Supporting Information

Baikouzis and Magnasco 10.1073/pnas.0803317105

SI Discussion

About the Pleiades and Boötes, from Hesiod's *Work and Days*. The stars were not just used for navigation but also as an agricultural calendar, as evidenced by the references to their heliacal and achronical risings and settings in *Work and Days*. Care must be exercised, because Hesiod does not overtly state whether the rising and setting described is the morning one or the evening one. The Pleiades would have their last evening visibility (heliacal setting, last setting in evening twilight) briefly after the vernal equinox; they would then stay totally invisible during ≈44 days (depending on latitude) and have their first morning visibility (first rising in morning twilight) in mid-spring. Their achronical rising (last observable rising in the evening, after which they are visible in the sky after sunset) would happen just before the autumn equinox, and their cosmical setting (first observable setting in morning twilight) would happen in November.

First note that Hesiod clearly understood the year to end at the vernal equinox:

> [560] for the helpful nights are long. **Observe all this until the year is ended and you have nights and days of equal length**, and Earth, the mother of all, bears again her various fruit.

As we have discussed in the text, the heliacal (evening) setting of the Pleiades (which happens roughly at the same time as the Hyades and Orion) is about the time of the vernal equinox. The heliacal setting of the Pleiades, after which they are invisible for over a month, is also referred to in two other passages:

> When the Pleiades, daughters of Atlas, are rising, begin your harvest, and your ploughing when they are going to set. [385] **Forty nights and days they are hidden and appear again as the year moves round**, when first you sharpen your sickle.
>
> But if desire for uncomfortable sea-faring seize you when the Pleiades plunge into the misty sea [620] to escape Orion's rude strength, then truly gales of all kinds rage.

εἰ δέ σε ναυτιλίης δμσπεμφέλου ἵμερος αἱρεῖ, εὖτ' ἄν Πληιάδες σθένος ὀβριμου Ὠαρίωνος φεύγουσαι πίπτωσιν ἐς ἠεροειδέα πόντου, δὴ τότε παντοίων ἀνέμων θυίουσιν ἀῆται: (618–621)

Arcturus, the brightest star in Boötes, first rises before sunset (thus invisibly) at the end of February (the apparent achronical rising). Because during this time it also sets after sunrise, it is neither seen to rise nor to set:

> When Zeus has finished [565] sixty wintry days after the solstice, then the star Arcturus leaves the holy stream of Ocean and first rises brilliant at dusk.

There are minor corrections of one or two days from the 12th century B.C.E. to the 7th when Hesiod wrote, and latitude corrections change these dates slightly, too.

Metonic Cycles. Because Day 0 is both a New Moon and the festival day of Apollo, a solar deity, Gilbert Murray speculated in *The Rise of the Greek Epic* that that day represents the end of a Metonic cycle, the 19-year cycle of recurrence of lunations in the solar calendar that is the base of the Jewish calendar and that Meton introduced as the official calendar of Athens in 432 B.C. {see Campbell [Campbell J (1964) *The Masks of God: Occidental Mythology* (Viking, New York)], p. 162; or Murray's 2nd Edition [Murray G (1924) *The Rise of the Greek Epic; Being a Course of Lectures Delivered at Harvard University* (Clarendon, Oxford)], p. 211 on}. The Metonic cycle has great practical importance not just for agricultural purposes; for example, it controls the tides. That Penelope is allegorical of the moon was argued by Murray to be self-evident—e.g., she weaves and unweaves a shroud. The allegory of a solar Odysseus is also clear: he wanders around, goes to the far west, underworld, then reappears in the east, has 360 boars of which one dies every day, etc., as detailed by Murray and Campbell. Finally, the two stories about the arrival of Odysseus are lunar analogies: in the older (vestigial) one, Penelope is forced to finish the shroud (New Moon) and then Odysseus appears. In the extant one, everyone tries to string the bow of the crescent Moon, but only the Sun can do so. Note that the previous full moon is when Odysseus "gladly spread his sails" off Ogygia, another first crescent allegory.

