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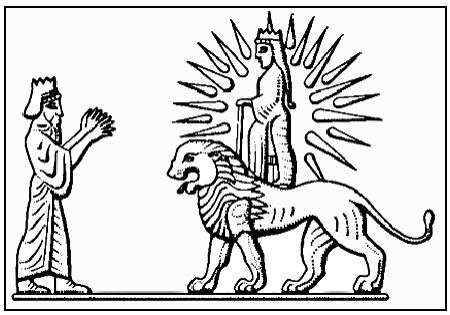

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"Astronomical Reflexes in Ancient Coins"

SALVO DE MEIS

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ASTRONOMICAL REFLEXES IN ANCIENT COINS

Salvo De Meis

Representations of dateable astronomical subjects are not very frequent in coins, however those which can be found are of considerable interest. First, because of their rarity, then for the related aspects which range from history, philology, dating, and, not least, aesthetics.

It is known that early coins were first minted on one side only (*rectum*, obverse), and short legends or decorative images (kings, gods, city symbols) were included; afterwards the other side too (*versum*, reverse) was decorated, and then, instead of the *quadratum incusum*[1], other images appeared, such as auxiliary ones or marks.

The main purpose of coins was commercial exchange, the preferred payment for soldiers or mercenaries, or goods and commodities. The so–called gold Δαρ[ε]ικός (fig.1) with the image of Dareios in kneeling schema, with bow and arrow, was quite often a corruption means, sometimes with better results than the army itself.[2]

In classical Antiquity, the first form of money appeared in Greece, around 630 B.C., near Pheidon of Argos, and the oldest gold and silver[3] coins are attributed by Herodotus [1, 94,1][4] to the Lydians (who claimed to be the inventors and first users); mention of this is in a fragment of Xenophanes[5], taken as good by Herodotus.

Anyway one of the coins type was the σίγλος, what shows a Mesopotamian derivation (akkadian *šiklu*).

The first coins were minted in Aigina, then Corinth and Athens, while Sparta started only in the 3rd century B.C.

In the obverse were represented also private people or the town symbols, such as the bee of Ephesos or the lion of Lydia, while the coins for soldiers had kings' heads.

Legends such as town names, mint symbols or even year and month are of later use, and include figures such as beasts, winged horses, corn ears (for Demeter), apples (μέλος) for the city of Melos, the head of Pallas for Athens.

This raises the question whether actually there were coins with astronomy related symbols, or if the heads of Zeus, Athena or Nike were just those of the protecting gods, not the images of stars and planets, and then the eagle of the Ptolemaioi must not be confused with the constellation Aquila.

1 It is the trace of the square punch which was put underneath the metal to be coined, to keep it still. It was formed by four parts crossed by two perpendicular grooves. Later the form evolved into more elaborated shapes, such as divisions in triangles.

2 See Roaf 1992, 202. Also Head, Historia Numorum[2], 825; R. N. Frye, personal communication.

3 Very early coins were made of elektron, an alloy which contained other metal besides gold.

4 Λυδοὶ γὰρ καὶ πρῶτοι ἀνθρώπον ἡμεῖς ἴδμεν, νόμιωσμα χρουσοῦ καὶ ἀργυροῦ κοψάμενοι ἐχρήσαντο.

5 Diels 1903, Frg. 4, Pythagoras, Xenophanes, 4, 47.

Similarly, the Dioscuri of the second century are not to be regarded as representations of the zodiacal sign; they were also represented in bigae or quadrigae, and Sol, Hercules, Jupiter were the gods, not the astronomical subjects.

In Seleucid, Partian, Bactrian coins one finds images of kings, such as that of Seleucus I Nikator, which had so much importance for the Seleucid Era, mostly used in Babylonian astronomy.

Seleucus is represented in a tetradrachm[6], with a leather helmet, bull's horn and ear; the reverse shows a Nike crowning a panoplia and with the legend ΒΑΣΙΛΕΩΣ ΣΕΛΕΥΚΟΥ and a monogram. (fig. 2)

The figure of king with lion head is also in coins of Alexander the Great, such as in a tetradrachm[7] (in the Berlin Museum) minted after the king's death.

Mints were not always local, and for example coins were imitated in Gallia or Britannia, such as at Massalia[8], the gold stater of Philip II (fig. 3); this is another aspect of the studies of ancient coins, which give information concerning not only commercial, but historical, military, economical themes as well.

The diffusion of coins generated of course falsifications already in early times, and laws were made against it, such as in Rome the Lex Cornelia testamentaria nummaria[9], which punished slaves with death and free people with exile; and after Constantine's time falsification of coins was considered as falsification of kings. Other laws, such as the Aternia et Tarpeia (454 B.C.) and Menenia et Sestia (451 B.C.)[10] stated the values of metal as exchange value, to

