function.

The Halieia of Rhodes and the Naa of Dodona/Ambrakia

The presence on the Games Dial of the Isthmia at the Isthmos of Corinth, the Olympia of Elis in the Peloponnese, the Nemea of Argos in the Peloponnese, and the Pythia of Delphi in Phokis is

12 See especially *SER*, p. 259, no. 5b (= *IG* XII,1 730), which lists the Halieia as being celebrated under the priests of Apollo Erethimios in years 8, 12, 16, 20, 24 and 28 of the list, thus assuring their pentaeteric cycle (the Halieia that should have appeared under the priest in year 4 was probably cancelled due to war; I would argue this apparently skipped year corresponds to the games of 85 BC at the very end of the First Mithridatic War). It is true that some inscriptions refer to both the Great and Small Halieia: *IK RhodPer* 555, l. 14: [Ἁ]λίεια τὰ μεγάλα καὶ τὰ μικρὰ δίς (mid. of 2nd cent. BC). Numerous other inscriptions mention only the Great Halieia: *Clara Rhodos* 2 (1932) p. 190, no. 19, l. 15 (early 1st cent. BC); *Clara Rhodos* 2 (1932) p. 188, no. 18, l. 16 (1st cent. BC?); *Clara Rhodos* 2 (1932) p. 210, no. 48, l. 4 (*ca.* 100-50 BC); *NSERC*, no. 36 (Roman period); *SER* 5, face b, l.3 (AD 4/5?); *Tit. Cam.* 75 (undated). It is hardly surprising to see the Small Halieia were largely ignored.

13 I have thoroughly reviewed the literary sources, and it is clear that the ancient historians who used Olympiad reckoning and whose works survive in quantifiable amounts (such as Polybios, Diodorus Siculus, and Dionysios of Halikarnassos) began a new Olympiad with the celebration of the Olympia, although they were not always precisely sure when it occurred given the variable nature of Greek luni-solar calendars, and they counted the individual years within an Olympiad by assuming the festival was always roughly at the same time of year (the evidence suggests between the middle and end of summer).

14 Based on a thorough examination of the season of the Nemea, Halieia and Olympia, I would also argue that the Nemea fell at the end of years 1 and 3 of a traditional Olympiad, and that the Halieia fell at the end of year 3. Although the Olympia and Pythia are in the correct Olympiad year, they should be at the beginning of years 1 and 3, not the end. I would also argue that the Naa should be at the beginning of Olympiad year 2, not the end of year 2.

hardly surprising – these were the four most prestigious Panhellenic games of Greco-Roman antiquity. The Halieia of Rhodes and Naa of Dodona in Epeiros, on the other hand, were relatively unimportant games, especially the Naa, so they do require an explanation.

As for the Halieia, 35 of the 37 epigraphical attestations of the spelling Ἁλίειᾰ are found on inscriptions from the island of Rhodes or the Rhodian Peraia.[15] Of the remaining two, one attestation is found at Miletus on the west coast of Asia Minor,[16] and a second copy of this same inscription at nearby Didyma.[17] In sum, if other inscriptions are any guide, any attestation of the spelling Ἁλίεια,[18] with an alpha and two iotas, has a 95% likelihood of coming from Rhodes itself, or in reality a higher percentage when one considers that the one attestation at Miletus and the one at Didyma are on monuments honoring the same athlete. That the Halieia were largely local and regional games for second-tier (or possibly older) athletes is not surprising, given that the games apparently often started just days after the Nemea had ended so there was not enough time for premier athletes to participate in both games in the same year.

The appearance of the Doric form Ἁλίειᾰ coupled with the fact that the Halieia were largely local and regional games, point to some relationship of the Mechanism to Rhodes, and this is especially notable given that the rest of the preserved inscriptions on the Mechanism employ Attic-Ionic forms.[19]

Apart from the Halieia, the other odd set of games on the Games Dial are the Naa. These games are even more obscure than the Halieia, with the spelling Νᾶα attested only once at Dodona,[20] once at Tenos,[21] once at Sikyon,[22] once at Priene,[23] three times at Athens (two of these on a single monument for Menodoros),[24] and two times at Delos (on a single monument, also for

15 *IG* XII,1 57, l. 8 (#1); *IG* XII,1 72a, l. 2 (#2); *IG* XII,1 73, a, l. 3 and b, l. 3 (#s 3, 4); *IG* XII,1, 74, l. 2 (#5); *IG* XII,1 75, b, l.2 (#6); *SER*, p. 259, no. 5b (= *IG* XII,1 730), ll. 9a, 13a, 21a, 26a, and 32a; line 17a has the spelling ΑΛΕΙΑ, and although this spelling is common later, here it is almost certainly an error for Ἁλ<ί>ειᾰ, the spelling elsewhere on this same inscription (#s 7, 8, 9, 10, 11, 12); *IG* XII,1 935, l. 2 (#13, partially restored); *ILindos* 2.322, l. 10 (#14); *ILindos* 2.392, b, l. 8 (#15, partially restored); *ILindos* 2.707, l. 2 (#16); *Tit. Cam.* 63, ll. 22-23 (#17); *Tit. Cam.* 75, l. 6 (#18); *Clara Rhodos* 2.188,18, l. 16 (#19); *Clara Rhodos* 2.190,19, l. 15 (#20); *Clara Rhodos* 2.210,48, l. 4 (#21); *NSERC* no. 18, l. 6 and no. 19, l. 9 and no. 36, l. 4 (#s 22, 23, 24); *SER*, no. 4, face b, l. 3, face b, l. 16, and face c, l. 4 has the spelling ΑΛΙΑ, which is probably an error for Ἁλί<ει>ᾰ as is the spelling elsewhere on this same stone, and nos. 18 and 19 (#s 25, 26, 27, 28, 29); *NSER* p. 125, no. 25, l. 2 (#30); *SEG* 39.759, ll. 5 and 16 (#s 31, 32); *IK RhodPer* 555, l. 14 (#33); *SEG* 43.527, l. 22 (#34); Zimmer and Baïrami, 2008, pp. 149-154, l. 1 (#35). The restoration of [Ἁλίε]ια at *IG* XII,1 1039, l. 2 from the islet of Saros/Saria is not certain (the drawing in *IG* suggests the letter where there should be an E is more consistent with a Σ, yielding perhaps [Πύθια ἐν Μαγνη]σίᾳ, or [Ἀρτεμ(ε)ί]σια, or [Ἡμερά]σια), etc.

