Phaethon and the Great Year[1]

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1 The Great Year

The Great Year was a widespread concept in classical times. Cicero's spokesman, the Stoic Balbus, defined it as follows:

> On the diverse motions of the planets the mathematicians have based what they call the Great Year, which is completed when the sun, moon and five planets having all finished their courses have returned to the same positions relative to one another. The length of this period is hotly debated, but it must necessarily be a fixed and definite time.[2]

It was believed that the turning points of the Great Year were marked by cosmic disruptions. During the Hellenistic period, two such turning points were recognised and interpreted as the 'solstices' of the Great Year: the world would be destroyed in a flood at the onset of the cosmic winter and in a fire at the onset of the cosmic summer. The *locus classicus* for this belief is an excerpt from the *Babyloniaca* of the Babylonian priest Berossus, as cited in Seneca:

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1 Without the unrelenting support of the Mainwaring Archive Foundation this article could not have been completed. I am also grateful to Ev Cochrane, Keith Hutchison, and Peter James for their very constructive thinking and suggestions.

2 Cicero, *de Natura Deorum*, II 20 (52), tr. Rackham; cf. *Somnium Scipionis*, apud Macrobius, *In Somnium Scipionis Commentarius*, II 11 2; Diodorus Siculus, *Bibliotheca*, II 47 6; Pliny, *Naturalis Historia*, II 6 40; Manilius, *Astronomica*, I 287-8; Censorinus, *de Die Natali*, 18; Heraclitus, *Homeric Allegories*, LIII 3-4; also Campion 1994.

APEIRON a journal for ancient philosophy and science
0003-6390/2006/3901 057-090 $36.00 ©Academic Printing & Publishing

> Berosus ... affirms that the whole issue is brought about by the course of the planets. So positive is he that he assigns a definite date both for the conflagration and the deluge. All that the earth inherits will, he assures us, be consigned to flame when the planets, which now move in different orbits, all assemble in Cancer, so arranged in one row that a straight line may pass through their spheres. When the same gathering takes place in Capricorn, then we are in danger of the deluge.[3]

The association of the Great Year with recurrent catastrophes seems to have rooted in a combination of two passages from Plato's *Timaeus*. In the first of these, 39C-E, Plato's spokesman was Timaeus of Locris, whom later tradition identified as a leader of the Pythagorean school.[4] Timaeus defined a planetary cycle that he called *tòn téleon eniautòn*, 'the Complete Year':

> Of the other stars the revolutions have not been discovered by men (save for a few out of the many); wherefore they have no names for them, nor do they compute and compare their relative measurements, so that they are not aware, as a rule, that the 'wanderings' of these bodies, which are hard to calculate and of wondrous complexity, constitute Time. Nevertheless, it is still quite possible to perceive that the complete number of Time fulfils the Complete Year when all the

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3 Berossus, *Babyloniaca*, apud Seneca, *Naturales Quaestiones*, III 28 7-29 2, tr. Burstein; compare Bidez 1904, 12; Kugler 1927, 52; Gundel 1977, 201; Campion 1994, 66f., 516. The Latin is: *Berosus, qui Belum interpretatus est, ait ista cursu siderum fieri. Adeo quidem affirmat ut conflagrationi atque diluvio tempus assignet. Arsura enim terrena contendit, quandoque omnia sidera quae nunc diversos agunt cursus in Cancrum convenerint, sic sub eodem posita vestigio ut recta linea exire per orbes omnium possit; inundationem futuram, cum eadem siderum turba in Capricornum convenerit.* In the 'age of Aries', Cancer and Capricorn were the constellations through which the sun passed at the summer and the winter solstice respectively. Aristotle, apud Censorinus, *de Die Natali*, XVIII 11, was the first to use the terms 'winter' and 'summer' in this context.

4 Bury VII 1952, 3. Proclus says that Timaeus as such accurately mediated Pythagorean tradition, *In Platonis Timaeum Commentarius*, I 223. 5-6 on 27D. Van der Waerden (1952, 129f.) concluded that the Great Year was a Pythagorean doctrine; compare Ulansey 1989, 74. On Plato's dependence on the Pythagoreans in general, compare Aristotle, *Metaphysics*, I 6 1-7 (987a-b); Plutarch, *Lives: Numa*, 11; *Quaestiones Plat*, 8; Harward 1928, 72; Philip 1966, 11, 69; Guthrie 1987, 38; Heath 1991, XXXIX, XLIf.; Huffman, 1993, 21, 24. Burkert (1972, 84f.) unhesitatingly states that the Timaeus was Pythagorean in outlook.

> eight circuits, with their relative speeds, finish together and come to a head, when measured by the revolution of the Same and Similarly-moving.[5]

What Timaeus introduces here is essentially the concept of the Great Year as the cycle defined by the return of 'all the eight circuits, with their relative speeds' to the position whence they had initiated their movements.[6]

The second passage, 22C-D, was put in the mouth of Plato's relative Critias, citing Solon's interview with a priest of the Egyptian city of Saïs. When Solon brought up the subject of Deucalion's flood, the old, anonymous priest interrupted him to explain that the myths of Phaethon's fall and Deucalion's flood — apparently known in Egypt as well as in Greece — encode truly historical catastrophic events:

> There have been and there will be many and divers destructions of mankind, of which the greatest are by fire and water, and lesser ones by countless other means. For in truth the story that is told in your country as well as ours, how once upon a time Phaethon, son of Helios, yoked his father's chariot, and, because he was unable to drive it along the course taken by his father, burnt up all that was upon the earth and himself perished by a thunderbolt — that story, as it is told, has the fashion of a legend, but the truth of it lies in the occurrence of a shifting of the bodies in the heavens which move round the earth, and a destruction of the things on the earth by fierce fire, which recurs at long intervals ... And when, on the other hand, the Gods purge the earth with a flood of waters, all the herdsmen and shepherds that are in the mountains are saved ...[7]

This statement 'is both the earliest extant account of the doctrine of eternally recurrent catastrophes and the model for all future theories ...'[8] Plato did not explicitly connect the 'Complete Year' to the recurrent

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5 Plato, *Timaeus*, 39C-E, tr. Bury

6 Adam II 1921, 290; Bury 1952, 82 note 2; Chroust 1973, 113 and note 2

7 Plato, *Timaeus*, 22C-D, tr. Bury

8 Campion 1994, 249

catastrophic disasters. Was the later tradition, then, justified in making this connection?

2 Plato's dilemma

Plato's dialogues provide an excellent starting-point for an enquiry into the nature of the Great Year, not only because many of the later sources ultimately depend on them, but also because Plato comes sufficiently early in time to function as a witness of pre-Socratic astronomical ideas. Unfortunately, the meaning of Plato's revelations is by no means straightforward. Wilhelm Gundel, the eminent German specialist on ancient astrology, possibly following Franz Boll, detected a fundamental contradiction between the two passages in the *Timaeus*, arguing that one passage requires the planets to deviate from the established order, whilst the other posits the uninterrupted regularity of planetary motion, even when the planets are in linear conjunction.

In one of the two relevant passages, Critias utters the words that catastrophes such as the one alluded to in the myth of Phaethon are really caused by *tōn perì gēn kaì kat' ouranòn ióntōn parállaxis*, 'a shifting of the bodies in the heavens which move round the earth', in Bury's translation.[9] What does that mean? Gundel interpreted this remark to the effect that the deluge, the conflagration, and other, minor catastrophes are the result of 'disturbances in the movements of the planets'.[10] Timaeus' statement concerning the Complete Year is extended by Gundel to include the concept of recurring catastrophes as mentioned in 22C-D, so that it can be seen as an early expression of the theory later evinced by Berossus and others, according to which the completion of the Great Year is marked by catastrophes of fire and water.[11] It seems fair enough to

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9 The genitive phrase 'of the bodies in the heavens' is understood in a subjective sense, as it is the bodies themselves that shift.