6 Baumeister 1887, No. 1107.

7 Baumeister 1887, No. 1095.

8 Massalia, now Marseilles, was founded by the Greeks around 600 B.C. as Μασσαλία. It seems that the copying of these staters was made due to their vast circulation, or after the Roman preys at Kynoskephale (197 B.C.) and Pydna 168 B.C.); the typical Celtic stylization transformed slowly the heads into other forms, horses into sticks-and-globes, in a sort of abstract art. Even in this situation there have been tentatives of seeing astronomical events in representations which are not only almost undecipherable, but without any sort of documentation, seeing comets and novae everywhere. The horse, even stylized as a large eye, has been understood as a sign of observation, but no historical evidence has been given to support such alleged dating. The horse remains the main motif of these coins. The evolution of the original stater to the Celtic one is clear from the figure 3, which, for example, shows how the legend ΦΙΛΙΠΠΟΥ degenerated into various decorative motifs, presumably also because the Celtic artisans did not understand what they were copying or wanted to show their interpretation. A coin with the legend CN.CORNEL.L.E ("Münzmeister", *triumvir monetalis,* in –86, Kl. Pauly 1311,n.47) has been erroneously interpreted as celebrating the solar eclipse of –119 November 11, "proof " of the Roman victory on the Gauls. Besides the time error, there is no document for this eclipse, which anyway was barely visible due to the low magnitude at Rome and Gallia (about 0.65) if not predicted (very difficult then) or because of clouds, in which case no "proof" could be claimed. (as L. Zimmermann, claims in Sky & Telescope, March 1995, 28-29. The author even invents a comet for the year –16, as the one inspiring Augustus to celebrate Caesar's comet of –43).

9 Ulp. Dig. 48, 10, 9. An example [Babelon 1885, 148] is the legend: M.SANQVINIVS Q.F. III VIR. A.A.A.F.F.S.C., meaning Marcus Sanquinius Quinti Filius, triumvir, aere, argento, auro, fiando, feriundo, Senatus consulto, stating the authority of this triumvir monetalis.

10 Cic. De Rep. II, 60 quotes that "*quarto circiter et quinquagesimo anno post primos consules* [i.e. 454 B.C.] *de multa et sacramento, Spurius Tarpeius et A. Aternius consules comitiis*

replace the use of animals for commerce. And the penalties for non observation of the laws were quite severe.

To remain within the subject of truly astronomical representations, one must anyway consider the mythological aspects which were transferred to stars and planets, already since Babylonian times, when the stars were gods. Such is the case of many coins, until we find that some astronomical event actually occurred and was celebrated; the danger is that some modern writer distorts the interpretation by seeing in the minted figures astronomical meanings, which are fully a product of his imagination, instead.

This is a real danger for the studies, because it is a poisoning of information for the beginners or for non specialized people, and a cause of irritation for the serious scholar, and although it is not a novelty, still it is a sign of lack of honest study, which spreads in many publications, even in some astronomical journals.

To have an astronomical meaning a coin must have a clear reference to a documented event, so that historical and philological data can support the identification, or that the event has been recalculated beyond doubts or it is historically known. This explains their rarity.

One of the most important examples is the silver denarius (fig. 4) struck during Augustus time[11]; the obverse shows the laureate head of the emperor with the legend CAESAR AVGVSTVS, while the reverse has a star with eight rays, one of them showing a sort of plume, an allusion to a comet tail, and the legend DIVVS IVLIVS. Another coin has the legend IVLIVS CAESAR, and has the head of Caesar, laureate and with a comet above.

These denarii celebrate the comet which appeared in 44 B.C., and which Augustus[12] with a clear sense of politics accepted that it was the soul of Julius Caesar, also taking it as a favourable omen, contrary to the common belief on these celestial bodies. He moreover put a crown on the statue of Caesar, as it can be seen in an aureus issued by the emperor[13] and in a denarius of L.Lentulus[14]. Plinius [NH, 2,23] writes that the emperor dedicated a temple to the comet that was seen during the *ludi*, the games he ordered to celebrate *Venus genetrix*; in fact other coins have a temple, such as we see in the aureus of 36 B.C. where a star is shown on the temple pediment, or that with a Salic priest (one of those dancing at the games) with stola, caduceus and round shield, and the legend AVGVST. DIVI F. LVDOS SAEC.[15], a clear dedication of the *ludi saeculares.*[16]

centuriatis tulerunt" and continues on the value of animals for interchange; Aul. Gel., XI, 1, 2.

11 Babelon 1885, II, 84, nn. 261-264, dates it at the first year of Augustus' empire, 17 B.C.

12 Commentarii de vita sua, fr. VI, also quoted by Plin. NH 2, 94. *Ipsis ludorum meorum diebus sidus crinitum per septem dies in regione caeli sub septemtrionibus est conspectum. Id oriebatur circa undecimam horam diei clarumque et omnibus e terris conspicuum fuit. Eo sidere significari vulgus credidit Caesaris animam inter deorum immortalium numina receptam, quo nomine id insigne simulacro capitis eius, quod mox in foro consecravimus, adiectum est.*

13 Babelon 1886, II, 417-8.

14 Issued in 12 B.C., see Zanker 1990, fig. 25.

15 Babelon 1886, II, 416-8. See also Zanker 1990, fig. 26.

Cassius Dio [45, 7, 1] quotes the appearance of the comet as an astral apotheosis. Other quotations are in Suetonius [Caesar, 88, 2; Aug. 10,2], Seneca [NQ, 7, 17, 2], Plutarch [Caesar, 69, 3], etc. Among the first ones to attempt locate the comet in the sky was Halley, who believed that the comet of 1680 was a return of it[17], and further was Lubienetzki 1681 [tab. 63, n. XLVI][18], but Riccioli[19] already had given a better dating, 44 B.C.