16 A. Rehm *et al.* 1958, no. 201, l. 11.

17 Gerkan and Krischen 1928, no. 369, l. 20.

18 There are a three instances of the Attic-Ionic form Ἡλίειᾰ (one at Athens, one at Samos and one at Ios), and several instances of the spelling Ἅλειᾰ both around the Greek world and at Rhodes (which seems to be a later spelling that begins at the end of the first century BC). These alternative spellings are interesting, but for the purpose of this argument they can be ignored since they are not the spelling on the Mechanism.

19 For a history of the Halieia games, see my forthcoming article in *Eulieme: Studies in Classical Archaeology, Epigraphy, Numismatics and Papyrology* scheduled to come out in the fall of 2020.

20 *L'Épire* 586,71.

21 *SEG* 37.709, l. 13.

22 *IG* IV 428, l. 8.

23 Freidrich and Hiller von Gaertringen 1906, no. 234.

24 *Agora* XVIII, C-196, crowns 25 and 28; *SEG* 38.179 (here restored but likely = *IG* II^2 3152+3153), crown X.

the same Athenian Menodoros),[25] and once at Rhodes, where the games are said to be at Ambrakia.[26] There is also the spelling Νάϊα attested one time at Tegea and three times at Messene.[27] Of these 14 attestations, it is important to note that four, or almost 30% of all attestations, are in honor of the same Athenian athlete, Menodoros, who had monuments in his honor that were erected in both Athens and Delos ca. 135-130 BC that included his two Naan victories. The relatively rare attestation of the Naa in our sources suggests that the Mechanism also had some tie to Epeiros.

The Calendar on the Metonic Spiral and Epeiros

A further tie to Epeiros is found on the Metonic Spiral of the Antikythera Mechanism. Before summarizing the results of a comprehensive study of this calendar here,[28] first I want to address the question of whether the calendar on the Mechanism can be that of Syracuse, the home of Archimedes. The evidence clearly indicates that this is not possible, as the months Apo[llonios] (restored but virtually certain and not on the Mechanism),[29] Karneios (not Kraneios as on the Mechanism),[30] Artamitios with a tau (not Artemisios with a sigma as on the Mechanism),[31] Panamos,[32] and Apellaios[33] are attested at Syracuse and its nearby military outpost of Akrai. In addition, the month name Damatrios is attested on an inscription that probably came from the area of Syracuse,[34] which is a month name also found at the Syracusan foundation of Tauromenion, but not on the Mechanism. In addition, I have now read the month name Ἑλώρειος on an inscription from Tauromenion,[35] but this month name probably originated at Syracuse (Syracuse had military fort at its southern border at the mouth of the Heloros river called Heloros, where we are told games called the Helor(e)ia were held,[36] probably as a part of the festival after which the month Heloreios was named). It is thus likely that Tauromenion's calendar, which is fully known (see Table III), came directly from Syracuse, the co-founder of Tauromenion.

25 *IDelos* 1957, crowns 25 and 28.

26 Zimmer and Baïrami 2008, pp. 149-154, lines 10-11, where the inscription reads reads ... Νᾶα ἐν Ἀμ[- - - -]/ [- - - -]ς παγκράτιον..., and the correct supplement is almost certainly Νᾶα ἐν Ἀμ[βρακίαι· -?-] / [. . *ca.* 10. .]ς παγκράτιον. See Iversen 2017, pp. 147-148.

27 *IG* V,2 118, l. 21. The three examples from Messene are as yet unpublished, but will be by Andronike Makres (whom I would like to thank for allowing me to mention them).

28 The fuller article may be found at Iversen 2017.

29 *IMagnesia* 72, line 3.

30 Plutarch, *Nikias* 28.1-2.

31 *SEG* 42.836, line 4 (from Akrai, a dependent of Syracuse).

32 *SEG* 42.833, line 8 (from Akrai).

33 *SEG* 42.832, line 8 and probably *SEG* 42.835, line 6 (from Akrai).

34 *SEG* 47.1462. The provenance of this inscription is in doubt; Manganaro (1997, no. III) originally argued for the area of Syracuse, but later changed his mind (Manganaro 2011 = *BullÉp* 2012.520) and now believes it comes from Halaisa Archonidea. The dating of *SEG* 47.1462, however, by the eponymous *amphipolis* (which is only attested as the eponymous office at Syracuse) and tribal/phratry designations in the form of ordinal numbers on this inscription strongly suggest Syracuse.

35 *IG* XIV 426, col. II, line 5 (I now read Ἑλωρε̣ίου) and Manganaro 1964, pp. 42-52, col. III, l. 30 (read Ἑλ[ωρείου πρ. Διο]γένης).

36 Iversen 2017, pp. 131-134. *Cf.* Hesychius E, 2253: Ἑλώριος ἀγών· τελούμενος ἐπὶ Ἑλώρου ποταμοῦ.

Antikythera Mechanism	*Epirote (Cabanes)*	*Order/Seasons of Epirote (Cabanes)*
Phoinikaios	Kraneios	7 (Aug./Sep.)
Kraneios	Panamos	8 (Sep./Oct.)
Lanotropios	Apellaios	9 (Oct./Nov.)
Machaneus	Machaneus	10 (Nov./Dec.)
Dodekateus	Deudekateus	11 (Dec./Jan.)
Eukleios	Eukleios	12 (Jan./Feb.)
Artemisios	Artemisios	1 (Feb./Mar.)
Psydreus	Psydreus	2 (Mar./Apr.)
Gameilios	Gamilios	3 (Apr./May)
Agrianios	Agrianios	4 (May/June)
Panamos	Phoinikaios	5 (June/July)
Apellaios	Haliotropios	6 (July/Aug.)

Table 2. Comparison of the Mechanism's calendar with Cabanes's reconstruction of the Epirote calendar.