This conjecture cannot be taken further unless other coincidences between lunar and solar calendar are noted: Was it a festival day of Apollo when Odysseus left Ithaca? We do not know. However, we do hear elsewhere that as Odysseus was being drafted by Agamemnon, he feigned madness and started ploughing destructively, with mismatched animals (ox and ass) and sowing salt; Palamedes put baby Telemachus on the plough's path and Odysseus swerved, revealing his sanity. As per Hesiod, "start your ploughing when the Pleiades set and your reaping when they reappear"; hence, the story might take place after the heliacal setting of the Pleiades on April 5. On the other hand, as per Odysseus's feigned madness, it might take place anytime, and it need not be ploughing season.

Also note that there are subcycles to the Metonic cycle, of 99 and 136 lunations: Perhaps the "almost" arrival in Ithaca when the bag of the winds was opened is an allegory of this subcycle, which would have happened 8 years before the final arrival, 14 April 1186 B.C.E.? (Two days in advance of the new Sun day.) That almost-arrival would have happened 10 days after the heliacal setting of the Pleiades, when "truly gales of all kinds rage" as per Hesiod. Finally, if the analogy follows, then the Fall of Troy would be (allegorically) placed half a Metonic cycle before, on 15 October 1188 B.C.E.; that night, there was a total lunar eclipse, partially visible from Troy at dawn, as the moon set eclipsed.

Runner-Up Dates. ***24 March 1157 B.C.*** This is a rather early date; Odysseus sets sail in late February, not March, and as a result kills the suitors more than a week before the vernal equinox, thus before the end of the year and of the winter, perhaps an unlikely date for the festival day of Apollo. The Mercury reference is satisfied fully, while the Venus reference is just shy of our 1:30 cutoff, making this an otherwise very good match to the first four references.

9 April 1191 B.C. This is a weaker candidate. Venus is not close to its highest, rising 1 h 6 min before sunrise, while the Mercury reference is missed by 3 days. Raft sunk closer to the equinox but not after it; suitor massacre does occur in Spring, though.