Even if the literary texts do not give precise astronomical information, I recalculated in 1990 the comet's orbital elements, and its position as seen from Rome can be derived from them, confirming the historical data of the observation mentioned by Augustus in July, not in September as it was assumed before[20]. Moreover, Chinese and Korean records[21] have independent mentions which are quite consistent with the observation of this comet; they were made during the fifth year of the reign of Chhu-Yuan[22]; fig. 5 shows the path of the comet in the sky, in a map with modern limits and Chinese constellations in the background in an updated orbit[23].

D.K. Yeomans of JPL, the leading cometary expert who studied this comet deeply [Yeomans 1991, 13, 367], confirmed me that he agreed that the Roman and Chinese observations concerned one and the same comet.[24] Another path is based on a different orbit [Kronk 1999, 22-23], but mine is higher in celestial latitude, thus corresponding better to Augustus' words (fig. 6). Such difference can be explained by the few data available, hence the incertitude in the orbital elements. Another question is the luminosity of the comet; a burst has been proposed, but this is not necessary, as we do not know exactly the magnitude from the observations.

The appearance in Rome might have been in the *undecima hora*, as quoted by Augustus in his *Commentarii de vita sua*, that is about 17 to 18 hours, Local Time, *in regione coeli sub septemtrionem*.

But while this conclusion meets the requirements of convergence of historical, philological and astronomical data derived from the coin, there are other cases full of absurd attributions and even alleged "historical" and astrological conclusions, which must be dismissed.

16 These were held in 17 B.C., confirmed by Censorinus, *de die natali* [17,11], but their sequence was not always 100 years; Censorinus [17, 10 sqq.] gives many dates, while in 17,7 he states that the measure of the Roman saeculum is left to incertitude; cf. too RE, s.v. Saeculum.

17 Halley 1715, II, 881-905.

18 Lubienetzki 1681. Often without astronomical support for ancient comets, however.

19 Riccioli 1651, Lib. VIII, Cap. III, 5.

20 For example, in the otherwise useful Pingré 1783, 277-278, followed by many others.

21 Ho Peng Yoke 1962, 127-225; the comet's records are at number 59 of the catalog.

22 King from 49 BC to 33; his dynastic name was Yuan Di, Chhu-Yuan is the "nian hao", the augural name until 43 BC.

23 For the sky map I used that of Ho, to which I superimposed the path of the comet.

24 Letter of 1991 May 30.

A simple one is the mention of a solar eclipse at Caesar's death[25], but it can be calculated with precise astronomical methods that no eclipse was visible in the known world in –43[26], and that from –50 to –40 four small eclipses occurred in Rome, the last on –47 Jan 4, but of magnitude 0.199, almost invisible if not predicted, hence the search is hopeless.

Other examples are typical of wrong identification from coin images.

One concerns a coin of Antioch, which has been misused even to date the birth of Christ[27]. It is a bronze of a Quadratus (fig. 7). The obverse shows a Tyche, that is Τύχη κτητική or ἀξιωματική, that is the fortune of acquiring, or of honors.

The reverse shows a ram with its head turned back, a crescent and five dots. The legend is :

ΑΝΤΙΟΧΕΩΝ ΕΠΙ ΚΟΥΑΔΡΑΤΟΥ ΕΤ ΕΡ. Now, the legends of other coins from Antiochia have names of *legati*, such as ΣΕΣΤΙΟΥ, ΜΟΥΚΙΑΝΟΥ, and C. Ummidius Durmius Quadratus was *legatus* to Syria. The mark ΕΤ ΕΡ means ΕΤΟΥΣ ΕΡ, that is year 105, corresponding to 58/59 A.D., counting from the Caesarian Era[28].

According to M. Molnar[29], the ram "is looking at a crescent Moon and a star". This induces him to state that it represents the lunar occultation of Venus of April 27, 51 A.D. and that the ram is looking at the Moon because of the exceptional event.

Such conclusions are completely wrong, because:

- The ram is Aries, traditionally represented with its head backwards, according to Manilius [Astronomicon, IV, 506] "*cervice prior flexa quam cornibus ibit*" and [ibid. I, 284] "*respicit admirans adversum surgere Taurum*", and other authors have similar statements.

  Hence there is to wonder at statements concerning the animal looking at something else, unless more specifically proven by the three criteria mentioned.
- There is no good reason to state that "the star" on the coin is Venus or another planet, and, moreover, one asks why to celebrate seven years later an event which, in the case of the Venus occultation, was unobservable and undocumented.

  In fact the occultation quoted occurred in the region during daytime, and with the Moon's illumination of 0.06 only, that is a very thin crescent, only 19° high, the ingress occurring at the illuminated side. Hence the occultation was not visible, and moreover in the year +51 it is most likely that it could not

25 Vergil, Georg. 1, 466-9, and Servius *ad loc.*; Plin., NH 2, 98 mentions *prodigiosi et longiores solis defectus*, etc. Servius writes of an eight-hour *defectus*, an impossible eclipse.

26 The annular eclipse of –43 April 18 was visible in South America and Antarctica, the total one of October 12 was visible from Kamchatka to North America.

27 It should be clear that at present such dating is impossible, as the sources are very vague and documents non existing, and that the "star" has just a religious meaning and that the word of the Evangelist is ἀστέρ, which may be a nova, a comet, or otherwise.