As for other possible homes for the calendar, contrary to the claims of Cabanes,[37] a leading scholar on Epeiros, the calendar on the Mechanism is consistent with all the known available evidence for the Epirote calendar. Here I give the calendar on the Mechanism and the reconstruction of the Epirote calendar by Cabanes side by side. As one can see, Cabanes disrupted the order of the five months in bold, started the calendar with Artemisios rather than Phoinikaios, and assigned the month Phoinikaios to June/July (the month normally coincident with Athenian Skirophorion), and the month Apellaios, in which the Naan games fell, to October/November (the month normally coincident with Athenian Pyanopsion).

The main reasons Cabanes argued for this different starting point, order, and the particular seasons are because he believes that there is evidence at Korkyra. where we know Artemitios comes after Eukleios as it does on the Mechanism, that Eukleios was the 12th month, hence Artemisios the first.[38] He also believes there is another month attested in Epeiros besides the twelve months on the Mechanism (namely the additional month of Haliotropios), which based on its etymology meaning "turning about the sun" should be placed around the time of a solstice.[39] Finally, he believes the Naa games, which are known to have been held in the month of Apellaios,

37 Cabanes 2011, pp. 249-260. See also Cabanes, 2003 = *CIGIME* 2.2, pp. 275-288.

38 *IG* IX,1² 4 798, ll. 50-51: ἐγδανεισάντω / ἐμ μηνὶ Δυωδεκάτωι καὶ Εὐκλείωι τῶι ἐπὶ Ἀριστομένεος (Cabanes reads instead ἐγδανεισάντω / ἐμ μηνὶ δυωδεκάτωι ⟨τῶι⟩ καὶ Εὐκλείωι τῶι ἐπὶ Ἀριστομένεος, turning what is clearly the month Dyodekatos into the ordinal 12th and positing a scribal error by inserting ⟨τῶι⟩).

39 I have inspected the stones or photos of the all the alleged instances of Haliotropios (with two iotas), and the correct reading on these is Lanotropios (as on the Mechanism), or what appears to be a variant (H)alotropios (with only one iota). Thus Lanotropios at *IMagnesia* 46, lines 2-3 (Epidamnos) and *L'Épire*, p. 553, no. 32 (Dodona). There is also (H)alotropios at *IMagnesia* 45, line 2 (Apollonia), as well as at *CIGIME* 2.2 76, line 3 and *CIGIME* 2.2 77, line 3 (both from Bouthrotos). I believe (H)alotropios and Lanotropios are different spellings for essentially the same month (based on two different roots that have a similar meaning), just as Karneios/Kraneios and Dodekateus and Dyodekatos/Deudekateus are.

fell in October/November.[40] Elsewhere I have demonstrated that all these claims are demonstrably wrong, or likely wrong.[41]

The Antikythera Mechanism and the Corinthian Family of Calendars

In Table III I summarize the evidence for months for what I call the Corinthian Family of Calendars. As one can see, apart from mostly minor orthographical differences, there is remarkable consistency in the names of the months attested at Corinth and its colonies in Northwest Greece and the cities of Epeiros, and that these months are consistent with those found on the Antikythera Mechanism. The most economical explanation of this remarkable consistency, with a total of at least 125 individual attestations,[42] is that all the colonies of Corinth in Northwest Greece retained the calendar of Corinth with very few changes, which was the same or very similar to that on the Antikythera Mechanism.[43]

The evidence from Epirote cities is also quite consistent with the calendar on the Mechanism. The simplest explanation for this is to posit that at some point the Epirote Confederacy as a whole required that its member states adopt a fairly uniform calendar,[44] and that calendar belonged to a city that was originally a colony of Corinth that had retained the Corinthian calendar.

The Likely Candidates for the Calendar on the Metonic Spiral

As for which cities could be the home of the calendar on the Metonic Spiral on this list, as we have already seen the calendar of Syracuse and its colonies in Sicily, can now be eliminated. Of those left in Table III, significant deviations from the Mechanism are found in the months of Alotropios at Bouthrotos and Apollonia instead of Lanotropios, and the apparent form Δυωδέκατος/Δευδέκατος at both Korkyra and Apollonia rather than the third declension form Δωδεκατεύς. All these places have direct ties to Korkyra, and so it seems likely that Korkyra and its colonies can be eliminated as homes for the calendar on the Mechanism.

Of the remaining candidates for the calendar of the Mechanism, the most likely are Corinth, Ambrakia, Dodona, and Epidamnos. If the Mechanism was built after the destruction of Corinth by Lucius Mummius in 146 BC, which is still an open question but seems likely to me,[45] then

40 The evidence that the Naa games fell in October/November rests upon a demonstrably wrong argument made long ago by Klee 1918, pp. 54-55.

41 See Iversen 2017, pp. 149-159. Daux 1956 also argued that a month of Datyios is attested at Dodona at *L'Épire*, p. 534, no. 1, line 19. For a good photo, see the *editio princeps* of Evangelidis 1956, p. 2. I argue instead that this was a man's name.

42 The data concerning the number of attestations are a bit skewed due to the 74 attestations of months at Bouthrotos alone, but nevertheless the remainder are an impressive amount of evidence.

43 That it was not unusual for colonies to retain the calendar of their mother city is demonstrated by Olbia, which clearly kept the entire calendar of its mother city, Miletos. See *SEG* 30.977 and 53.788.

44 The inscription published by Tziafalias and Helly 2007, ll. 57-83 (= *SEG* 57.510) suggests that the (post 167 BC) Koinon of the Molossoi possessed a common calendar, which was probably the same as the earlier Epirote calendar.