10 'Störungen in den Planetenbewegungen ... ', Gundel 1977, 93

11 'Das Weltenjahr läuft ab, heißt es an dieser Stelle, wenn alle acht Sphären ihre großen Umlaufsperioden vollendet haben und alle zugleich wieder in ihrer Anfangsstellung sind, die sie bei Erschaffung der Welt inne hatten. Das erinnert von selbst an die Kataklysmentheorie, welche zwei Generationen später Berossos ... etwas präziser mit dem Umschwunge aller Planeten und mit bestimmten Tierkreisbildern in

connect Timaeus' statement regarding the Complete Year to the catastrophes of fire and flood, even though the speaker does not enunciate it and the context is all we can rely on.[12] Yet, if this interpretation of the two passages is correct, a discrepancy arises:

> In Timaeus p. 22C hängen Sintflut und Weltbrand von einer παράλλαξις, d. h. von einem Abirren der um die Erde laufenden Gestirne ab, also ebenfalls von einer Störung der geordneten Planeten- und Fixsternbewegung. Das wird an dieser Stelle durch den Phaethonmythus veranschaulicht, dem ja der Gedanke von einem Abirren der Sonne und der damit verbundenen partiellen Zerstörung durch Feuer zu grundeliegt. Das steht in wesentlichem Gegensatz zu der Timaeus p. 39D vorgetragenen Lehre des großen Jahres; dieses ist beendet, wenn alle acht Umläufe, d. h. der Umschwung der sieben Planeten und des Fixsternhimmels, wieder an die Stelle gelangt sind, wo der Anfangspunkt ihrer verschiedenartigen Bewegung war. An sich ist es ja dieselbe Idee, welche der Lehre des "größten" Jahres bei Aristoteles und später bei Berossos zugrunde liegt, aber die Weltkatastrophe und die Welterneuerung wird von Plato mit dieser Gestirneinteilung nicht an dieser Stelle in Kontakt gestellt.[13]

The 'disturbances in the movement of the planets' as illustrated in the story of Phaethon (22C-D) apparently require cosmic bodies out of orbit, whereas the regular cycle of the 'Complete Year' (39C-E), which Gundel associates with catastrophes, presupposes that the planets remain in their present orbits throughout.

Was Plato's thinking so muddled that he failed to see the contradiction? Or did he intend to convey two conflicting theories in these two passages, the one ascribed to the Saïtic priest, the other to Timaeus? In that case, the difference may have amounted to a dichotomy between Egyptian and Pythagorean traditions, the former perhaps more catastrophist than the latter. The conduit of the two speakers could simply have

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Einklang gebracht haben soll. Weiter hat Plato die Verbindung der Weltkatastrophen mit dem Planetenlauf gekannt ... ' Gundel 1977, 92f.

12 In his commentary, Taylor (1928, 52f.) did not connect the passages and prescinded from a discussion of Phaethon altogether.

13 Gundel 1977, 202

been an expedient smoke-screen for Plato to conceal his own confusion regarding the matter. Gundel did not pronounce himself in this respect, but did suggest that underlying *Timaeus* 22C-D and Berossus was a more archaic, perhaps obsolete view that the end of the world at the turning of the Great Year was brought about by a *collision* rather than a *conjunction* of planets: the planets would abandon their orbits and smash into each other. He buttressed this view with the speculation that the word *synodos* (σύνοδος), which Heraclitus used for the 'conjunction' of the planets,[14] etymologically requires not just a meeting, but an actual collision on the same plane:

> Der griechische Terminus, der von dem Zusammenprall der Planeten spricht, is συνοδεύειν *oder* σύνοδος ... Das verlangt ein Zusammentreffen und auch ein Zusammenstoßen auf derselben Ebene, also nach Breite und Höhe stoßen die Planeten ineinander und lösen dadurch das Weltende aus. Dazu ist dann den jüngeren astronomischen Erkenntnissen entsprechend bei Seneca der erläuternde Zusatz gekommen: *sic sub eodem posita vestigio, ut recta linea exire per orbes omnium possit*. Die Astrologie hat also uralte primitive Vorstellungen entsprechend den modernen Doktrinen umgeformt und so sanktioniert, obwohl sie in dieser Neugestaltung nicht mehr ihre ursprüngliche Berechtigung behalten konnten.[15]

But is the case really as straightforward as Gundel claimed? Is the alleged contradiction between the two passages in the *Timaeus* real? And had the theory of the great conjunction absorbed an earlier notion that the planets perish in a great collision? A more plausible possibility is that the opinions of Plato's informants were consistent with each other and that the contradiction is simply due to a misunderstanding at our end.

To start with Gundel's proposition that *synodos* must originally have meant 'collision', this is actually forced and slightly biased. Etymologically, the word refers to a convergence of paths and it is normally employed in the general sense of 'assembly, meeting, coming together'.[16] The same applies to the Latin *convenio*, used in Seneca's citation of

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14 Heraclitus, *Homeric Allegories*, LIII 3-4

15 Gundel 1977, 201

16 Liddell 1996, 1720 s. v. 'σύνοδος'

Berossus. The element of convergence, expressed by the prefix *syn-* in Greek and *con-* in Latin, is sufficiently accounted for in the common arrival of the planets in the same constellation.

Nor was the notion of colliding planets or stars necessarily more primitive than that of the linear conjunction. As I shall show, it was still very much alive in Seneca's own time, a few centuries after Berossus had propagated the ostensibly more advanced theory of the linear conjunction. Seneca himself actively believed that the stars and planets abandon their stations at the end of a cosmic cycle, yet at the same time he also subscribed to Berossus' concept of a linear conjunction of planets at the turning-points of the Great Year. For this reason, it is unlikely that Seneca or any other Stoic philosophers felt intrinsic tension between these two concepts. Apart from that, it is difficult to understand how the notion of cataclysms caused by a collision could have acquired an association with a linear conjunction of planets, which would seem far less 'rational'.

For these reasons, Gundel's idea that *Timaeus* 22C-D reflected a more archaic concept than *Timaeus* 39C-E is untenable. Where does this leave the supposed discrepancy between these passages? Firstly, one has to bear in mind that Plato's perception of the 'Complete Year' was probably less rigid than that of some of his successors. In *Timaeus* 39C-E, Plato crafted his or rather Timaeus' words carefully so as not to sound too definitive regarding the Complete Year. He made it clear that the orbits of only a few 'stars' had been measured and the context reveals that these were the moon, the sun, Mercury, and Venus; of the 'other stars', Mars, Jupiter, and Saturn, the orbital periods were apparently not known. Against this background, Plato's words 'it is still quite possible to perceive that the complete number of Time fulfils the Complete Year when all the eight circuits ... finish together' can only be interpreted to the effect that Plato saw the concept of the 'Complete Year' as plausible, yet not definitively established because the exact periods of Mars, Jupiter, Saturn, and perhaps even Mercury and Venus were not yet known. In other words, Plato's 'Complete Year' was merely a hypothetical construct lacking a mechanism of control and Plato seemed rather overwhelmed by the complexity of the movements of these bodies in the sky.

But did Plato allow for planets straying from their established paths at the end of the cosmic era? Perhaps — contra Gundel — the word *parállaxis* (παράλλαξις), rendered by Bury as 'shifting', does not necessarily require the element of irregularity as presupposed in 'aberration'. Although Liddell and Scott prefer 'change, deviation, mutation' for the passage in *Timaeus*, it sometimes means 'alternation, alternating mo-

tion',[17] which indicates a regular rather than an anomalous type of shift. What sort of change or alternation other than a change in orbit could have been meant? Comparison with one of Plato's other dialogues suggests that Plato may have thought of a change in *direction* along the same orbits.