28 Bickerman 1968, p. 73 and n. 60, indicates that the Era of Caesar (or Pharsalus) begun on 48 B.C. in June.

29 The Coins of Antioch, Sky and Telescope, Jan. 1992, 37-39.

have been calculated in advance to allow for preparation of observations or anyway for a prediction.

- It can be seen on the contrary that five dots are represented, and, if any, the Pleiades *could* be taken into account, also due to the form in which the "stars" are displayed.
  For example in the Aratus Codex Vossianus[30], the Pleiades are in a circled disposition around a centered figure, as in the coin.
  In the year +56 several lunar occultations (or close approaches) of the Pleiades were visible from Antiochia, on March 9, April 5, June 26, August 20, November 9, all at the border Aries-Taurus, and this *might* be a reason for a celebrating coin, although historical data are wanted for a reliable dating.
- A very similar coin was issued by Antoninus Pius in a set of zodiacal signs (fig.8), see below, without any reference to observed phenomena; also the other signs have stars: phenomena here too?
- It is enough to look at F.H. Cramer's work[31], where 9 pages of coins with crescent (and crescent with stars) are listed, or to an Etruscan coin with crescent and 9 stars[32], to exclude – without need of historical proof – astronomical events; or to browse through the many illustrations of the classical handbooks of numismatics[33] which represent images that somebody, without any solid reason, could wrongly associate to astronomical phenomena.

Hence, caution must lead research, and Molnar's dating is to be rejected, with his conclusions.[34]

Similarly, in the falsification of the gold stater of Philip II, in Gaul a progressive stylization occurred[35], however somebody, without historical and philological support has even claimed that the obverse represents the Sun, the Moon and a hypothetical comet, of which even a dating is proposed without proof!

Incidentally, Molnar seems to specialize in proposing almost non observable phenomena, such as a conjunction Mercury-Jupiter in +106. This occurred on August 13 at 8:24 UT, hence in daytime and moreover at only 9° of elongation from the Sun, hence not visible. However Molnar uses it to date a coin of Traianus[36], which has two heads (claimed, without reason to represent Mercury and Jupiter) and a star in the obverse. Besides the invisibility of the planets, what the star means is not revealed by Molnar. The type is however the same of other coins with the legend NERVA ET TRAIANVS.[37] Moreover the coin is a *restitutio* of a former one, as the legend states: IMP. CAES.TRAIANVS.AVG.CC-IDAC PP.REST, hence again the dating is wrong. The complete name of the emperor

30 Fol. 42^{v}.
31 Cramer 1954, 31-39.
32 EI XIV (1951), 536 Tav. C.
33 Babelon, Cohen, Mac Donald, Mattingly, Belloni, for example, quoted *infra*.
34 Not to speak of other similar "datings" concerning the birth of Christ.
35 See EI XVI (1950) 311 s.v. Gallia ; EUA III (1971) 270 s.v. Celtiche, correnti; Olmsted 2001, plates 63-70.
36 Mercury, Jan-Feb 1995, 26, fig. 8.
37 Gnecchi 1907, 105.

was Marcus Ulpius Nerva Traianus Crinitus, anyway, as the young consul was adopted by emperor Nerva on 27 October 97 in the occasion of the revolt of praetorians, and named co-regent as well.[38] Also Plinius in his Panegiric of Traianus refers about the deification of Nerva by his adoptive son.[39]

Evidently Molnar is particularly unlucky with astronomical phenomena and Roman politics, and we wonder what he could derive from the Thracian coin in the British Museum, which has a crescent and nine stars above plus two below[40]. Even, there was no quintuple planetary grouping during the period of Nerva and Traianus[41].

A type of coins has the figure in the reverse, being a negative silhouette of that one in the obverse, resulting from a coin put underneath the metal while minting or from a simplified sketch of the obverse. One is from Poseidonia[42], as the legend ΠΟΣ shows; similar images, say bulls, in both figure-and-silhouette forms are from Sybaris. In this case the god is Neptune, the god of the town, shown with his trident.

A tetradrachm from Samos with the legend ΛΟΧΙΤΗΣ and the mark ΣΑ(μίων) has a protome of bull[43], as in the common representations of Taurus, and it might be "the warriors of Samos". (fig.9)

Another from Gela (ΓΕΛΑΣ)[44] has also a protome of bull with human bearded face. This is no recollection of the Mesopotamian anthropomorphic bulls, but the personification of the river god Acheloos, which is a mixture of the myth according to which Herakles broke the horns of Acheloos and another legend which names "Acheloos" every underground water. Such myths expanded both in Magna Graecia and in Athens.[45]

An interesting set of coins (actually medals) with astronomical and astrological images was issued by Antoninus Pius[46] in the year 8 of his imperium in Egypt and in later years, to celebrate the return of the Sothiac cycle in +139 [47]