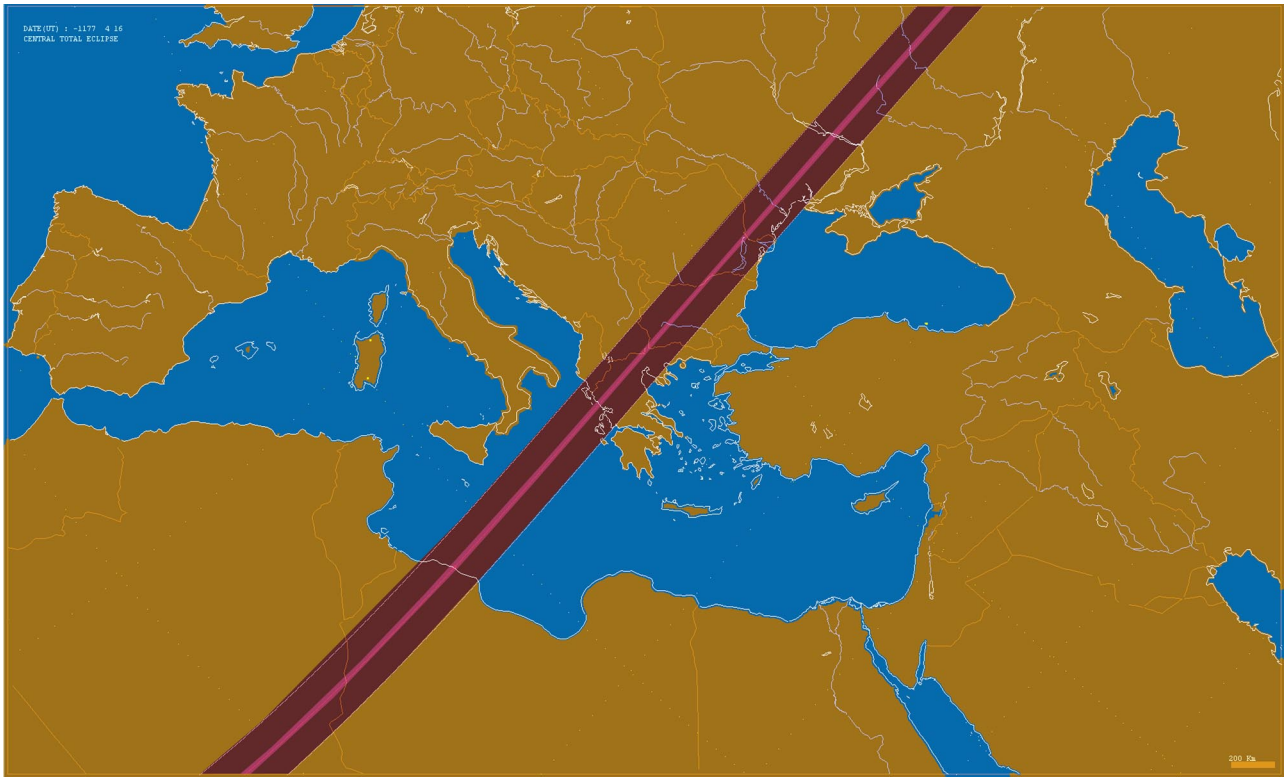

Fig. S1. Track of the eclipse. This figure was plotted by using EmapWin. Various Delta T models or revisions shift around the exact track of the eclipse by about one degree of longitude. As this eclipse lies well before the earliest fully verified eclipse used for estimating Delta T, the value of Delta T is extrapolated from the mean parabolic tendency, and shorter terms fluctuations are not taken into account. See the Five Millenium Canon for details on correction implementation. Errors in the estimated Delta T (described in http://sunearth.gsfc.nasa.gov/eclipse/SEcat5/uncertainty.html) for this period can be estimated to be ≈3° [Stephenson and Houlden (1986)], 4° (Huber's model, calibration year = 500 B.C.), or 2° (Huber's model, calibration year = 750 B.C.). In all cases, the track is NE–SW. This particular track is shifted northward from the path from Starry Night Pro, where Ithaka and Paliki lie on the northern edge of totality. Delta T for this track as shown, 28,907. From Starry Night Pro: 27,602.7 s. The Five Millenium canon lists 28,590 s for this particular eclipse under the latest revision.