3 Winding the cosmos back and forward

Plato's *Politicus* also touches on the subject of the Great Year. Here, the Eleatic 'Stranger' tells the Younger Socrates that the full cosmic cycle entails two phases:

> During a certain period God himself goes with the universe as guide in its revolving course, but at another epoch, when the cycles have at length reached the measure of his allotted time, he lets it go, and of its own accord it turns backward in the opposite direction, since it is a living creature and is endowed with intelligence by him who fashioned it in the beginning. Now this reversal of its motion is an inevitable part of its nature ...[18]

> ... we must not say either that the universe turns itself always, or that it is always turned by God in two opposite courses, or again that two divinities opposed to one another turn it. The only remaining alternative is what I suggested a little while ago, that the universe is guided at one time by an extrinsic divine cause, acquiring the power of living again and receiving renewed immortality from the Creator, and at another time it is left to itself and then moves by its own motion, being left to itself at such a moment that it moves backwards through countless ages, because it is immensely large and most evenly balanced, and turns upon the smallest pivot ...[19]

The transition from one phase to the other is accompanied by catastrophic circumstances:

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17 Liddell 1996, 1316 s. v. 'παραλλαξις'

18 Plato, *Politicus*, 269C, tr. Fowler

19 Plato, *Politicus*, 269E-70D, tr. Fowler

> Inevitably, then, there is at that time great destruction of animals in general, and only a small part of the human race survives; and the survivors have many experiences wonderful and strange, the greatest of which, a consequence of the reversal of everything at the time when the world begins to turn in the direction opposed to that of its present revolution, is this ...[20]

To illustrate this in terms of 'real' history, the Stranger introduces the concept of the 'golden age' of Kronos,[21] during which the sun and the other planets moved in the same direction as the sphere of the fixed stars. At the conclusion of this blissful era, the gods — evidently the planetary gods — let go and a disastrous episode ensued as the spheres began to move backward in the reverse direction:

> So, too, all the gods who share, each in his own sphere, the rule of the Supreme Spirit, ... let go the parts of the world which were under their care. And as the universe was turned back and there came the shock of collision, as the beginning and the end rushed in opposite directions, it produced a great earthquake within itself and caused a new destruction of all sorts of living creatures. But after that, when a sufficient time had elapsed, there was rest now from disturbance and confusion, calm followed the earthquakes, and the world went on its own accustomed course in orderly fashion ...[22]

As Plato indicates, the motivation for this theory of a cosmos that alternately winds forward and backward was the legend of Atreus, according to which the sun used to rise where it now sets and vice versa. The Stranger explained this myth with the supposition that the seven spheres of the planets, which constitute 'a living creature', during one half of the cosmic cycle move in the opposite direction to the sphere of the fixed stars, which is 'God himself', and during the other half along with it.

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20 Plato, *Politicus*, 269E-70D, tr. Fowler

21 Plato, *Politicus*, 271-2, tr. Fowler

22 Plato, *Politicus*, 272E-3A, tr. Fowler. The qualification *kata tous topous*, which Fowler translates as 'each in his own sphere', likely refers to the planets in their orbits, as does the 'parts of the world which were under their care'.

Gundel's prevaricating discussion places Plato's statements in *Politicus* in opposition to those in *Timaeus*,[23] but there really is a coherent view behind all Plato's pronouncements on this score. The twofold cycle as discussed in *Politicus* is probably identical to the 'Complete Year', familiar from the *Timaeus*, for it would hardly seem likely that Plato believed in two different eschatological cycles at the same time and the reversal described in *Politicus* is characterised as *megistēn kai teleōtatēn*, 'the greatest and most complete', using the same word for 'complete' as employed in *Timaeus*.[24] The 'Great and Complete Year', then, apparently has two phases, defined by the direction in which the planetary spheres revolve with respect to the fixed stars and separated by episodes of catastrophe.[25,26] The occurrence of catastrophes at the junctures of these

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23 Gundel (1977, 201f.) basically says that, in *Politicus*, the disasters are caused by the inversion of the direction in which the planets revolve, whereas in *Timaeus* 22C-D they are due to a deviation of the planets from their orbits.

24 Plato, *Politicus*, 270C, tr. Fowler. On the connection with *Timaeus*, Adam II 1921, 298. Compare Bidez 1939, 76: ' ... l'idée fondamentale du mythe du *Politique*, y compris la doctrine d'un retour périodique au règne de Kronos, est voisine du postulat de l'astrologie chaldéenne, c'est-à-dire de la doctrine suivant laquelle les phases de l'existence du monde avec ses cataclysmes grands ou petits n'ont point d'autre cause que les révolutions des planètes et du ciel, et lorsque Platon parle de la catastrophe finale où le monde serait près de s'abîmer, maintes expressions rappellent la théorie des révolutions stellaires ainsi que le grand hiver ou l'inondation universelle ... '

25 Adam regards the two phases as 'two Great Years, in the first of which ὁμοιότης prevails and the Universe is fresh and strong, while in the second, in which we are living now, ἀνομοιότης begins to assert itself and the Universe flags and wanes. ... the World "waxes" in the first, and "wanes" in the second, without, however, suffering dissolution. ... in the life of the Universe there are two recurrent cycles, in one of which peace and uniformity prevail, while in the other discord and dissimilarity gradually assert their sway. ... the two cycles are of equal length ... To my mind it is quite clear that in the myth of the *Politicus*, we have before us an astronomical, and not a metaphysical conception. ... The only possible explanation of the two cycles is that each of them represents a Great Year.' II 1921, 208 note, 202 note, 297f. Adam further compares the two 'harmonies' of the *Republic*, II 1921, 295, 298f., and warns that it is unjustified to associate one of the cycles with the creation, the other with the destruction of the world, II 1921, 298. I agree that creation and destruction were held to occur in the intervals between the cycles.

26 It does not seem justified to see in these phases an allusion to the alternation of deluge and conflagration as the means by which the world is brought to an end. As 22C-D shows, the *Timaeus* identified flood and fire merely as 'the greatest' of 'many

phases strongly supports the unity of *Timaeus* 22C-D, which only spoke of a recurrence of disasters, and *Timaeus* 39C-E, which hesitatingly introduced the 'Complete Year' without mentioning catastrophes.[27]

The involvement of the planets in this scenario is of pivotal importance. On the basis of *Timaeus* 39C-E, it may reasonably be supposed that, for Plato, the catastrophes marking the transition from the 'forward' cycle to the 'backward' cycle and vice versa occurred when all planets came in conjunction with each other. Consequently, these catastrophes would take place at regular intervals, and it is this regularity of the cosmic disasters that typifies Plato's model of catastrophism.[28] Indeed, the theory advocated by the Stranger and certainly endorsed by Plato himself offers an interesting solution to the significance of *Timaeus*' 'shifting of the bodies in the heavens', to which the Egyptian priest ascribed catastrophes such as the fall of Phaethon. This 'shifting' would appear to be just such a reversal of the direction in which the planets move as the Stranger meant in *Politicus*. It was, in other words, an 'alternation' more than a 'deviation'.[29]

Still, in fairness to Gundel, the notion of a linear conjunction of planets has to be balanced against the widespread apocalyptic tradition that

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and divers destructions of mankind', besides 'lesser ones by countless other means.' Apparently, the strict binary interpretation arose only later, undoubtedly under the influence of Plato's twofold cycle.

27 What Fowler translates as 'the shock of collision' superficially supports Gundel's interpretation of a crash of planets, but *symballōn*, literally 'throwing together', does not refer to the planets, but to what Fowler translates as 'the universe'. The full sentence is: *ho de metastrephomenos kai symballōn, archēs te kai teleutēs enantian hormēn hormētheis, seismon polyn en heautōi poiōn allēn au phthoran zōiōn pantoiōn apergasato.* This appears to indicate that the sudden reversal caused a shock, turning the 'end' into a new 'beginning', or 'throwing them together'. Compare: 'With a jerk the universe changed its rotation, driven by an impulse in which beginning and end reversed their positions. This shock caused a great tremor in the universe ... ' tr. Skemp.

28 An excellent discussion of Plato's cyclical view of world history, punctuated by cosmic catastrophes, is given in James (1995, 104-11, 122f., 163).