45 Carman and Evans 2014, Freeth 2014 and Jones 2020 have all persuasively argued the Saros Eclipse Dial has a start-up date of April 29, 205 BC. It appears the designer deliberately picked this date because the sun and moon were both very close to their apogees at this month's full moon. As Alexander Jones has pointed out to me, this does not happen very often (the full moon on May 12, 205 BC is a better candidate than that of May 12, 91 BC or May 12

Mainland/Northwestern Greece

Corinthian-Epirote

Antikythera	*Corinth*	*Ambrakia*	*Charadros*	*Dodona*	*Gitana*	*Byllis*	*Epidamnos*
Φοινικαῖος	Φοινικαῖος	Φοινικαῖος	Φοινικαῖος	Φοινικαῖος			
Κρανεῖος							
Λανοτρόπιος				Λανο[τ]ρόπιος			
Μαχανεύς AB[46]							Μαχανεύς
Δωδεκατεύς							
Εὔκλειος				Εὔκλειος			
Ἀρτεμίσιος		Ἀρτεμίσιος	Ἀρτεμίσιος				
Ψυδρεύς		Ψυδρεύς	Ψυδρεύς			Ψυδρεύς	
Γαμείλιος	Γαμίλιος?[47]			Γαμίλιος	Γαμίλιος		
Ἀγριάνιος	Ἀγριάνιος?[48]						
Πάναμος	Πάναμος		Πάναμος	Πάναμος			Πάναμος
Ἀπελλαῖος				Ἀπελλαῖος			Ἀπελλαῖος
Intercalated month							ἐμβόλιμος[49]

72 BC; it is not until the full moon of May 11, AD 308 that another good candidate comes along). Hence, I am (still) of the opinion that the Mechanism was designed within a generation of the Antikythera shipwreck (which sank ca. 70-50 BC), almost surely on Rhodes now that I have deciphered the Halieia on the Games Dial.

46 The intercalation on the Mechanism has now been read at Μαχανεύς in year 11 by various members of the AMRP, including me.

47 I agree with N. F. Jones (1980, pp. 165-177 and 1998) that *SEG* 30.990 (found on Delos) is likely to come from Corinth, or, as Cabanes and Ceka suggest (*CIGIME* 1.2.2.A, pp. 50-51), from Ambrakia. See also *SEG* 56.948.

48 [Ἀγ]/ριᾳ̣ν̣[ίō] may possibly appear on Corinth MF-1975-86, a sacred calendar inscribed on lead found on Corinth's Temple Hill that will soon be published by me in Hesperia (probably first issue of 2021) in an article of unpublished inscriptions from Corinth's Temple Hill. The only other likely supplements are [- - τ]ρίᾳ .[- -] or [- - τ]ριᾳ̣κ̣[άδι].

49 We do not know after which month the intercalary month was inserted at Epidamnos.

Mainland/Northwestern Greece				*Sicily*		
Korkyraian			*Uncertain* ← ? →	*Syracusan*		
Korkyra	*Bouthrotos*	*Apollonia*	*Issa*	*Syracuse*	*Akrai*	*Tauromenion*
Φοινικαῖος	Φοινικαῖος					Ἰτώνιος
	Κρανεῖος Κρανῆος	Κρα[νεῖος]		Καρνεῖος		Καρνεῖος
	Ἀλοτρόπιος	Ἀλοτρόπιος				Λανοτρό[πιος]
Μαχανεύς			Μα[χανεύς]?[50]	Ἀπο[λλώνιος]		Ἀπολλώνιος
Δυωδέκατος		Δευδέκατος				Δυοδεκατεύς
Εὔκλειος	Εὔκλειος Εὔκληος Εὐκλήιος					Εὔκλειος
Ἀρτεμίτιος			Ἀρτεμίτιος		Ἀρτεμίτιος	Ἀρτε[μίτιος]
Ψυδρεύς	Ψυδρεύς	Ψυδρεύς				Διονύσιος
	Γαμείλιος Γαμίλιος			[Ἑ]λώρειος		Ἑλώρειος
	Ἀγριάνιος			Δαμάτριος		Δαμάτριος
Πάναμος	Πάναμος	Πάναμος			Πάναμος	Πάναμος
Ἀπελλαῖος	Ἀπελλαῖος	Ἀπελλαῖος			Ἀπελλαῖος	Ἀπελλαῖος
	ἐμβόλιμος[51]					Ἀπελλαῖος β΄

50 If the Μα[- - -] preserved on J. Brunšmid 1898, no. 2-14, column I, l. 1. refers to the month Machaneus, it appears that Issa took the form of the Corinthian calendar that was in use by its closer cousins in NW Greece.

51 We do not know after which month the intercalary month was inserted at Bouthrotos.

Corinth could also be excluded. Of these, Ambrakia is the only one with the spelling Ἀρτεμίσιος (attested on an inscription dating to 167 BC[52]), rather than the expected Doric tau.[53] In addition, Ambrakia and Dodona are attractive candidates since the Mechanism mentions the Naan games, which as we saw based on the sparse number of attestations seem to have been a relatively minor set of games. I would, therefore, argue that the Epirote calendar, as represented by Dodona and Ambrakia, is the most likely candidate for the calendar on the Metonic Spiral of the Antikythera Mechanism.

The Antikythera Mechanism, Rhodes, and Epeiros

In the foregoing discussion I have shown that the missing games in year 4 on the Games Dial were the relatively minor Halieia of Rhodes, and that the calendar on the Metonic Spiral cannot be the calendar of Syracuse, but that it is consistent with the known evidence concerning the calendars of Ambrakia and Dodona of Epeiros, both associated with the very minor Naan Games, which also appear on the Games Dial. It would appear, therefore, that the Mechanism had some connection with both Rhodes and Epeiros. How to explain this?

It is clear that the Antikythera Mechanism is the product of an astronomical and philosophical tradition that developed or was wedded to a tradition of manufacturing such devices. Rhodes was one of the few places where similar devices are attested as having been manufactured (and most of the earliest evidence that concerns itself with this kind of astronomical device is connected with Rhodes in the first century BC, right around the time of the shipwreck, which is not likely to be mere coincidence). I would thus agree with those who have argued that the Mechanism was manufactured on Rhodes (and the reading of the Halieia is the first evidence found on the Mechanism itself supporting the association),[54] but I would add the qualification that it was probably made for a client or recipient who came from Epeiros. Whether this owner or someone to whom it came into possession was on the boat when it sank, or the device was being transported for an owner in Epeiros as a stop-off point on the probable journey to Rome is impossible to know.

I would further suggest that the Ur-Mechanism may have been designed for the Rhodian calendar, and the Metonic Spiral was merely adjusted by having the names of the Epirote months substituted for the Rhodian. The odd rotation of the Games Dial *ca.* 8° counter clockwise, or roughly one lunar month, may have also been made as an elegant adjustment for the one month difference in starting points of the Rhodian and Epirote calendars.[55]

52 *SEG* 35.665/1845, Block B, l. 23.