38 Kl. Pauly s.v. Traianus, col. 920, 6.
39 Cramer 1954, 151-153.
40 Cramer 1954, No.58, B.M., Thrace, p. 165, No. 33.
41 De Meis 1994, Table 1.
42 Baumeister 1887 No.1024
43 Baumeister 1887 No.1063, tetradrachm from Samos; shows the Vitta (sacrificial crown), laurel bough, and a bee.
44 Baumeister 1887 No. 1136.
45 Kl. Pauly. s.v. Acheloos.
46 The diagram is modified from Flammarion, Le terre del cielo, Milano 1913, 70. See also Gundel 1992, Kat. No.254.
47 This "Sirius period" or cycle of 1461 Egyptian years (1460 common), has been deeply studied by Neugebauer 1938, with the conclusion motto "Lasciate ogni speranza". According to Censorinus, De Die Natali, c. 18, writing in +238, the Sothiac period reoccurred "*abhinc annos centum Imperatore Antonino Pio II et Bruttio Praesente Coss., iidem dies fuerint ante diem XII. Kal. August., quo tempore solet canicula in Aegypto facere exortum*", that is in +139. Ideler 1806, 76-94, writes that Censorinus gives a reliable date for the heliacal rising of Sirius, and makes further calculations. The whole question deserves however a special study. As the Egyptian year is of 365 days and the Julian one 365.25, the difference will be 365 days after 365/0.25 = 1460 years, the length of the annus sothiacus or canicularis, because the date

and thus the beginning of a new period for the world, in coincidence with his own new power; it was around this period that Ptolemy was flourishing[48](again in fig. 8).

The letters LH are in all the coins, meaning 58, the age of Antoninus, born on September 19 of +86[49], and show that the year was +144/5.

One of the images represents Antoninus and the full display of the Zodiac and of the gods, and especially important is another one [Gundel 1992, Kat. n. 128] which has two concentric Zodiacs with the same beginnings, thus probably showing the coincidence of the vague year and the Sothiac cycle.

It is well known the attitude towards astrology of Nerva and Traianus, and Antoninus is equally faithful to it, especially in his stay in Egypt[50], and so the figures represent the various zodiacal signs and the gods in their ὑψώματα[51]: Aries (f.)-Mars; Taurus (f.)-Venus; Gemini[52](m.)-Mercury; Cancer (f.)-Luna, Leo (m.)-Sol; Virgo (f.)-Mercury; Libra (m.)-Venus; Scorpius (f.)-Mars; Sagittarius (m.)-Jupiter; Capricornus (f.)-Saturn; Aquarius (m.)-Saturn; Pisces (f.)-Saturn.[53] The gods are represented as busts with a πόλος above their heads.

Of interest is also a coin representing Augustus with a foot on a globe with circles (fig.10), and another one from Carrhae, with star, crescent and globe on a basis, which is in the Hunterian Collection [Mc Donald pp. 301-2], minted by

would let coincide the 1st Thoth and the heliacal rise of Sirius (Sothis), and that every 4 years the date will change of one day. Now, besides Neugebauer's considerations, it can be shown by recalculation that, for example from +131 to +143 the 1st Thoth occurred in a range from July 22 to 19, while the heliacal rise of Sirius at latitude 30° (Memphis or Heliopolis) was around July 19 or 20 or 21, according to values of the arcus visionis of –10°, –11°,–12°. With the same values, that heliacal rise occurred from –1330 to –1317 about July 17, 18, 19. The difference of one day has no importance for the heliacal rising, subject to many variables, but the point is that for several many years there is no specific year in which the coincidence Sirius rising-Thoth is one and the same. This means that many years can be found in which the "sothiac" year may have been renewed. Really, "lasciate ogni speranza", but Antoninus did not know it (or used it on purpose).

48 Toomer 1984, 1, states that taking care of the Canobic Inscriptions, "the Almagest can hardly have been published earlier than the year 150". Ptolemy's observations in his book range from +127 to +141, hence in Antoninus' time.

49 The hybrid Latin and Greek notation is L = 50, H = 8.

50 See Cramer 1954, 146-154.

51 Bouché-Leclercq 1899, 195.

52 It is of interest to note that instead of the Dioskuroi Castor and Pollux (represented as naked youngsters), here Herakles (with clava and lion skin) and Apollo (dressed, near a quite large lyre) are shown. Sometimes Amphion and Zethos, Boeothian Dioskuroi are represented in other zodiacs, such as for example in the Bianchini Egyptian planisphere [Boll 1903, 305]. This was found in Rome and, robbed by Napoleon, is now in the Louvre. A mention of Herakles and Apollo as Gemini is in Hyginus [Astr., II, 22] and Manilius [II, 440] quotes "formosus Phoebus" as protector of Gemini. Incidentally a Carolingian manuscript has a miniature with Herakles and Apollo as Gemini. See Gundel 1992, p. 328 Kat. No. 460 (2).

53 The abbreviations "m." and "f." mean masculine and feminine, according to the nature of the sign, and of the night or day "house".

emperor Lucius Aurelius Verus, as the legend ΛOYK AV HO VHPOC shows. Another shows the head of Augustus, crescent and seven stars[54].

This last image is rather known also for other issues, such as that of TVRPILIANVS with one large star [Cohen 1880, 135 n. 495] and crescent, or others with more stars. In Cohen[55] and Babelon[56] we find a silver denarius of 74 B.C. with a horizontal crescent, seven stars and the legend TRIO, a sort of rebus for Septemtrio, and below the crescent L. LVCRETI; the obverse has a Sol, that is a head with radiuses. L. Lucretius Trio was one of the *triumviri monetales* encharged to mint money.