29 After Plato, the 'standard' theory of the Great Year connected the two phases of the cosmic cycle to the catastrophes of fire and flood. This system of two cosmic 'seasons', the summer associated with fire, the winter with water, likely developed from a combination of Plato's statements in the *Timaeus* and the *Politicus*.

feared the fall of all stars and planets from the sky at the end of time, a tradition evinced perhaps nowhere more clearly than by Seneca:

> Let all the heavenly bodies, separated as they are by vast distances and appointed to the task of guarding the universe, leave their posts; let sudden confusion arise, let stars clash with stars, let the harmony of the world be destroyed, and the divine creations totter to destruction; let the heavenly mechanism, moving as it does with the swiftest speed, abandon in the midst of its course the progressions that had been promised for so many ages, and let the heavenly bodies that now, as they alternately advance and retreat, by a timely balancing keep the world in a state of equipoise be suddenly consumed by flames, and, with their infinite variations broken up, let them all pass into one condition; let fire claim all things, then let sluggish darkness take its place, and let these many gods be swallowed up in the bottomless abyss.[30]

The issue now is whether the theme of the falling stars or planets is absolutely irreconcilable with that of the great conjunction or not. Are these two competing eschatological beliefs — perhaps a Stoic versus a Pythagorean idea — that have nothing to do with each other? Or could they have been part of a coherent system?[31]

The paucity of explicit source material makes it difficult to be confident on this matter, but still allows an inspired guess. For Plato, the 'shock of collision' and the 'great earthquake' felt at the 'turning back' of the cosmos must have been related to catastrophic interludes such as Phaethon's fire, that were associated with the turning-points of the Great Year.[32] Manilius, Philostratus, and Nonnus all alleged that Phaethon's

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30 Seneca, *de Beneficiis*, VI 22, tr. Basore; cf. *Thyestes*, 776-878; *Sibylline Oracles*, III; V 211-13, 512ff. On similar statements, compare Gundel 1977, 202. Note that the 'heavenly bodies that ... alternately advance and retreat' are the planets.

31 In the quote, Seneca poetically admonished each of the stars to clash 'in the midst of its course'. This does not permit the conclusion that this clash was generally thought to happen in the middle of the cosmic cycle. Seneca used the idea of a sudden realisation of the apocalypse, prior to its allotted time, as a literary device.

32 'When the backward movement ends, and the forward begins, a few men are left surviving ... ' Adam II 1921, 295. A 'shock of turning' separates the two cosmic periods from each other and gradually the universe becomes 'less and less accurate in its movements' 1921, 296.

fire drove the constellations from their stations, apparently in keeping with a widespread interpretation.[33] Apparently, the fires, floods and earthquakes concomitant with the great conjunction of planets were thought to be so destructive that they forced all celestial bodies from their positions, including not only the planets, but all the stars as well, precipitating a temporary return to the primordial state of absolute darkness. The linear conjunction and the downfall of planets belonged together in a fixed sequence that can be analysed as the reverse of the creation process. The subsequent restoration of cosmic order was to start with the formation of a new string of planets in conjunction, like athletes in the starting-blocks,[34] and from these starting points the wandering stars would begin to run the courses of their orbits anew. On this model, the temporary prevalence of chaos, with the luminaries of the sky in exile, was therefore not so much the logical opposite or an archaic predecessor of the conjunction of planets — as Gundel thought — as the phase following on the conjunction.

4 Constantly changing

In their descriptions of the Great Year, both Plato and Berossus used phrases that can at first sight be construed as meaning that the planets stray from their accustomed courses when they produce the planetary conjunction. In the case of *Timaeus* 22C-D, the *parállaxis* referred to a change in direction, prompted by the reversal of the cosmic clock, rather than an alteration of orbits. But what about Berossus?

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33 ' ... the inexperienced signs could not withstand the fires which wandered from their guide-post and a chariot out of control.' Manilius, *Astronomica*, I 684-749, tr. Goold. ' ... the blazing stars fled before fresh flames ... ' IV 828-39, tr. Goold. ' ... at his fall the heavens are confounded. Look! Night is driving Day from the noonday sky, and the sun's orb as it plunges toward the earth draws in its train the stars ... ' Philostratus the Elder, *Imagines*, I 11 (310-11), tr. Fairbanks. 'The sevenstar voices of the Pleiades rang circling round the sevenzone sky with echoing sound; the planets from as many throats raised an outcry and rushed wildly against them. Cypris pushed Zeus, Ares Cronos; my own wandering star [Mercury] approached the Pleiad of Spring ... ' Nonnus, *Dionysiaca*, XXXVIII 348-409, tr. Rouse.

34 The Stoics would compare the dispersion of the planets at the onset of a new era to the release of horses in a hippodrome or of wild animals in the woods, Gundel 1977, 202.

Berossus explicitly said that the planets *nunc diversos agunt cursus*, 'now move in different paths'. What does this mean? The context and the choice of word reveal that no change in orbit is required. On the contrary, the term *diversus* means 'different' in the sense of 'diverse' rather than 'mutated'. It connotes variety not over time, but at a single point in time. The contrast drawn is that between the planets *currently* moving in different positions with respect to each other, but *eventually* synchronising their paths and 'tuning in' with each other for the brief instant of the grand conjunction.[35] Precisely the same usage of the phrase 'different orbits', *hetérois kýklois*, is found in Pseudo-Aristotle's introduction to the behaviour of the planets.[36]

It has now been shown how Plato and Berossus used language such as a 'shifting of the bodies' and 'different orbits' with respect to the regular orbits of the planets and the Great Year. The alleged contrast between *Timaeus* 22C-D and 39C-E has made place for a coherent theory of the Great Year, consistent with statements in the *Politicus*, and the notion of the fall of stars from the sky has been reconciled with that of

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35 Whereas Berossus intended to say that the planetary orbits differ with respect to each other, Diodorus and Cicero were mainly concerned with the variability of each of the planets during its course. Diodorus remarked that, according to the 'Chaldaeans', each of the planets 'has its own particular course, and its velocities and periods of time are subject to change and variation.' *Bibliotheca*, II 30 7-31 1, tr. Oldfather. As follows from Plato's *Laws*, 7. 821B-C, 822A, what is meant here is that the Babylonian astrologers were aware of the variable speeds and orbital periods of the planets with respect to each other as well as the changes that *appear* to occur in their fixed courses from the perspective of an earth-bound stargazer. Cicero set forth the theory of the immutability of the heavens in the same chapter as that of the Great Year, defined by the *disparibus motionibus* or the 'diverse motions' of the planets, *de Natura Deorum*, II 20 (51-3); compare Martianus Capella, *The Marriage of Philology and Mercury*, 850-1.

36 'The others, the *planets*, move, according to their nature, at speeds different from the fixed stars and from each other, each in a different circle, in such a way that one is nearer the earth, another higher in the heavens.' Pseudo-Aristotle, *de Mundo*, 2 (392a), tr. Furley. The Greek is: *... tà dé, planētà ónta, oúte tois protérois homotachōs kineisthai péphyken oúte allēlois, all'en hetérois kaì hetérois kýklois, hōste autōn tò men prosgeióteron einai, tò dè anōteron*. Compare: ' ... by means of a single revolution of the whole heaven completed in a night and a day, the various motions of all the heavenly bodies are initiated, and though all are embraced in one sphere, some move rapidly and others more slowly, according to their distances and their individual characters.' 6 (399a), tr. Furley.

the linear conjunction of planets. Armed with this information, we are ready to face the one remaining conundrum: the role and identity of Phaethon.

The 'Complete Year' (39C-E) was clearly defined by planets and the 'long intervals' at which destructive floods and fires occur on earth (22C-D) equally suggest the periodicity set by planetary motion. Does this imply, then, that Gundel correctly related the *parállaxis* of 'the bodies in the heavens which move round the earth' to planets? There is no reason to doubt that Plato had planets in mind as these 'regularly shifting' bodies, but this obscures the role of Phaethon. Phaethon was essentially a 'false sun' that crashed down from the sky. How did Plato relate this to the regularity of the orbits and the conjunction of the planets? Did he regard Phaethon as one of those shifting planets or was Phaethon some other object that appeared when the planets were in conjunction? Was Phaethon a planet or a comet? Plato remains silent on the subject.

An early tradition appears to have identified Phaethon with Venus. During the Hellenistic era, the astronomers agreed to call the planet Jupiter 'Phaethon', although a few dissenting sources identified Saturn as such.[37] Throughout antiquity, literary sources identified Phaethon with the sun and occasional hints are found that Phaethon was thought to be a meteor or a meteorite. As an example of the latter, Ovid, narrating Phaethon's fall, spoke of 'fire ravaging his ruddy hair' and 'a long trail through the air'.[38] All of these identifications could have derived from the pre-Homeric concept of a temporary 'replacement sun' or mock sun. Kugler explained this as a memory of an extremely bright meteor.[39] But how could the appearance of a meteoric Phaethon relate to the great conjunction of all planets at the turning-points of the Great Year? What

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37 For Jupiter: Pseudo-Aristotle, *de Mundo*, II 15-31 (392a); Geminus, *Elementa Astronomiae*, 1; Manetho, in John Malalas, *Chronicle*, II 3 (25); Cicero, *de Natura Deorum*, II 20 (51-3); Philo, *Quaestiones et Solutiones in Exodum*, II 73, 75; Nonnus, *Dionysiaca*, XLI 339-50; Martianus Capella, *The Marriage of Philology and Mercury*, 850-1. For Saturn: Pseudo-Eratosthenes, *Catasterismoi*, 43; Hyginus, *Poetica Astronomica*, II 42. Compare Condos 1997, 167, 253 note 4; Charvet 1998, 191; Le Boeuffle 1983, 84, 178 note 7.