53 Apart from the ubiquitous attestations of Ἀρτεμίσιος in the Macedonian calendar, the spelling Ἀρτεμίσιος is only attested at Dorian Thera on an inscription that otherwise employs some Doric forms (*IG* XII,3 436, date unknown). It is also found on an inscription from Astypalaia (*IG* XII,3 172, ll. 101-102), but this inscription dates to the Roman period and employs the koine.

54 Price 1974, pp. 13 and 56; Iversen 2017, p. 159; Jones 2017, pp. 93-94; Jones 2020, section 7. Although in the first century BC Rhodes clearly attracted a circle of people interested in modeling the heavens in such a way, I would hesitate to ascribe it directly to the workshop of Poseidonios, who is known to have made a similar device on Rhodes around the time of the shipwreck (Cicero *De natura deorum* 2.88, published in 45 BC, but set in the 70s BC).

55 For the seasons of the months of the Rhodian calendar, particularly that the first month of the Rhodian bouleutic year, Karneios, usually began with the first month after the autumn equinox, see forthcoming article by me in *Eulieme: Studies in Classical Archaeology, Epigraphy, Numismatics and Papyrology* scheduled to come out in the fall of 2020. Also see Jones 2020, section 7.

Apart from the direct tie to Rhodes via the reading of the Halieia, further evidence that the Mechanism may be of Rhodian origin comes from the back plate inscription, which refers to the planets as Ἀφροδίτη Φώσφορος, Ἄρης Πυρόεις, and probably Ζεὺς Φαέθων.[56] While these were common names for the planets (usually one or the other names were used, not both), still it is remarkable that the closest epigraphical parallel occurs on the famous "Keskinto" astronomical inscription from Rhodes.[57] This inscription is also noteworthy, because although found on Rhodes, it employs Attic-Ionic forms (the only inscription in Attic-Ionic on Rhodes that I can find), as do the writings of other astronomers who worked on Rhodes. Thus the fact that Attic-Ionic forms are found on the Mechanism is no barrier to arguing it was manufactured on Rhodes, where astronomers used the universally recognized Attic-Ionic dialect of science. In addition, the Rhodians had been allies of Persia until they went over to Alexander the Great during or just after the siege of Tyre in the spring and summer of 332 BC.[58] As such, doubtless there were those on the island who would have known Persian, and given its closer proximity to the east possibly could have come into contact with the Babylonian astronomical records that fell under Persian and then Makedonian control, which would have been extremely helpful for constructing the Saros Dial. In addition, the palaeography of the inscriptions, while on a unique medium, nevertheless is consistent with lettering found on inscriptions from Rhodes dating to the end of the third to the middle of the first centuries BC.

Since the palaeography of the inscriptions has been cited so authoritatively to defend this or that date, it is particularly important to address this issue carefully. Kritzas (as reported in T. Freeth, Y. Bitsakis *et al.* "Decoding the Ancient Greek Astronomical Calculator Known as the Antikythera Mechanism," *Nature* 44, November 2006, Supplementary Information, p. 7) believes "the style of writing could date the inscriptions to the second half of the 2nd Century BC and the beginning of the 1st Century BC, *with an uncertainty of about one generation (50 years)*" [italics mine].

This statement has been interpreted by some to mean the writing dates definitively to *ca.* 150-100 BC (perhaps to tie it to Hipparchus), but Kritzas's analysis actually suggests a window of *ca.* 200-50 BC, with which I would largely concur (and just to be clear, I would add that my *circa* includes an uncertainty around the edges, so it could conceivably be even a little earlier than 200 BC and a little later than 50 BC).

The letters Kritzas used to come to this conclusion are Π (with shorter right leg), Σ (with the two horizontal hastae not parallel), M (with the two side strokes not vertical, but at an angle), Y (with a short vertical line), Z for zeta rather than Z, Ω for omega rather than Ω, B with uneven circles (the upper smaller than the lower), a very small O (omicron), Θ (theta with short line in the middle rather than a dot), Φ (with arc-like shape), and four-bar xi (Ŧ).

Crowther (in Freeth 2014, Note S2) also accepts these letters for his stylistic criteria but argues instead that "It seems better, accordingly, to widen the palaeographical dating range for the Antikythera inscriptions to the end of the third to the beginning of the first century BC, *with a preference for the earlier half of this period*" [my italics], or in other words Crowther favors a

56 Freeth and Jones 2012.

57 *IG* XII,1 913 = Jones, 2006.

58 Arrian 2.24.5 says the siege of Tyre ended in Athenian Hekatombaion after seven months (Curtius is the only source that claims it took only six months). Arrian (2.220.3) also says that the Rhodians sent 9 triremes during the siege, probably around May of 332. Justin/Trogus (11.10) and Curtius (4.5.9), on the other hand, say Rhodes came over to Alexander immediately after Tyre was taken, and thus after July/August of 332. Curtius' wording is especially pointed: *Sed Rhodii urbem suam portusque debebant Alexandro.* The imperfect tense seems to be inceptive.

date *ca.* 210-150 BC rather than *ca.* 150-100 BC and apparently eliminates *ca.* 75-50 BC, the time of the shipwreck. Again, this critical move is undoubtedly made to cover the apparent start-up date of the Saros Eclipse Prediction Dial in 205 BC (and perhaps also to move it closer in time to Archimedes).

Moreover, Crowther goes on to single out parallels found on stone at Corinth to bolster his preference for an earlier date,[59] saying their lettering "is reminiscent of lettering on bronze, which seems to have been the regular medium for texts of this kind at Corinth." The irony here is that all the examples that Crowther cites as "Corinthian inscriptions" were certainly not, or almost certainly not, inscribed at Corinth, they were only found there. Crowther's most important example (Robertson 1976), for instance, employs the very peculiar and easily recognizable Elean dialect and was certainly inscribed at Elis, while the other examples cited employ the non-Doric koine and are probably dikastic decrees of foreign origin. Furthermore, no bronze examples of decrees or any other kind of document on bronze have been found at Corinth, nor do we have any literary references to a bronze-inscribing tradition at Corinth (making bronze yes, inscribing on bronze, no), making such claims very speculative.[60]

It is also worth testing these dating criteria with actual examples. In what follows I will compare what is claimed about the dating of these letter forms with Rhodian inscriptions that are securely dated to the first half of the first century BC, both because the chronology of Rhodian inscriptions of this era is quite secure, and to provide an example of how shaky these stylistic criteria are (and of course also to show that palaeographically that the Mechanism could also have been inscribed at Rhodes, the home of the Halieia, in the first half of the first century BC around the time of the shipwreck).