This coin was reissued, with slight modifications, by Traianus after about two centuries, as we can see from the legend in the reverse IMP.CAES.TRAIAN.AVG.GER.DAC.P.P.REST.[57]

A silver denarius and a three denarii worth kistophorous[58] are shown with the figure of Capricornus. This was the zodiacal sign adopted by Augustus, although he was born under Libra[59]. Suetonius [Aug. 94, 12] gives a *post quem* explanation concerning the horoscope cast by the astrologer Theogenes, and there is abundant literature on this subject, with variations on the theme and would-be justifications, based on the claim that the horoscope was referred to the *dies genitalis* or instead to the *dies natalis*, that is the dates of the conception or of the birth of the emperor[60].

A denarius with (obverse) a head of Augustus and AUG. DIVI. IL and (reverse) a capricorn with a globe and IMP. XI, is dated in EI[61] as of 12-11 B.C. Further images and comments can be found in Zanker 1990; of interest a denarius representing Octavian with a foot on a globe, which has a net of meridians and parallels[62].

However, Vespasianus too was not born under Capricornus[63], but he as well issued a coin with capricorn and a (starred) globe below, besides another one with two capricorni (and SC, *Senatus Consulto*).

The choice of the sign can be traced in Firmicus Maternus [Math. 8, 28, 1]: *in prima parte Capricorni quicumque habuerit horoscopum erit rex imperator*. [64]

54 Cohen 1880, 84, N. 142.
55 Cohen 1880, 85
56 Babelon 1886, II, 580 N.32
57 "P.P." stands for "pater patriae".
58 κιστόφοροι were originally tetradrachms from Asia Minor and Creta, later used by Romans: Cicero (proconsul), Augustus, Vespasianus for example. The name derives from the "cista mystica" of Dionysos in which where ivy garlands.
59 Augustus was born on September 23, 63 B.C., *paulo ante solis ortum,* as in Suetonius (*Aug. 5*).
60 See Cramer 1954, 83, who dates the horoscope of Augustus to +11, even if his coins with capricorn were minted in –27 [Kraft K. JNG 17 (1967), 17-27]*.
61 Enciclopedia Italiana, vol. XVII, s.v. "Globo".
62 Zanker 1990, fig. 31a, also in Gundel 1992, 61 and Kat. No.306.
63 According to Suetonius, Titus Flavius Vespasianus Augustus was born near Rieti on November 17, 9 A.D.; hence his sign was Scorpius. [v. RE, KP].
64 See Domenicucci 1996.

A brief note about celestial globes for their correlation with astronomical coins is in order here.

Several art documents represent a personage with a globe and a "radius"; the coin of Samos, minted in 230 A.D.[65] represents Pythagoras sitting and with radius and globe, to commemorate his wisdom, and the legend is ΠΥΘΑΓΟΡΗΣ ΣΑΜΙΩΝ, to confirm his birthplace. (fig. 11). The coin is reproduced also in the frontispice of Diels 1903. A similar coin from Klazomene has Anaxagoras in the place of Pythagoras[66], others show Urania. For example, an image of Urania with globe and radius is on several coins issued by Q. Pomponius Musa in 68/66 B.C.[67] and the globe has traces of the zodiacal limits. Moreover the support of the globe has been interpreted as a mere base, and according to Schiaparelli it might have been a *dioptra*[68]; however in other coins the support is clearly a tripod or a column, such as we shall see in the coins showing Pythagoras and Hipparchos.
Similar Roman coins with Urania or other personages with globe and radius were issued also by Augustus, Traianus or Commodus[69]

A coin issued at Nicaea by Alexander Severus (III century A.D.)[70] shows Hipparchos, the greatest astronomer of Antiquity, with a globe in front of him. (ΙΠΠΑΡΧΟΣ ΝΙΚΑΙΟΥ). (fig. 12).

The globes were used not only to study astronomy and mathematics, but also to give visual help in the readings of the astronomical poems such as Aratus' Φαινόμενα or later the Aratea, and the Byzantine Leontios gives precepts for their fabrication: περὶ κατασκευῆς Ἀρατείας σφαίρας;[71] their use for predictions of stellar phases was indispensable at that epoch, and Ptolemy [Alm. VIII, 3] gives precepts for the construction of a solid star globe.

Cicero writes [de rep. I, 14, 21] that Philus[72] (one of the participants of the dialogue) refers that C. Sulpicius Gallus predicted the lunar eclipse of the battle of Pydna (–167 June 21)[73] and that in the house of M. Marcellus he had seen a mechanical orrery built by Archimedes, which was taken to Rome as war prey[74]. Such globe was sung by Ovid in Fasti VI 277-8[75]. Again Cicero [de rep. I, 14, 22] indicates Thales as the inventor of the solid globes, and it was Anaximandros who first postulated that the universe was a globe[76].

65 BM
66 RE VII, 1428, 18.
67 RE XC, s.v. Zodiakos, 617, 23
68 This is reported by Tabarroni G., Sfere celesti nelle monete romane, but without precise indication of the source.
69 Tabarroni G., *cit.*, Gundel H. RE XC, 617 sqq.; Cohen 320.
70 Paris, Bibl. Nat., Cabinet des Medailles.
71 Buhle Th., repr. in Maass E., Comm. in Ar. Rel. (VII).
72 L. Furius Philus, was a student of astronomy, mentioned by Cicero elsewhere [Ad Quintum fratrem, III, 5; de amicitia 4, 14]. See Kl. Pauly s.v. Furius, II, 643, n. 31 and RE XII, 2360.
73 See De Meis 2002.
74 Marcellus conquered Syracuse in 212 B.C.
75 "*arte Syracosia suspensus in aëre clauso / stat globus, immensi parva figura poli*".
76 RE VII, 1428, 8.