38 Ovid, *Metamorphoses*, II 320, tr. Miller

39 Kugler 1927, 38

do planetary conjunctions have to do with meteors or meteorites? Clearly, a crucial element in the logical chain of argument has been overlooked by modern interpreters. At this point it should be asked which *mechanism* Plato or his informants, specifically the Pythagoreans, had in mind when they proposed that the planetary conjunctions marking the turning-points of the Great Year cause deluges and conflagrations on earth? In order to answer this question, it is necessary to determine to what extent scientists until Plato's time distinguished between meteors, comets and planets.

5 Comets and planets related

Planetary theory seems to have taken off not much earlier than the sixth century BCE at the earliest. There is not a shred of evidence that the Greeks in the time of Homer and Hesiod were acquainted with any planet other than Venus, besides the sun and moon, of course. In Democritus' time, about 430 BCE, the total number of the planets was still open and the 'orbits of the five planets' were still not comprehended.[40] Plato, as seen, fixed the total number of planets at seven, but only provided the names of the sun, the moon, Mercury, and Venus.[41] The *Epinomis*, probably written by Plato's pupil Philip of Opus, offered the first complete list of planet names, but the author still showed little confidence regarding the non-divine name for Mercury and admitted that he only knew the planet's patron god, Hermes.[42] The full set of

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40 Seneca, *Naturales Quaestiones*, VII 3 1-2; compare Heath 1913, 128. Burkert (1972, 312) expresses disbelief: 'It is incredible that Democritus should not have known the five familiar planets'. But Seneca does not say that Democritus did not know the five planets: he knew the planets, but not their periods, and suspected there might be more planets than those. This is also how Huffman (1993, 260) understands the passage: 'Democritus is supposed to have written a book on the planets ... and a report in Seneca (A92) may suggest that he thought that there could be more than five planets'.

41 'Die Siebenheit der Planetengötter kam erst verhältnismäßig spät nach Griechenland. Noch Platon sagt im Timäus, daß mehrere Planeten (nämlich Mars, Saturn, Jupiter und Merkur) "noch keine besonderen Namen haben" ', Knappich I 1953, 115.

42 Pseudo-Plato, *Epinomis*, 986D-7D; compare Roscher's paraphrase: ' ... dass man

technical names of the planets — Phosphorus, Stilbōn, Pyroeis, Phaethōn, and Phaenōn — does not occur before the Hellenistic period.[43]

Planets and comets have in common that they wander through the sky with respect to the fixed stars and so the planets could at first be seen as the most recognisable subset of 'wandering stars', yet still fundamentally related to comets. Pre-Socratic philosophers did not draw a sharp line between planets and comets and repeatedly suggested a dynamic relationship between these classes of cosmic bodies, probably facilitated by the absence of a rigorous, Aristotelian distinction between the ethereal world of planets and stars on one hand and the elemental world of comets and meteors below. Some Pythagoreans, says Aristotle, held the view that a comet is a rare apparition of a planet:

> Of the Italian schools some of the so-called Pythagoreans say that a comet is one of the planets, but that it appears only at long intervals and does not rise far above the horizon. This is true of Mercury too; for because it does not rise far above the horizon, many of its appearances are invisible to us, and so it is only seen at long intervals of time.[44]

In the same breath, Aristotle notes that Hippocrates of Chios and one of his pupils strengthened the case for the affinity of comets and planets with the argument that the tails do not really belong to the comets:

> Hippocrates of Chios and his disciple Aeschylus held views similar to this. But they maintain that the tail does not belong to the comet itself, but that it acquires it when in its passage through space it draws up moisture which reflects our vision towards the sun. It appears at longer intervals than any of the other stars because it is the slowest of all in falling behind the sun ...[45]

Merkur u. die anderen Planeten ausser Venus nicht mit Namen nennen konnte, weil sie nicht von Griechen, sondern von Barbaren zuerst beobachtet wurden ... ', 1902, 2522 note *; further Bialas 1998, 142; Scherer 1953, 92.

43 Burkert 1972, 300 note 6

44 Aristotle, *Meteorologica*, I 6 30-72 (342b25-3b), tr. Lee

45 Aristotle, *Meteorologica*, I 6 1-2 (342b25-3b), tr. Lee

Diogenes of Apollonia (fifth century BCE), also classified comets as 'stars', according to Stobaeus.[46] In this respect, Diogenes agreed with the Pythagorean tradition.[47] Apollonius of Myndus (fourth century BCE), finally, is on record with the statement 'that a comet is not one body composed of many planets but that many comets are planets ... a celestial body on its own, like the Sun and the Moon.'[48] Apollonius traced the description of comets as planet-like bodies to the Babylonians.[49]

The association of comets and planets in these early astronomical contexts throws some much-needed light on the issue of Phaethon and the 'shifting of the bodies in the heavens'. As a Pythagorean, Plato's mouthpiece Timaeus could well have been one of those who, according to Aristotle, viewed planets and comets as closely linked phenomena. Perhaps Timaeus regarded Phaethon as one of a class of cometary bodies that cause fires and floods on earth at fixed intervals. If he did, what would he have made of the alternative associations of Phaethon with

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46 'Diogène dit que les comètes sont des astres.' Diogenes of Apollonia, Fr. T30 = A15 DK, apud Stobaeus, *Eclogae Physicae*, I 28 1a = Aetius, *Placita Philosophorum*, III 2 8, tr. Laks. The Greek is: *Diogénēs astéras einai tous komētas*.

47 'Des onze opinions rapportées dans le chapitre, Diogène (8.) est le seul, avec «certain pythagoriciens» (1.), à identifier, d'une manière ou d'une autre, les comètes à des astres.' Laks 1983, 196. Laks (1983, 196) interprets *astéras* as 'stars' rather than 'planets', suspecting that Diogenes' motivation to rank comets with stars was the common belief that meteors or 'falling stars' forebode the fate of *all* stars at the feared end of the cosmic cycle: 'Le rapprochement des comètes, dont la «chevelure» est signe de l'embrasement, avec l'existence d'une catégorie d'étoiles invisibles, étaye l'idée que les comètes ne se distinguent pas pour Diogène de ces pierres enflammées dont la course reste normalement cachée, mais dont la chute «fréquente» apporte une témoignage pour la constitution générale des astres ... ' This is a sensible idea, but the fundamental question why the stars would be believed to come down at the eschaton in the first place remains unanswered. In the light of the comparative evidence discussed here, the interpretation 'planets' is likelier. In Diogenes' time, the term *planētēs*, 'wanderer', would not yet have been in use.

48 Seneca, *Naturales Quaestiones*, VII 16 1, tr. Corcoran. I suspect Apollonius was Pythagorean, but have found no evidence for this.

49 'Apollonius says that the Chaldaeans place comets in the category of planets and have determined their orbits ... ' Seneca, *Naturales Quaestiones*, VII 4 1, tr. Corcoran. Corcoran has correctly translated *in numero stellarum* as 'in the category of planets'; Le Boeuffle's paraphrase (1989, 39) is more neutral: 'Il affirme ... que les comètes sont des astres qui, comme les autres ont un cours réglé par des lois constantes'.

various planets, in vogue at his time? Did Plato or his predecessors simply confuse planets with comets? It would be unfair to deny Plato — or Timaeus — the ability to have distinguished between planets and comets altogether. The *Timaeus* makes it sufficiently clear that the number of wandering stars was believed to be seven, leaving little doubt that at least Plato correctly distinguished planets from comets. What sort of other link, then, could have existed between the various ingredients of Plato's theory of catastrophe as laid down in the *Timaeus* — a conjunction of planets in one constellation, the fall of a possibly meteoric or cometary Phaethon, and the conflagrations and deluges experienced on earth?