For instance, one can compare *IG* XII,1 730 (= *SER* p. 259, no. 5b), which I would argue covers the priests of Apollo Erethimios for the years 89/8 to 62/1 BC (certainly based on quite strong prosopograhical evidence it dates somewhere in the first half of the first century BC).[61] This inscription has pi with a shorter right leg (claimed to belong to the second half of the 2nd century BC), some sigmas without parallel horizontals (claimed to belong to the second half of second century BC, beginning of first),[62] short vertical for upsilon (claimed to belong to the second half of the second century BC), omega as Ω and not ω (claimed to belong to the second century BC), beta with smaller upper circle (claimed to be "old"), an arc-like phi (claimed to be "old"), and even a four-bar xi (Ξ) one time in line 9 (also claimed to be "old").

On another inscription (*ILindos* 2.334, which is dated securely on prosopographical grounds to around 50 BC), there is mu with side hastae that are not completely vertical (claimed to the second century BC), theta with short line (claimed to belong to the second century BC), a rela-

59 Crowther cites and gives a photo of a squeeze of Robertson 1976; he also cites *Corinth* VIII.3 46a-b (and here I will follow Robertson 1976, p. 257, n. 5 in arguing that fragment 46a while similar, belongs to another inscription); and the fragment I-77-13, which joins to *Corinth* VIII.3 46b and is to be published by me.

60 Crowther seems to be alluding to the hypothesis that Corinth's paucity of inscribed material on stone can be explained by positing that it had a rich tradition of inscribing on bronze presumably all lost to recycling. On why this thesis is unlikely to explain Corinth's dearth of inscribed material, see Dow 1942, pp. 113-119, especially p. 116 and a forthcoming article by me in *Hesperia* (probably in the first issue of 2021) on some unpublished inscriptions found on Corinth's Temple Hill.

61 For a good facsimile of this inscription, see Hiller von Gaertringen 1894, p. 18. For my new date of this inscription, see my forthcoming article in *Eulieme: Studies in Classical Archaeology, Epigraphy, Numismatics and Papyrology* scheduled to come out in the fall of 2020.

62 A better example of sigma can be found at *ILindos* 295, dated securely to, or shortly after 85/4 BC, when Damatrios (son of Aristogenes) was priest of Athena Lindia.

tively smaller omicron (claimed to be "old"), as well as pi with shorter right leg, upsilon with a short vertical hasta, the Ω shape, and probably also four-bar xi (but the stone is broken at the top and a bit to the left of the letter in col. I, line 1 to make the reading somewhat uncertain, although context-wise it is virtually certain it must be a xi, and the visible remnants strongly favor the four-bar xi).

It should be noted here that Crowther's (Freeth 2014, Note S2) preference for the earlier dating relies heavily upon the form Z for zeta. This form is found on Rhodes at *ILindos* 2.309 and 2.311, both securely dated to, or shortly after, Zenodotos' priesthood of Athena Lindia in 64/3 BC. Also on these two inscriptions the arc-like phi, upsilon with a short vertical, mu with two lines at an angle, and Ω-shaped omega also appear.

In short, all the letter forms that are claimed by both Kritzas and Crowther as belonging to the end of the third century to the beginning of the first are found on Rhodian inscriptions not only in those years, but also as late as *ca.* 50 BC. I would go even further and say that in my opinion, the only letter form that clearly suggests a preference for the earlier dating in Rhodian epigraphy is four-bar xi (Ǝ), but this is thus far only attested on the numerals (which tend to be more conservative) on the Front Cover Inscription of the Mechanism. Even so, as we saw above this older xi is attested on stone at Rhodes as late as ca. 89/8 - 63/2 BC at Hiller 1894, line 9, and probably also as late as about 50 BC at *ILindos* 2.334, col. I, line 1.

This older xi on the Mechanism, however, is perhaps offset by the cursive omega now identified on the Back Plate Inscription[63] and the glyph-monogram for ὥρ(α), ⳩, that is composed of a ω-shaped omega crossed by a rho. This digraph, which is ignored by Kritzas and Crowther, is first found on papyri of the first century of our era or later. Furthermore, ω-shaped omega does not appear regularly on Greek inscriptions until the late first century BC and later,[64] although it becomes the regular form on papyri by the third century BC.[65] Another letter shape only suggested by Gregg Schwendner after 2014 and confirmed by Iversen and Jones in 2019 (p. 487) is the hooked-alpha, ⲁ, for which there are examples that appear on papyri from the late 3rd century to the middle of the first century BC.

Finally, there is the form ⊏ for stigma. As Jannaris (1907) notes, the symbol ⊏ for stigma probably originated in Alexandria in the first half of the third century BC where it is found on papyri. From here it spread to other Greek centers, where the evidence suggests it was first adopted in the first century BC.[66] The earliest inscribed example I have been able to find is found on an odd inscription found during construction of a new road between Yatağan and Milas on the south side of Stratonikeia (Karia) in front of the large nymphaeum there.[67] This inscription

63 See Iversen and Jones 2019, pp. 486-488.

64 A few rare earlier examples can be found on stone. For instance, Lougovaya 2015, 113 reports that *SEG* LIX 1767B (= Lougovaya 2015, 108, B), which comes from Ptolemaic Narmouthis (Egypt) and dates sometime from 117 to 115 BC, has a cursive omega in line 3, as well as cursive forms for pi and mu more typically found on papyri, mixed in with non-cursive forms. *SEG* LIV 1568, which is from Alexandria Arachosia and dates to the late second-century BC, also reports a cursive omega. Examples of cursive omegas on stamped bricks that date to the 20th and 33rd year of the reign of Attalos I (222/1 and 209/8 BC) can be found at Pergamon (*I. Pergamon* II, nos. 689-691).