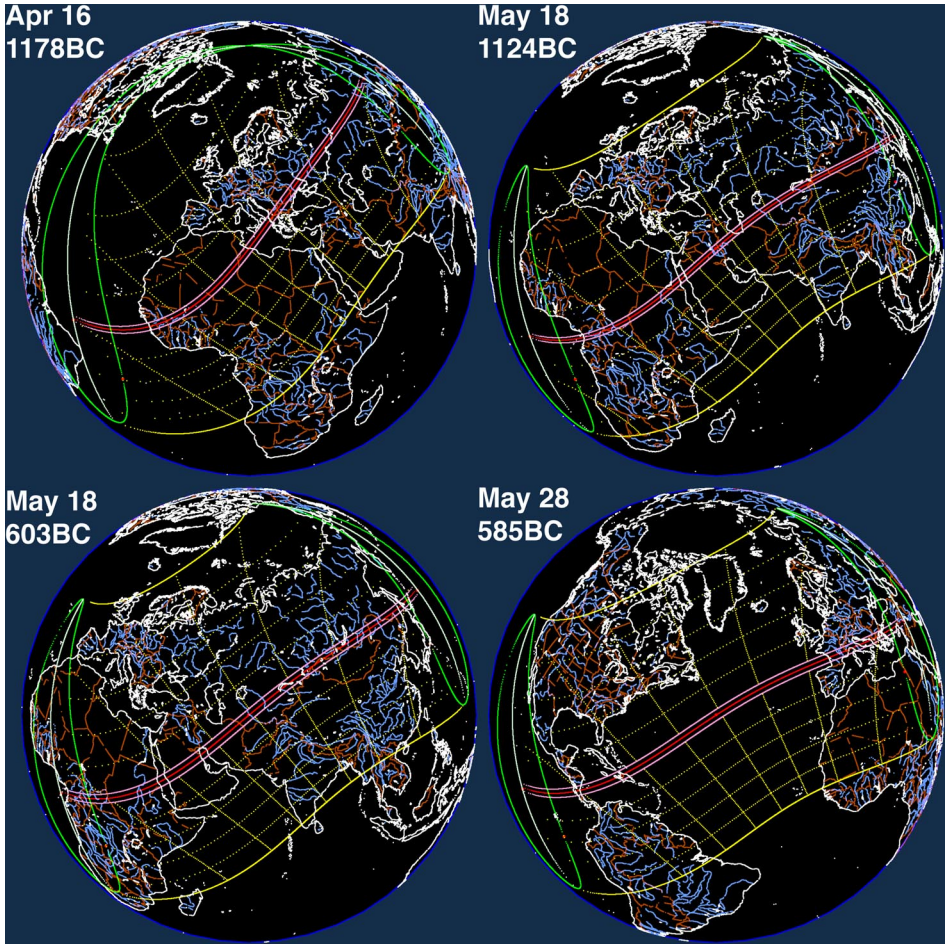

Fig. S2. Eclipses separated by cycles appearing consecutively in Greece and Mesopotamia. (*Upper*) Schoch's eclipse (*Left*) and the eclipse one Exeligmos later (*Right*); the second one was total over Babylon. (*Lower*) Eclipse allegedly predicted by Thales (*Right*); the eclipse one Saros cycle before (*Left*) passed just south of Ur.

Table S1. Relevant fragments

Mercury	v.48: And he took the wand wherewith he lulls to sleep the eyes of whom he will, while others again he awakens even out of slumber. On to Pieria he stepped from the upper air, and swooped down upon the sea, and then sped over the wave like a bird, the cormorant, which in quest of fish over the dread gulfs of the unresting sea wets its thick plumage in the brine. In such wise did Hermes ride upon the multitudinous waves. [55] But when he had reached the island which lay afar, then forth from the violet sea he came to land… v.97: Thou, a goddess, dost question me, a god, upon my coming, and I will speak my word truly, since thou biddest me. It was Zeus who bade me come hither against my will. Who of his own will would speed over so great space of salt sea-water, great past telling? Nor is there at hand any city of mortals who offer to the gods sacrifice and choice hecatombs. But it is in no wise possible for any other god to evade or make void the will of Zeus, who bears the aegis.
Constellations	v.270: and he sat and guided his raft skilfully with the steering-oar, nor did sleep fall upon his eyelids, as he watched the Pleiades, and late-setting Boötes, and the Bear, which men also call the Wain, which ever circles where it is and watches Orion, and alone has no part in the baths of Ocean. For this star Calypso, the beautiful goddess, had bidden him to keep on the left hand as he sailed over the sea. xi.370 The nights are still at their longest.
Equinox	v.282: But the glorious Earth-shaker, as he came back from the Ethiopians beheld him from afar, from the mountains of the Solymi: for Odysseus was seen of him sailing over the sea;
Venus	xiii.93: Now when that brightest of stars rose which ever comes to herald the light of early Dawn, [95] even then the seafaring ship drew near to the island.
New Moon	xiv.161: In the course of this self-same day Odysseus shall come hither, as the old moon wanes, and the new appears. He shall return, and take vengeance on all those who here dishonor his wife and his glorious son. xiv.457: Now the night came on, foul and without a moon, and Zeus rained the whole night through, and the West Wind, ever the rainy wind, blew strong. xix.306: In the course of this very month shall Odysseus come hither, as the old moon wanes and the new appears. v.225: So he spoke, and the sun set and darkness came on. (this was March 15, the day of Hermes visit, almost new moon).
Eclipse	xx.345–356: So spoke Telemachus, but among the wooers Pallas Athena roused unquenchable laughter, and turned their wits awry. And now they laughed with alien lips, and all bedabbled with blood was the flesh they ate,1 and their eyes were filled with tears and their spirits set on wailing. Then among them spoke godlike Theoclymenus: ″Ah, wretched men, what evil is this that you suffer? Shrouded in night are your heads and your faces and your knees beneath you; kindled is the sound of wailing, bathed in tears are your cheeks, and sprinkled with blood are the walls and the fair rafters. And full of ghosts is the porch and full the court, of ghosts that hasten down to Erebus beneath the darkness, and the sun has perished out of heaven and an evil mist hovers over all.″

Extracted from the Perseus Digital Library at Tufts University, www.perseus.tufts.edu.