6 Comets and conjunctions of planets

Yet another strand of Pre-Socratic thought distinguished comets and planets, but retained a generic relationship between the two. According to this theory, later supplanted by the Aristotelian paradigm, comets were not planets, but nevertheless derived from planets — planets in conjunction.

Diodorus does not put it so strongly, but includes 'the appearance of comets' in his list of atmospheric events presaged by the planets according to Chaldaean astrology.[50] This suggests that the 'Chaldaeans' somehow related the movements of the planets to the appearance of comets. Other and earlier sources reveal that the close encounter of two planets was regarded as an occasion on which comets could be formed. Democritus, for instance, opined that comets are a 'coalescence of two or more stars so that their rays unite'.[51] Anaxagoras thought along similar lines: 'Anaxagoras and Democritus say that comets are a conjunction of planets, when they appear to touch each other because of their nearness.'[52] 'He [Anaxagoras] held ... comets to be a conjunction of planets which

50 Diodorus Siculus, *Bibliotheca*, II 30 1-5

51 Democritus, apud Aetius, *Placita Philosophorum*, III 2 2, in Heath 1913, 125. In accordance with the common usage of the word, 'planets' are again meant by 'stars' as proper stars were not believed to be moving with respect to each other.

52 Aristotle, *Meteorologica*, I 6 1 (342b), tr. Lee; compare Dreyer 1906, 29; Heath 1913, 125.

emit flames ... '[53] A hint that Democritus' views were at least partially based on observation indicates that these puzzling notions were more than fanciful speculation:

> Democritus, however, has defended his view vigorously, maintaining that stars have been seen to appear at the dissolution of some comets.[54]

This event is possibly the same as the one associated with the Greek historian Ephorus of Cyme (fourth century BCE), who said that a comet once observed by all mankind 'split up into two planets, a fact which no one except him reports'.[55] Leucippus of Miletus (fifth century BCE), was cited to a similar effect: 'Comets are due to the near approach to each other of two planets.'[56]

These statements, though tantalisingly concise, seem consistent with each other, proving that the idea of a comet produced on occasion of a planetary conjunction at some point in time enjoyed a reasonably wide acceptance.[57] Zeno of Citium (fl. third century BCE), introduced the notion into Stoicism, says Seneca:

> Our Stoic Zeno has the following theory: he judges that stars come together and combine their rays, and from this union of light there comes into existence the image of a rather long star. Therefore, some suppose that comets do not exist but that only the appearance of comets is rendered through the reflection of neighbouring celestial bodies or through the conjunction of stars clinging together.[58]

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53 Diogenes Laertius, *Life of Anaxagoras*, II 9, tr. Hicks

54 Aristotle, *Meteorologica*, I 6 3 26-33 (343b), tr. Lee

55 Seneca, *Naturales Quaestiones*, VII 15 2f., tr. Corcoran. For 'two planets' Seneca again has *in duas stellas*, literally 'in two stars'.

56 Leucippus, apud Aetius, *Placita Philosophorum*, III 2, in Dreyer 1906, 29. The 'near approach' should probably be interpreted as a 'conjunction'.

57 'Anaxagoras explained comets to be produced by the concourse of planets and by their combined splendour. Democritus of Abdera, following Anaxagoras, conceived that comets were the result of a concourse of certain planetary stars. Apollonius and Zeno are reputed to have upheld very similar ideas ... ' Chambers 1909, 203

58 Seneca, *Naturales Quaestiones*, VII 19 1, tr. Corcoran

Seneca reviewed this theory as follows:

> Some of the ancient scholars favour this explanation: when one of the planets has come into conjunction with another the light of both blends into one and presents the appearance of an elongated star. This happens not only when planet touches planet, but even when they only come close. For the space between the two planets lights up and is set aflame by both planets and produces a train of fire.[59]

Aristotle marked an important turning-point in the history of Greek philosophy, as some of his central teachings were diametrically opposed to the views held by his predecessors, including Plato. The Pre-Socratic thinkers had grouped comets in the same region of the universe as planets and Plato had allowed for changes in the heavens, regarding the spheres of planets and stars themselves as imperfect in relation to the realm of the Ideas.[60] Aristotle suppressed Plato's 'ideal' world, postulated the absolute immutability of the visible heavens and on this agenda based his rants against the cometary theories reviewed above.[61] Because his model did not allow that 'perishable' objects such as comets and meteors could exist in the realm of stars and planets, Aristotle forcefully distinguished them from the planets and relegated them to the highest region of the four elements, that of fire, directly below the moon. Along with haloes, parhelia, auroras, and other unusual atmospheric phenomena, meteors and 'bearded comets' were now blended together into a single category explained by a single cause:

> Now when as a result of the upper motion there impinges upon a suitable condensation a fiery principle which is neither so very strong as to cause a rapid and widespread conflagration, nor so feeble as to be quickly extinguished, but which is yet strong enough and widespread

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59 Seneca, *Naturales Quaestiones*, VII 12 1, tr. Corcoran. By 'coming close' Seneca certainly does not refer to a collision, but to an obscuration, brought about when one planet moves in front of another and so visually blocks it out.

60 Plato, *Republic*, 529B, D, 530B. 'Plato was right against the view that Aristotle imposed on the world for centuries.' Shorey 2000, 184-5; compare James 1995, 122f., 128f.

61 Aristotle, *Meteorologica*, I 6 1-2 (342b25-3b) and against Democritus, I 6 3 26-33 (343b).

> enough; and when besides there coincides with it an exhalation from below of suitable consistency; then a comet is produced ...[62]

But although the notion that comets are formed during planetary conjunctions was permanently condemned, aspects of the pre-Aristotelian views, not lightly eradicated, continued to surface as late as the time of Seneca, and beyond. Seneca rejected the theory of comets formed during planetary conjunctions with as much ire as Aristotle had done, yet he rehabilitated the Pythagorean tenet that comets belong in the realm of stars and planets and not, as Aristotle had argued, in the atmosphere as a sort of illusory phenomenon produced by light effects.[63] Even Aristotle himself could not entirely dispense with the traditional association of comets and planets. Although he successfully repudiated the factor of planetary conjunction and identified the element of fire, not the starry ether, as the place where comets originate, the thinker still maintained that comets are formed as a result of the friction caused by the rotating spheres of the planets on the stationary spheres of the elements: ' ... when the exhalation is formed by the movement of one of the stars — either of the planets or of the fixed stars — then one of them becomes a comet.'[64]

Thus, even Aristotle, the champion of anti-Pythagorean thought, saw himself forced to retain the concept of comets somehow formed under the influence of planetary 'exhalations', and it was probably by the grace of this allowance that the idea of a close relationship between comets and planets could survive, although exclusively in the domain of astrology.[65] According to the renowned astronomer, Claudius Ptolemy, comets of

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62 Aristotle, *Meteorologica*, I 7 9-25 (344a), tr. Lee. 'Aristotle himself thinks that comets are in the nature of meteors, and that their range is in the region nearest the earth.' Chambers 1909, 203; compare Tester 1987, 67. This attitude is illustrated in Aristotelian works such as the treatise *de Mundo* (late third or early second century BCE), 2 (392a-b).

63 Corcoran VII 1971, xxii-iv

64 Aristotle, *Meteorologica*, I 7 (344a. 34-b. 13), tr. Lee. Seneca explained meteors and other types of illumination in the sky in a similar way, *Naturales Quaestiones*, I 1 5-6; II 14 1-2.