A probably Roman marble globe from Arolsen was published in 1862[77], and is apparently dispersed at present[78]; it showed a zodiacal band with a sequence of images of the signs[79].

Another one is in the Vatican Museums[80] and is dateable [Gundel 1992, 203] about the second century A.D. The interest is in the clearly depicted zodiacal band, although the figures are not classical (for example Aries and Taurus front to front, Virgo is naked, Libra is a naked man holding a scale made of shells).

A further one is in Mainz[81], and shows some 48 constellations, also as seen from outside, that is with East and West inverted [82]. There are lines of the ecliptic and of the colures, of the equator and of the tropics. It has been dated around 150 and 200 AD on the basis of stylistic criteria. Dating is possible checking the longitude of Aries, although the longitudes of several stars are wrong, such as for example Sirius, Aldebaran, Orion.

Of course the most known celestial globe is that of the Atlante Farnese, which clearly shows the structure of meridians and thus gives hints for the dating of the original work, from the passage of the equinoctial colure through the horn of Aries, that is the star g Arietis. Ptolemy [Alm. VII, 5] gives for this star the longitude 6.33°, latitude 7.12°, which correspond to a right ascension around 3° and a declination around 9°, thus the original sculpture has been dated at about the second century A.D.[83]; figure 13 is from the Maass' Aratus, to which I have a superimposed a net of parallels and meridians to guide in estimating longitudes.

Thiele[84] saw in the figures the representation of a throne, void because dedicated to a living emperor; Gundel [RE XI 1168 s.v. Kometen] showed that this was the Thronus Caesaris, a constellation of the time of Augustus[85], just over the Crab, thus demonstrating post-hipparchian (and augustean) additions.

A direct study of the statue was made by Francesco Bianchini (1662-1729), who had also detailed engravings made for future publications. One is shown

77 Gaedechens 1862.

78 Tabarroni 1961, xxix, 42-44.

79 Aries and Taurus are both with their head towards east, while the other images are correctly represented, as seen from the Earth.

80 Sala dei Busti 341.

81 At the Römisch-Germanisches Zentralmuseum (RGZ), Inv.O.41339.

82 Details in Kuenzl 1996.

83 Bianchini measured directly on the globe, an equatorial distance of about 3° from the colure to the star. Recalculation of the positions of the star gives values comparable to this from the year 60 to 110 A.D., namely from 2.82° to 3.46°. As this might be a too early date for Ptolemy's observations (see above), it is possible that he observed later, and by calculation obtained the value of 3°; however his estimate for the mean annual precession (1°/century) was smaller than the real one (1.397°/century) and thus an approximation for dating is not easy. While, according to Graßhoff 1990, 215, several coordinates stem from Hipparchian observations, not all have the same difference in longitude, thus showing real observations.

84 Thiele 1898, 41-42.

85 Besides Böker R., Caesaris thronus [RE, Suppl. VIII (1956) 918-921], see the comments to the denarius of Augustus. A. Le Boeuffle 1977, p.151, is inclined to believe that the constellation is the Southern Cross, but how could Romans see it?

here.[86] (fig. 14). Gundel [RE, XC, 615 s.v. Zodiakos,] accepts a dating of the second half of the first century A.D. Such dating however refers to the original statue of which the Farnese Atlas is a copy, with additions.

A picture of the original globe may be compared to Bianchini's drawings, and shows a slight displacements of the Aries' horn (and of Virgo) with respect to the colures.

Constellations' myths can be found in coins, such as the following ones. Generally all classical constellations are represented, except Orion.

A tetradrachm of ca. 370 B.C. from Klazomene has in the reverse a swan, the animal sacred to Apollo, together the name of the money officer, ΠΥΘΕΟΣ, while the obverse gives the name of the artifex ΘΕΟΔΟΤΟΣ ΕΠΟΕΙ aside the head of Apollo[87].

A didrachm from Phaistos[88], a city in southern Kreta, has a figure of Herakles with the skin of the Nemean lion and the club, fighting the hydra of Lerna while a big crab is pinching his foot[89]. The reverse shows a bull with the legend ΦΑΙΣΤΙΩΝ and the explanation is that the town derived its name from ΦΑΙΣΤΟΣ, the nephew of Herakles, who apparently initiated the cult of the hero.

A stater from Corinth [Baumeister 1887, No. 1009] shows Pegasus, born from the blood of the Gorgon and being the city's emblem celebrated by Pindarus [Olymp., XIII, 63]. The obverse shows a *quadratum incusum*, an indication of the archaic epoch of the mint.

A silver stater of Euagoras I (ca. 435-374 B.C.) with a legend which Baumeister discusses [90] as found only in syllabaries of Cyprus, has a head of Heracles covered by the lion skin, while the reverse has a capricorn (the legend should read βα σι λέ ως ΕΥ).