65 For a useful chart of the development of letter shapes on papyri, see Kenyon 1899, p. 161.

66 Some inscribed examples include *CIG* 2655 = *RIG* 877 = *Syll.*[3] 1020, line 29 (from Halikarnassos, dating to the first century BC); *IG* X.2,1 97, line 1 (from Thessalonike, erroneously corrected to ⟨Ε⟩ by Edson, dating 23/2 BC); *CIG* 1970 = *IG* X.2,1 526 (from Thessalonike, dating to AD 154/5 with Edson's misreading as zeta corrected by Daux, 1973, p. 593, no. 526).

67 See Şahin 2005, col. II,C = *IK Stratonikeia* 1508 = van Breman 2001 = *SEG* LXII 852.

lists those who have paid money that appears to have given them access to something "day and night" (τοῖς ἔχουσι τὰ *nomen patronym ethnicum* δεδωκότος (δρ.) -΄· ἡμέρα καὶ νύξ). It is noteworthy that many of these contributors came from Rhodes, which controlled the area of Stratonikeia at some point in the third century BC before they lost it to Makedonian control, after which they regained it after the Battle of Kynos Kephalai in 197 and held it until the Battle of Pydna in 168 BC, which concluded the Third Makedonian War, after which the Stratonikeians along with all of Karia were declared autonomous by the Roman Senate (but apparently the Rhodians continued to maintain a significant presence there).[68] R. van Breman dates it ca. 81 BC based on lettering that is very similar to *IK Stratonikeia* 505 (= *SEG* LII 1059), a Roman *Senatus Consultum* dating to 81 BC found at Lagina, which was under Stratonikeian control. She also suggests the block was built into the nymphaeum and that those who contributed to its construction had access rights to the water "day and night." At the end of this inscription (col. II,C), it appears more limited access rights on certain dates were given for those who lived outside the gates and did not contribute:

τοῖς ἔξω πυλῶν Ἀρτεμεισι-
ῶνος *vac.* η΄ *vac.* ϛι΄ *vac.* ζκ΄
Ἑκατησιῶνος β΄ *vac.* ι΄ *vac.* ηι΄ εκ΄
Διοσθεῶνος ε΄ *vac.* γι΄ *vac.* ακ΄ προτ(ριακάδι)[69]

As van Breman notes, to all appearances, this calendar seems to have employed the backward count of days in the last decade of the month between the 21st and the τριακάς; thus the days are Ἀρτεμεισιών 8, 16, 24, Ἑκατησιών 2, 10, 18, 26, and Διοσθεών 5, 13, 21, 29. Since all these dates are 8 days apart (assuming Ἀρτεμεισιών was a full month of 30 days and Ἑκατησιών was a hollow month of 29 days), it seems most likely that these months were consecutive, and possibly tied to water rights during the prime growing season in the spring. In any case, the separation of 8 days guarantees that ⊏I = ϛι΄ = 16, not EI = ει΄ = 15 as previous editors have supposed, a letter form found near in time to the Antikythera Shipwreck ca. 70-60 BC in a context that involved Rhodians.

Thus the Mechanism displays several letter forms found on stone and papyri that could date anytime from the late 3rd century to the middle of the first century BC, although the stigma is a special symbol thus far found outside of Alexandria on inscriptions dating from the first century BC (with one early example around 81 BC within the historic Rhodian Peraia), while the glyph-monogram for ὥρ(α) has thus far been found only on papyri beginning in the first century AD.

I have engaged in this exercise not only to demonstrate that the Mechanism could have been inscribed on Rhodes in the first half of the first century BC around the time of the shipwreck, but more importantly to show that pronouncements about dating by letter-style must be used with extreme caution and skepticism. The reality is that one can cherry-pick examples from just about anywhere in the Greek world to bolster an argument that relies upon letter style. In the end, it is extremely common for inscriptions to have mixed letter-forms in all periods (often even the same letter is inscribed in two different ways such as xi on Hiller 1894). In fact, many are the instances of dating of inscriptions by letter style (as opposed to individual inscribers'

68 See Livy 33.18; 33.30.10.

69 van Breman (2011) with help from P. Thonemann correctly identified the monogram at the end of the line as standing for προτριακάς (she read ΠΤΡ for π(ρο)τρ(ιακάδι)), but the photo in Şahin 2005 indicates clearly ΠΡ are in ligature with the top horizontal of Π extending far to the right with an O at its tip and a T underneath, thus προτ(ριακάδι).

hands such as the work Stephen V. Tracy does) that later were shown to be wildly off by a century or more,[70] and unless further securely dated examples of such tiny writing on bronze (where the inscriber used a burin and not a chisel) can be found, which is surely responsible for the necessity of having flaring-shaped letters that are more in keeping with smaller letters typically found before 150 BC, the most that can reliably be said is that the writing dates from the end of the third to the middle of the first century BC, and that it could have been inscribed just about anywhere in the Greek world.

The palaeography, therefore, is not a very helpful argument and must be combined with other evidence. To my mind, the appearance of the Halieia (with the spelling Ἁλίεια which is found almost exclusively on Rhodes and the Rhodian Peraia), combined with Rhodian material being on the ship, combined with the date of the shipwreck as being *ca.* 60 BC, combined with the likelihood that such a mechanism had a limited working life of about 30 years (according to Michael Wright), combined with the closest parallel interest in the astronomical theories modeled by the Mechanism being attested at Rhodes in the first century BC (i.e., Geminus, Book 8), combined with the earliest and closest literary parallel for such a device being built at Rhodes in the first half of the first century BC right around the time of the shipwreck (i.e., Poseidonios' *spheara*),[71] combined with the known tradition of the astronomers at Rhodes writing in the Attic-Ionic dialect (Hipparchus and Geminus),[72] combined with the closest parallel to the planet names on the Mechanism being found on an astronomical inscription from Rhodes that employs the Attic-Ionic dialect, combined with the evidence that the palaeography writing could come from the first half of the first century BC on Rhodes – all these in my mind outweigh any other current known evidence (such as the apparent start-up date for the Saros Dial in 205 BC that was evidently chosen because it was the best example of when the sun and moon were both close to their apogee at a full moon) to make the first half of the first century BC on Rhodes the most likely, if not the most attractive, candidate.