Table S2. Full table of the exhaustive search

Moon/Const		Venus			Hermes		Equinox	
Year BC	**Ti**	**Rises Ti-5**	**sunrise**	**diff**	**MWRA**	**Δ**	**Sinks Ti-11**	**Before**
1251	12-Apr				23-Mar	-14	1-Apr	XXX
1250	2-Apr	4:45:55	6:49:20	2:03:25	7-Mar	-8	22-Mar	
1249	22-Mar				21-Feb	-5	11-Mar	
1248	9-Apr	5:56:56	6:37:00	0:40:04	10-Feb	24	29-Mar	
1247	30-Mar				1-Feb	23	19-Mar	
1246	17-Apr				19-Apr	-36	6-Apr	XXX
1245	5-Apr	5:15:46	6:43:08	1:27:22	1-Apr	-30	25-Mar	
1244	26-Mar				15-Mar	-23	15-Mar	
1243	13-Mar	7:06:18	7:20:12	0:13:54	1-Mar	-22	2-Mar	
1242	3-Apr	4:45:10	6:47:36	2:02:26	16-Feb	12	23-Mar	
1241	23-Mar				7-Feb	10	12-Mar	
1240	11-Apr	5:56:17	6:33:35	0:37:18	28-Jan	39	31-Mar	
1239	1-Apr				12-Apr	-45	21-Mar	
1238	21-Mar				25-Mar	-38	10-Mar	
1237	8-Apr	5:12:26	6:38:04	1:25:38	9-Mar	-4	28-Mar	
1236	28-Mar				23-Feb	-1	17-Mar	
1235	15-Apr				12-Feb	28	4-Apr	XXX
1234	5-Apr	4:44:04	6:44:14	2:00:10	3-Feb	27	25-Mar	
1233	24-Mar				21-Apr	-62	13-Mar	
1232	12-Apr	5:56:37	6:31:51	0:35:14	4-Apr	-26	1-Apr	XXX
1231	2-Apr	6:39:26	6:48:43	0:09:17	18-Mar	-19	22-Mar	
1230	23-Mar				3-Mar	-14	12-Mar	
1229	9-Apr	5:17:24	6:39:40	1:22:16	18-Feb	16	29-Mar	
1228	29-Mar				8-Feb	15	18-Mar	
1227	17-Apr				30-Jan	43	6-Apr	XXX
1226	6-Apr	4:43:45	6:42:29	1:58:44	21-Jan	41	26-Mar	
1225	26-Mar				27-Mar	-35	15-Mar	
1224	14-Apr	5:55:49	6:28:27	0:32:38	11-Mar	0	3-Apr	XXX
1223	3-Apr	6:22:27	6:43:05	0:20:38	25-Feb	3	23-Mar	
1222	24-Mar				14-Feb	4	13-Mar	
1221	11-Apr	5:12:05	6:29:07	1:17:02	4-Feb	32	31-Mar	
1220	31-Mar				26-Jan	30	20-Mar	
1219	20-Mar				7-Apr	-52	9-Mar	
1218	8-Apr	4:38:58	6:35:14	1:56:16	21-Mar	-16	28-Mar	
1217	27-Mar				4-Mar	-11	16-Mar	
1216	15-Apr	5:52:08	6:22:54	0:30:46	19-Feb	21	4-Apr	XXX
1215	5-Apr	6:04:46	6:39:43	0:34:57	9-Feb	21	25-Mar	
1214	25-Mar				31-Jan	19	14-Mar	
1213	12-Apr	5:13:03	6:27:23	1:14:20	17-Apr	-39	1-Apr	XXX
1212	2-Apr				30-Mar	-31	22-Mar	
1211	22-Mar				14-Mar	-26	11-Mar	
1210	10-Apr	4:38:20	6:31:52	1:53:32	27-Feb	8	30-Mar	
1209	29-Mar				15-Feb	8	18-Mar	