65 ' ... Saturn und Mars gelten in der hellenistischen Astrologie seit Alters als die Erzeuger von Kometen und sonstigen schlimmen meteorologischen Phänomenen.' Gundel 1928, 451.

particular types, 'the so-called "beams", "trumpets", "jars" and the like ... naturally produce the effects peculiar to Mars and to Mercury — wars, hot weather, disturbed conditions, and the accompaniments of these.'[66] A similar view was found in the co-authored book of the Egyptians Nechepso and Petosiris (second century BCE), quoted by Hephaestio of Thebes (fifth century CE), who claimed that the planets in astrology had strong cometary associations. Venus was associated with Hippeus, the horseman type of comet; Mercury with Xiphias, the swordsman and the torch-holder; Jupiter with the long-haired comet; Saturn with Doceus or Disceus; the disc-throwing comet; and Mars with Lampadias, the typhoon.[67] This view was rehearsed throughout the Middle Ages in the form that the planets, and Mars in particular, generate comets when in certain aspects and conjunctions; Albertus Magnus, Gerard de Silteo, Roger Bacon, and Aegidius of Lessines are given as examples.[68] Roger Bacon and Abū Ma'šar alike argued that conjunctions and aspects of Jupiter, Saturn, and Mars were important factors in generating comets.[69] As late as 1680 Cassini claimed that comets are the exhalations of other stars.[70]

Summing up, Pre-Socratic scholars not only held that comets and planets are closely akin, but they explained this kinship arguing that comets are produced when planets are in conjunction. This idea was successfully driven to extinction by Aristotle and Seneca. The ideas abandoned by Aristotle were first formulated at a time that the orbits of the planets had not yet been analysed and conjunctions could not be predicted. With the benefit of hindsight it may now be reasoned — correctly or not — that this interpretation of 'comets' was partly based on observations of splitting or disintegrating comets and meteorites, and partly on an optical illusion produced by the interference of the 'rays' of

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66 Ptolemy, *Tetrabiblos*, II 9, tr. Robbins

67 Nechepso-Petosiris, Fr. 10, apud Hephaestio of Thebes, *Apotelesmatica*, I 24 5-11; compare Campestrius, apud Lydus: 35ff., in Pingree I 1973, 76; Tester 1987, 66. Boll (1916, 26f.) suspected that these comets were named after the planets on account of their colours.

68 Schechner 1997, 94

69 Schechner 1997, 95

70 Bailey 1990, 99

the planets in conjunction; it is thought that two planets positioned near each other from a geocentric point of view each appear brighter than when they are 'lost in space'. As the citation from Zeno shows, the ancients had no means to distinguish such illusory streams of light from genuine comets and to them the link of planetary conjunctions with the purported comets — objects we now differentiate as actual comets and other atmospheric phenomena, such as meteors, haloes, and auroras — offered a realistic explanation for all comets, even if, in modern terms, comet formation has nothing to do with planetary conjunctions. Before it can be demonstrated that this substratum of early astronomy may form the missing link in the interpretation of Plato's *Timaeus*, it will be necessary to examine the role of the thunderbolt in the myth of Phaethon in a brief interlude.

7 The lightning connection

According to a widespread tradition, Phaethon was brought down by a thunderbolt from Zeus.[71] Given the preponderance of fire in the myth of Phaethon it is surprising, to say the least, that these mythographers needed to add a flash of lightning to their repertoire — as Ovid wrote: 'to quench fire with blasting fire'. This is all the more true if the motif of the thunderstricken Phaethon formed the oldest nucleus of the myth, as Knaack believed.[72] The excess of fire underscores the importance and the originality of the theme.

For a start, the theme of lightning is closely interwoven with the fall of comets and meteors. Nonnus poetically described the thunderbolt hurled to Typhon by Zeus as 'a writhing comet'.[73] Wainwright established that the symbol of the thunderbolt was widely employed in the ancient Near East to represent sacred meteorites.[74,75] In Egypt, the sacred

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71 Plato, *Timaeus*, 22C-D; Ovid, *Metamorphoses*, II 304-31. More than a dozen other references could be given.

72 Knaack 1884, 2183

73 Nonnus, *Dionysiaca*, I 509, tr. Rouse

74 Wainwright 1930, 35; 1931, 185, 189. 'The thunderbolt is the meteorite.' 1933, 43. Wainwright (1933, 49) assumed that the rationale for this association was the fact that meteorites often break to pieces on approaching the ground, whilst the thun-

object of the god Amūn at Thebes was a meteorite, yet at the same time Amūn was intimately connected with, if not actually derived from Min, the thunderbolt-god of Koptos.[76] At Seleucia Pieria in northern Syria Zeus Keraunios, the personified thunderbolt, was venerated as a sacred stone that must certainly have been a meteorite.[77] And the expression *asteroblēta keraunón*, 'star-flung thunderbolt', shows that the lightning was thought to traverse the sky like a meteorite.[78] From this perspective, Phaethon's meteoric associations, explored earlier, converge with his being struck down by lightning. Might the element of the lightning flash also make sense in terms of the theory of comets produced during planetary conjunctions?

Certainly many languages exhibit a strong lexical connection between words for 'lightning' and words for stars or planets,[79] but such etymologies prove little as long as the parallel meanings of 'lightning' and 'planet, star' can be derived from common roots meaning 'brilliance, shine, splendour'.

More informative are a few statements in the works of Pliny and Seneca that testify to a perceived relationship between lightning and various celestial bodies. Pliny reported a tradition according to which the three outer planets — Mars, Jupiter, and Saturn — have the capacity

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derbolt rends and tears to pieces anything it strikes. This explanation is unpersuasive, for the ancients rarely noted or emphasised the splitting of sacred meteorites. Instead, the comparison may have had a double basis: a perceived similarity between the lightning flash and the meteor presumed to bring down the meteorite; and the affinity of the meteorite to the thunderstone believed to come down in the lightning, especially if meteorites really do fall amid thunderous sounds, McBeath 2003.

75 The fourteenth century apparently saw a recrudescence of this association, for from that time onwards Welsh *draig*, *dragon*, and *dragwn* meant both 'lightning' and 'meteor, meteorite', just as English, *drake*, *dragon*, and *fire-drake* acquired the meaning of 'meteor', McBeath 2003, 36.

76 Wainwright 1930, 35-8; 1931, 185

77 Wainwright, 1931, 188f.

78 Wainwright 1931, 189

79 Klein 1987, 4 s. v. *'avrēq*; 86 s. v. *barqa'i*; Eilers 1976, 5f., 44; Pokorny I 1959, 124 s. v. 'bheleg-'; 1027 s. v. 'stēr-'; Scherer 1953, 20, 37f.; Moran 1971, 1326

to cast forth a peculiar type of lightning, that is different from the ordinary lightning produced by the 'clashing' of clouds:

> Those who pursue these enquiries with more subtlety think that these bolts come from the planet Saturn, just as the inflammatory ones come from Mars, as, for instance, when Bolsena, the richest town in Tuscany, was entirely burnt up by a thunderbolt.[80]

The theory 'known to the founders of the science' was relatively unknown even in Pliny's own time:

> Most men are not acquainted with a truth known to the founders of the science from their arduous study of the heavens, that what when they fall to earth are termed thunderbolts are the fires of the three upper planets, particularly those of Jupiter, which is in the middle position — possibly because it voids in this way the charge of excessive moisture from the upper circle (of Saturn) and of excessive heat from the circle below (of Mars); and that this is the origin of the myth that thunderbolts are the javelins hurled by Jupiter. Consequently heavenly fire is spit forth by the planet as crackling charcoal flies from a burning log, bringing prophecies with it ... And this is accompanied by a very great disturbance of the air, because moisture collected causes an overflow or because it is disturbed by the birth-pangs so to speak of the planet in travail.[81]

Pliny makes an attempt, perhaps not very successful, to explain the formation of Jupiter's lightning in terms of the current 'meteorological' model of the planets, which defined Saturn as cold, Mars as hot, and Jupiter as intermediate. Who were these 'founders of the science'?[82] One of Pliny's sources of inspiration here may have been the obscure Epigenes of Byzantium (probably second century BCE), cited by Seneca:

> The planet Saturn seems to Epigenes to exert the greatest power on all the motions of the celestial bodies. When it presses upon the constella-

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80 Pliny, *Naturalis Historia*, II 53 138f., tr. Rackham

81 Pliny, *Naturalis Historia*, II 18 82, tr. Rackham

82 According to Rackham (1991, 224 note a), Pliny's immediate source were the Etruscans.

> tion closest to Mars or passes into the moon's vicinity or encounters the rays of the sun, since it is windy and cold by nature, it attracts and collects air in many places. Then, if Saturn absorbs the rays of the sun there is thunder and lightning flashes. If it also has Mars in conjunction there are lightning bolts.[83]