Finally, it has recently been argued, including by James Evans, the *honorandus* of this tome,[73] that the astronomical events on the Parapegma of the Antikythera Mechanism work best for latitudes in the range 33.3°N – 37.0°N. This range is too low for Epeiros, but does work for Rhodes, the northern tip of which sits at about 36.4°N.

Abbreviations

Agora XVIII = D. J. Geagan, *The Athenian Agora: Results of Excavations Conducted by the American School of American Studies at Athens*, vol. XVIII, *Inscriptions: The Dedicatory Monuments*, Princeton 2011.

BE = *Bulletin épigraphique* (Paris 1888-).

CIG = A. Boeckh and J. Franz, eds. *Corpus Inscriptionum Graecarum*, 4 vols. (1828-1877).

70 See for instance Iversen 2010. Based on the letter-forms, it was assumed this inscription (Corinth I 2649) dated before the destruction of Corinth in 146 BC (see Anderson 1967, p. 11), but the inscription was almost certainly inscribed at Athens and dates AD 165/6 to 168/9, or more than 300 years later than was first believed based on letter forms.

71 Cicero *De natura deorum* 2.88, published in 45 BC, but set in the 70s BC. The references to Archimedes' sphere (including in this passage) actually first appear in texts of the first century BC and look suspiciously anachronistic.

72 Note that Archimedes was famous for using his beloved Doric dialect.

73 M. Anastasiou, J. Seiradakis, J. Evans, S. Drogou and K. Efstathiou 2013.

CIGIME 1.2.2A = P. Cabanes and N. Ceka, eds., *Corpus des inscriptions grecques d'Illyrie méridionale et d'Épire, Inscriptions d'Apollonia d'Illyrie*, Athens 1997.
CIGIME 2.2 = P. Cabanes, and F. Drini, eds., *Corpus des inscriptions grecques d'Illyrie méridionale et d'Épire*, *Inscriptions de Bouthrôtos*, Athens 2007.
Clara Rhodos 2 = G. Jacopi, "Nuove epigrafi dalle Sporadi meridionali," *Clara Rhodos* 2 (Rhodes 1932), pp. 165-256.
Corinth VIII,3 J.H. Kent, ed., *The Inscriptions, 1926-1950*, Princeton, 1966.
IDelos = Inscriptions de Délos, Paris, 1926-1972.
IG = Inscriptiones Graecae. Berlin.
II^2 J. Kirchner, ed., *Inscriptiones Atticae Euclidis anno posteriores*, 2nd ed., Part II, 1-2, 1927-1931.
IV M. Fraenkel, ed., *Inscriptiones graecae Aeginae, Pityonesi, Cecryphaliae, Argolidis. Corpus Inscriptionum graecarum Peloponnesi et insularum vicinarum* 1, 1902.
V,2 F. Hiller von Gaertringen, ed., *Inscriptiones Arcadiae*, 1913.
IX,1^2 1 G. Klaffenbach, ed., *Inscriptiones Aetoliae*, 1932.
IX,1^2 4 K. Hallof, ed., *Inscriptiones insularum maris Ionii*, 2001.
X.2,1 = Ch. Edson, ed. *Inscriptiones Thessalonicae et viciniae*, 1972.
XII,1 F. Hiller von Gaertringen, ed., *Inscriptiones insularum maris Aegaei praeter Delum, fasc. 1. Inscriptiones Rhodi, Chalces, Carpathi cum Saro, Casi*, 1895.
XII,3 F. Hiller von Gaertringen, ed., *Inscriptiones insularum maris Aegaei praeter Delum, 3. Inscriptiones Symes, Teutlussae, Teli, Nisyri, Astypalaeae, Anaphes, Therae et Therasiae, Pholegandri, Meli, Cimoli*, 1898.
XIV G. Kaibel, ed., *Inscriptiones Siciliae et Italiae, additis Galliae, Hispaniae, Britanniae, Germaniae inscriptionibus*, 1890.
IK = Inschriften griechischer Städte aus Kleinasien. Bonn.
Iasos W. Blümel, ed., *Die Inschriften von Iasos*, 2 vols., (1985).
RhodPer W. Blümel, ed., *Die Inschriften der rhodischen Peraia* (1991).
Stratonikeia = M. C. Şahin, ed. *Die Inschriften von Stratonikeia*, 4 vols. (1981-2010).
ILindos = Ch. Blinkenberg, *Lindos. Fouilles et recherches, 1902-1914*, vol. II, *Inscriptions,* 2 tomes (Copenhagen and Berlin 1941).
IMagnesia = O. Kern, ed. *Die Inschriften von Magnesia am Maeander*, Berlin, 1900.
I. Pergamon II = M. Fränkel, E. Fabricius, C. Schuchhardt, *Die Inschriften von Pergamon*, vol.. II, *Römische Zeit - Inschriften aus Thon*, Berlin, 1895.
L'Épire = P. Cabanes, *L'Épire de la mort de Pyrrhos à la conquête romaine (272-167 av. J.C.).* Centre de Recherches d'Histoire Ancienne 19. Paris, 1976.
NSER = G. Pugliese Carratelli, "Nuovo supplemento epigrafico rodio," *ASAtene* 33-34 (1955-1956), pp. 157-181.
NSERC = A. Maiuri, *Nuova silloge epigraphica di Rodi e Cos* (Firenze 1925).
RIG = Ch. Michel, ed. *Recueil d'inscriptions grecques* (1900).
SEG = Supplementum Epigraphicum Graecum (Leiden 1923-).
SER = G. Pugliese Carratelli, "Supplemento epigrafico rodio," *ASAtene* 14-16 (1952-1954), pp. 247-316.
Syll.^{3} = W. Dittenberger, ed. *Sylloge Inscriptionum Graecarum*, third edition, 3 vols. (1915-1920).
Tit. Cam. = M. Segre and G. Pugliese Carratelli, "Tituli Camirenses," *ASAtene* 27-29, N.S. 11-13, (1949-1951), pp. 141-318.

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