1208	16-Apr	5:52:21	6:21:11	0:28:50	5-Feb	36	5-Apr	XXX
1207	6-Apr	5:52:24	6:38:00	0:45:36	27-Jan	35	26-Mar	
1206	27-Mar				10-Apr	-48	16-Mar	
1205	13-Apr	5:13:12	6:25:39	1:12:27	23-Mar	-13	2-Apr	XXX
1204	3-Apr				7-Mar	-7	23-Mar	
1203	24-Mar				21-Feb	-3	13-Mar	
1202	11-Apr	4:38:22	6:30:06	1:51:44	11-Feb	25	31-Mar	
1201	30-Mar				2-Feb	22	19-Mar	
1200	20-Mar	6:18:14	7:06:31	0:48:17	23-Jan	22	9-Mar	
1199	7-Apr	5:42:02	6:37:30	0:55:28	2-Apr	-29	27-Mar	
1198	28-Mar				17-Mar	-23	17-Mar	
1197	15-Apr	5:14:51	6:23:20	1:08:29	26-Feb	14	4-Apr	XXX
1196	5-Apr				11-Feb	19	25-Mar	
1195	25-Mar				7-Feb	12	14-Mar	
1194	13-Apr	4:40:12	6:27:52	1:47:40	29-Jan	40	2-Apr	XXX
1193	1-Apr				12-Apr	-45	21-Mar	
1192	21-Mar	6:19:44	7:04:52	0:45:08	26-Mar	-39	10-Mar	
1191	9-Apr	5:27:36	6:34:05	1:06:29	9-Mar	-3	29-Mar	
1190	29-Mar				20-Feb	3	18-Mar	
1189	18-Mar	5:28:46	7:09:07	1:40:21	5-Feb	7	7-Mar	
1188	6-Apr				3-Feb	28	26-Mar	
1187	26-Mar				25-Jan	26	15-Mar	
1186	15-Apr	4:39:36	6:24:26	1:44:50	5-Apr	-24	4-Apr	XXX
1185	3-Apr				18-Mar	-18	23-Mar	
1184	23-Mar	6:20:02	7:01:34	0:41:32	3-Mar	-14	12-Mar	
1183	11-Apr	5:14:51	6:30:38	1:15:47	18-Feb	18	31-Mar	
1182	31-Mar				8-Feb	17	20-Mar	
1181	19-Mar	5:30:28	7:07:28	1:37:00	31-Jan	13	8-Mar	
1180	7-Apr				15-Apr	-42	27-Mar	
1179	28-Mar				29-Mar	-35	17-Mar	
1178	16-Apr	4:39:45	6:22:41	1:42:56	13-Mar	0	5-Apr	XXX
1177	4-Apr				26-Feb	3	24-Mar	
1176	25-Mar	6:20	6:58:16	0:38:06	13-Feb	6	14-Mar	
1175	13-Apr	5:03:46	6:27:13	1:23:27	4-Feb	34	2-Apr	XXX
1174	2-Apr				27-Jan	31	22-Mar	
1173	21-Mar	5:32:06	7:04:14	1:32:08	18-Jan	28	10-Mar	
1172	9-Apr				21-Mar	-15	29-Mar	
1171	29-Mar				6-Mar	-11	18-Mar	
1170	19-Mar	4:51:24	7:08:31	2:17:07	20-Feb	-7	8-Mar	
1169	6-Apr				10-Feb	21	26-Mar	
1168	26-Mar	6:20:51	6:56:32	0:35:41	31-Jan	20	15-Mar	
1167	14-Apr	4:56:50	6:25:27	1:28:37	23-Jan	47	3-Apr	XXX
1166	3-Apr				6-Apr	-37	23-Mar	
1165	22-Mar	5:33:35	7:02:31	1:28:56	14-Mar	-26	11-Mar	
1164	10-Apr				25-Feb	10	30-Mar	
1163	31-Mar				9-Feb	16	20-Mar	
1162	20-Mar	4:53:14	7:09:04	2:15:50	6-Feb	8	9-Mar	
1161	7-Apr				26-Jan	37	27-Mar	
1160	28-Mar	6:22:39	6:55:35	0:32:56	10-Apr	-47	17-Mar	
1159	16-Apr	4:50:35	6:24:50	1:34:15	25-Mar	-12	5-Apr	XXX
1158	5-Apr				7-Mar	-5	25-Mar	