This last statement is of profound importance: Saturn is thought to produce lightning bolts if it absorbs the rays of the sun and if it 'has Mars in conjunction'. As demonstrated, various early thinkers thought that comets were produced on occasion of planetary conjunctions. At least one early scholar now asserts that planetary conjunctions may also result in cosmic lightning. These loose strands of a nascent astronomical theory are not only compatible, but suggest that the 'comets' and 'thunderbolts' produced when planets meet are similar, if not identical phenomena.[84] This is also suggested by some cuneiform material that confirms Pliny's claim at least as far as Mars is concerned. According to these data, the Babylonian god of the planet Mars, Nergal, was able to emit fire. Various passages held the flaring-up of Mars responsible for the destruction of cattle.[85] The actual term used for these Martian flares is *mìqit(-ti) išāti(m)*, 'lightning stroke', literally 'fall of fire',[86] which Weinfeld astutely interpreted as a cometary or meteoric phenomenon. Weinfeld observed that Nergal, who shoots with arrow-stars, is called *Nergal ša šibṭi*, 'Nergal of the comet'.[87] Because the verb *šabaṭu* is in Akkadian associated with a strike of plague, Nergal's feared responsibility for plagues could have derived from the god's association with comets or meteors. The same

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83 Seneca, *Naturales Quaestiones*, VII 4 2, tr. Corcoran

84 For different reasons, Joseph Bidez (1904, 15) considered the possibility that the above statements in Pliny ultimately derived from Berossus' theory.

85 'Wenn der Mars aufleuchtet, geht das Vieh des Landes Amurru zugrunde'; 'Wenn das Aufleuchten des Mars gesehen wird, ist (Fall)en) im Land: Fall des Viehes'. Von Weiher 1971, 77. 'When the light of the planet Mars will be seen, there will be (lit. "fall" ...)) a pestilence in the land, there will be an epidemic against the cattle' Weinfeld 1983, 129 note 40.

86 Von Weiher 1971, 77 and note 3, 84f.; Gelb 10. II 1977, 100-2 s. v. 'miqittu'. 'The fire which issues from the planet of Mars, which appears in the role of Nergal ..., is called in Akkadian: *miqit išāti* — fall of fire ... ' Weinfeld 1983, 128 note 37.

87 CT. 42, 41. 68, in Weinfeld 1983, 130f.

association informs our understanding of Nergal's intimate connection with devastating fire: 'Resheph, Nergal and Apollo are connected with heavenly bodies, mainly with falling stars (meteors) which shoot like arrows — an action which characterizes a divinity of this type.'[88]

On these grounds I propose that Phaethon's meteoric aspect, vividly expressed by Ovid, is ultimately identical to the thunderbolt said to have brought him down. Perhaps Plato thought of this same 'thunderbolt' as the force that caused the cosmic conflagrations at the junctions of the 'Complete Year'.

8 A new solution

In the foregoing I have attempted to show that there is a surprising level of coherence in the pre-Aristotelian statements regarding the Great Year, planetary conjunctions, and cosmic catastrophes. This warrants the conclusion that Plato was drawing on a coherent, probably Pythagorean set of ideas that he presented in a synthesised model. One or two centuries before Plato, little was known about the orbits of the planets and the distinction between comets and planets, although existent, was blurred. Plato's mindset may have comprised the following beliefs:

1. that there is a Great Year, divided into two phases that correspond to a backward and a forward revolution of the planetary orbits as compared to the fixed stars;

2. that the two phases of the Great Year coincide with the alignment of all planets in one constellation;

3. that 'fire' — meteors, comets or lightning — is produced when planets are in conjunction;

4. that the meteors, comets or lightnings produced as a result of the conjunctions of all planets at the turning-points of the Great Year cause conflagrations, deluges, and other disasters on earth.

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88 Weinfeld 1983, 128f.

This theory is consistent with the earliest traditions regarding Phaethon, comets, and planets, and removes the discrepancy perceived by Gundel in the *Timaeus*. It makes good sense of the two relevant passages in the *Timaeus*, now seen to form a logical unity, and shows that Critias' statement regarding the 'shifting of the bodies in the heavens' (22C-D) cannot justifiably be interpreted as evidence in favour of planets displaced from their orbits, but was an essential part of the doctrine of the 'Complete Year', which held that, at the end of each phase of the cosmic cycle, the planets reverse the direction in which they revolve. Phaethon's role in the argument was absolutely crucial. According to this theory, the grand conjunction would have precipitated the formation and fall of luminous objects variously identified as comets, meteors, or planetary thunderbolts. As the latter two phenomena were known to be capable of reaching down to the earth,[89] they could serve as the *means* by which the universal destruction through fire or water would be brought about. The association of lightning and rain is well known. The blazing trail in Phaethon's wake, interpreted as the mythologised representation of a meteor, the thunderbolt that struck him down, or a cometary tail, set the earth alight and so caused the cosmic conflagration.[90]

The hypothesis that, in the Pythagorean theory, a comet would be formed on occasion of the planetary conjunction casts light on the persistent tendency to identify Phaethon as a planet — a former 'replacement sun', Venus, Jupiter, or Saturn. Such identifications must have been correct to the extent that the comet was indeed believed to have come into being as an 'exhalation' of the planets in conjunction.

Plato's successors subsequently retained only isolated components of the theory, suppressing its original integrity, and so it could happen that some, including Ovid, portrayed Phaethon as a meteor or a meteorite

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89 I doubt if the ancient Greeks were familiar with cometary impacts.

90 This solution appears to have been anticipated, though not spelled out, by Gundel, who noted that Kugler's meteoric interpretation of Phaethon's fall 'wahrscheinlich auf eine altpythagoreische Kometentheorie zurückgeht, die bereits Plato und Aristoteles nennen ... ' (1928, 451). The only 'Old-Pythagorean comet theory' that Gundel could have been referring to is Plato's connection of Phaethon with the Great Year and Aristotle's discussion of the theory that comets relate to planetary conjunctions. As seen, this insight did not prevent Gundel from seeing a discrepancy between the various passages in *Timaeus* and *Politicus*.

without a reference to the Great Year, others taught that comets are formed during planetary conjunctions, and yet others, notably Berossus and Seneca, propounded the doctrine of the Great Year and its catastrophes without a reference to comets, meteors, or Phaethon. Aristotle radically minimised the scale of the deluges occurring on the turning of the Great Year, suggesting that they merely involve 'a great winter and excess of rains' and that Deucalion's flood was no more than a local mishap.[91]

Needless to say, such a Pre-Socratic theory of a comet or 'thunderbolt' formed as a product of the great linear conjunction was not necessarily correct from a modern perspective. As seen, Plato hesitated somewhat to accept the theory of the conjunction of all planets, not because the concept lacked intrinsic value, but because there was not yet enough confidence in the orbital periods of the planets and so the theory could not be verified with calculations. This indicates that the theory of the great conjunction did not derive from actual observation of the great conjunction itself, but from philosophical conjecture. However, the origin of the curious association between planetary conjunctions and the igneous 'exhalations' they formed is an altogether different matter, beyond the scope of the present investigation.[92]

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91 Aristotle, *Meteorologica*, I 14 (352a); compare Macrobius: 'Never does a flood or conflagration sweep all lands and the whole race of men, however', *In Somnium Scipionis Commentarius*, II 10 14, tr. Stahl.

92 As said, observations of disintegrating comets and illusory streaks of light are a potential source for the idea, but the extrapolation of such information to a great conjunction involving all seven planets requires a stretch of the imagination, especially because the great conjunction was coupled with the theme of global destruction. Other explanations may be contemplated. There appears to have been more cometary activity during the 3rd and the 2nd millennia BCE than afterwards, Bailey 1990; Clube 1982. It has also been found that the 'auroral ovals' extend much further towards the equator at the time of planetary conjunctions. And plasma physicist Anthony Peratt (2003), of the Los Alamos National Laboratory, New Mexico, has recently proposed the occurrence of a high-energy aurora that would have produced possible prototypes for the objects interpreted as a conjunction of all planets and the comets formed on that occasion.

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