1157	24-Mar	5:36:23	7:01:35	1:25:12	19-Feb	-1	13-Mar	
1156	12-Apr				11-Feb	26	1-Apr	XXX
1155	1-Apr				2-Feb	24	21-Mar	
1154	21-Mar	4:53:49	7:07:26	2:13:37	24-Jan	22	10-Mar	
1153	9-Apr				2-Apr	-27	29-Mar	
1152	29-Mar	6:23:14	6:53:53	0:30:39	17-Mar	-22	18-Mar	
1151	19-Mar	6:23:13	7:10:07	0:46:54	28-Feb	-15	8-Mar	
1150	7-Apr				12-Feb	20	27-Mar	
1149	26-Mar	5:37:24	6:58:16	1:20:52	7-Feb	13	15-Mar	
1148	14-Apr				29-Jan	41	3-Apr	XXX
1147	2-Apr				13-Apr	-45	22-Mar	
1146	23-Mar	4:54:27	7:04:11	2:09:44	27-Mar	-38	12-Mar	
1145	10-Apr				10-Mar	-3	30-Mar	
1144	31-Mar	6:22:50	6:50:30	0:27:40	23-Feb	2	20-Mar	
1143	20-Mar	6:10:02	7:08:27	0:58:25	12-Feb	2	9-Mar	
1142	8-Apr				3-Feb	30	28-Mar	
1141	28-Mar	5:38:14	6:54:57	1:16:43	26-Jan	27	17-Mar	
1140	15-Apr				5-Apr	-24	4-Apr	XXX
1139	4-Apr				20-Mar	-19	24-Mar	
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1137	11-Apr				19-Feb	17	31-Mar	
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1134	9-Apr				22-Jan	43	29-Mar	
1133	29-Mar	5:39:18	6:53:15	1:13:57	29-Mar	-34	18-Mar	
1132	18-Mar				12-Mar	-28	7-Mar	
1131	6-Apr				26-Feb	5	26-Mar	
1130	26-Mar	4:56:03	6:59:13	2:03:10	14-Feb	6	15-Mar	
1129	13-Apr				5-Feb	33	2-Apr	XXX
1128	2-Apr	6:23:41	6:47:03	0:23:22	25-Jan	33	22-Mar	
1127	23-Mar	5:42:37	7:03:34	1:20:57	18-Jan	30	12-Mar	
1126	11-Apr				22-Mar	-14	31-Mar	
1125	30-Mar	5:40:19	6:51:31	1:11:12	6-Mar	-10	19-Mar	
1124	20-Mar				20-Feb	-6	9-Mar	
1123	8-Apr				10-Feb	23	28-Mar	
1122	28-Mar	4:56:52	6:55:56	1:59:04	1-Feb	21	17-Mar	
1121	15-Apr				18-Apr	-37	4-Apr	XXX
1120	4-Apr	6:23:03	6:43:41	0:20:38	1-Apr	-31	24-Mar	
1119	24-Mar	5:32:48	7:01:54	1:29:06	15-Mar	-25	13-Mar	
1118	12-Apr				28-Feb	9	1-Apr	XXX
1117	1-Apr	5:40:41	6:48:10	1:07:29	16-Feb	10	21-Mar	
1116	22-Mar				5-Feb	11	11-Mar	
1115	9-Apr				28-Jan	37	29-Mar	
1114	30-Mar	4:57:35	6:52:36	1:55:01	19-Jan	36	19-Mar	
1113	16-Apr				24-Mar	-11	5-Apr	XXX
1112	5-Apr	6:23:20	6:41:57	0:18:37	8-Mar	-6	25-Mar	
1111	26-Mar	5:21:08	6:58:37	1:37:29	22-Feb	-2	15-Mar	
1110	14-Apr				7-Feb	32	3-Apr	XXX
1109	2-Apr	5:41:29	6:46:25	1:04:56	2-Feb	25	22-Mar	
1108	23-Mar				24-Jan	24	12-Mar	
1107	11-Apr				4-Apr	-27	31-Mar	
1106	31-Mar	4:58:30	6:50:52	1:52:22	24-Mar	-27	20-Mar	
1105	19-Mar				1-Mar	-16	8-Mar	
1104	7-Apr	6:22:33	6:38:34	0:16:01	11-Feb	21	27-Mar	
1103	27-Mar	5:13:51	6:56:55	1:43:04	7-Feb	14	16-Mar	
1102	15-Apr				29-Jan	42	4-Apr	XXX
1101	3-Apr	5:42:17	6:44:43	1:02:26	21-Jan	38	23-Mar	
1100	24-Mar				27-Mar	-37	13-Mar	