Very interesting is the representation of a lion-bull combat in a tetradrachm from Akanthos.[91] Figure 15 is shaded here to evidence the lion. Another one is in the previous fig. 1 with the Δαρεικός. This motif was deeply studied by W. Hartner[92]. Considering the decorations of the Achaemenian palaces of Persepolis he showed the astronomical meaning of this motif from 4000 B.C. until Greek times, with a peculiar astronomical insight.

Hartner, who clearly states his separation from Pan-Babylonism, to avoid misunderstandings, noted that the constellations of Taurus, Leo and Scorpius around 4000 B.C. do not occupy the positions of the equinoxes and of the summer solstice, but they precede them by 10° to 25°; he examines the heliacal

86 It can be seen in Tabarroni 1956.
87 Baumeister 1887, No.1062.
88 Baumeister 1887, No.1057.
89 V. Herakles by Euripydes.
90 Baumeister 1887, No. 1071.
91 Baumeister 1887, No.1088.
92 Hartner 1965.

phenomena and finds that, at Persepolis, on February 10, 4000 B.C.[93] while the Pleiades are setting heliacally the other constellations are in particular positions, such as at culmination or achronical rising, Leo being at the zenith. The myth generated would have been the supremacy of the Lion, killing the Bull which is trying to escape below the horizon. So far so good; however the same configuration can be found every year, except that precession is on alert, and in 500 B.C. the relative positions of Leo and Taurus are the same, but the date has changed into March 28.

The heliacal phenomena are the bounding elements, so Hartner makes an "accuracy test" comparing for the equinoxes and solstices the phenomena of the representative stars he has chosen, using a stereographic diagram with the horizon of Persepolis.

- Spring equinox. (–4000 April 4 Julian = March 21 Gregorian). The Pleiades rise heliacally, but Hartner has been mislead by the diagram for the cosmic setting of Antares (α Sco), because this occurs five months later, not five days (when a normal setting takes place). Hartner rarely makes mistakes, but this time he relied on a diagram instead of computing. The culmination of Cygnus is correct.
- Summer solstice. (–4000 July 26 Julian = –4000 June 23 Gregorian). Regulus and Sirius rise heliacally, γ Cas (the Deer, *lu-lim*) is near the zenith, a little after culmination.
- Autumn equinox. (–4000 October 23 Julian, –4000 September 23 Gregorian). Antares rises heliacally. According to Hartner, Aldebaran (α Tau) is two to three days after cosmic setting (with an arcus visionis of 15°). Again he has been mislead by the diagram: it is not a cosmic setting (which occurred on April 8 Julian) but Aldebaran rose when the Sun set.
- Winter solstice . (–4000 January 20 Julian = December 21 Gregorian). 1-*iku* (β Peg) rises heliacally, two days before α Peg, six days before Fomalhaut.

In –500 there occurred analogous phenomena, and the continuity of the motif has its reason in the easy observable positions of the constellations, transmitted in myth and art. Incidentally this configuration may be observed at present on May,
However the heliacal phenomena occur on days quite different from solstices and equinoxes. For example, always at Persepolis, the Pleiades (η Tau) rise heliacally on June 7 and Antares sets cosmically on November 28, rising acronically on June 2, that is not on March 21.

Some implication by Hartner on the Zoroastrian calendar are better clarified by Panaino 1999. Moreover in a personal communication, Panaino gives further details[94].

93 In his paper Hartner uses the Gregorian calendar also for years before 1582, in order to maintain the dates of the months. This is not the usual method, and might give some complication; for example in –4000 the spring equinox is stated on March 21, whereas the correct Julian date was April 24, as in that year there was a difference of about 32 days between the Julian and the Gregorian calendar. Hence February 10 Gregorian corresponds to March 13 Julian.

94 According to Hartner (1979), the gāhāmbārs, as normally considered season feasts would represent a survival of the Old Avestan Calendar, embedded in the later one, where they indicated the cosmic set of some asterisms visible at Persepolis. The gāhāmbārs should have

Many images from vase decorations to seals or other ancient artefacts are shown in Hartner's paper, but no coin; however this is an example of intercultural aspects, which coins may show from commerce to history and astronomy.

Abstract

Commerce is the main purpose of coins, however, since Antiquity, besides marks for identification and value, important information was added in their decoration. The representation of kings, gods, myths, was among the most frequent, but astronomical events were also reproduced, although rarely.

This paper concerns the study of several astronomical subjects reproduced in ancient coins, to investigate about possible determination of historical or astronomical events, not on general motifs such as isolated constellations or zodiacal signs. Some examples are given on the astronomical reconstruction of phenomena, with indications on how to avoid wrong conclusions, caused by false interpretations, which lack the complete convergence of historical, astronomical and philological reasons.

The study is therefore mainly based on detailed astronomical investigation, supported by historical and philological hints to involve other specialists in this type of research.

Some known subjects such as the Lion-Bull combat motif, Caesar's comet, representations of the full Zodiac, are considered, while other ones are dismissed, due to their incoherent astronomical data, as it occurs in several Antiochian or Roman coins.

Use is made of drawings, astronomical maps and computing data, to clarify the statements.

A brief note is made about celestial globes and their correlation with "astronomical" coins, and dating of some of them is proposed.

Finally, one of the aims of this paper is to solicit, and welcome, every mention of other examples, and a further one is the invitation to colleagues to pursue this subject, especially for its place in the MELAMMU Project.

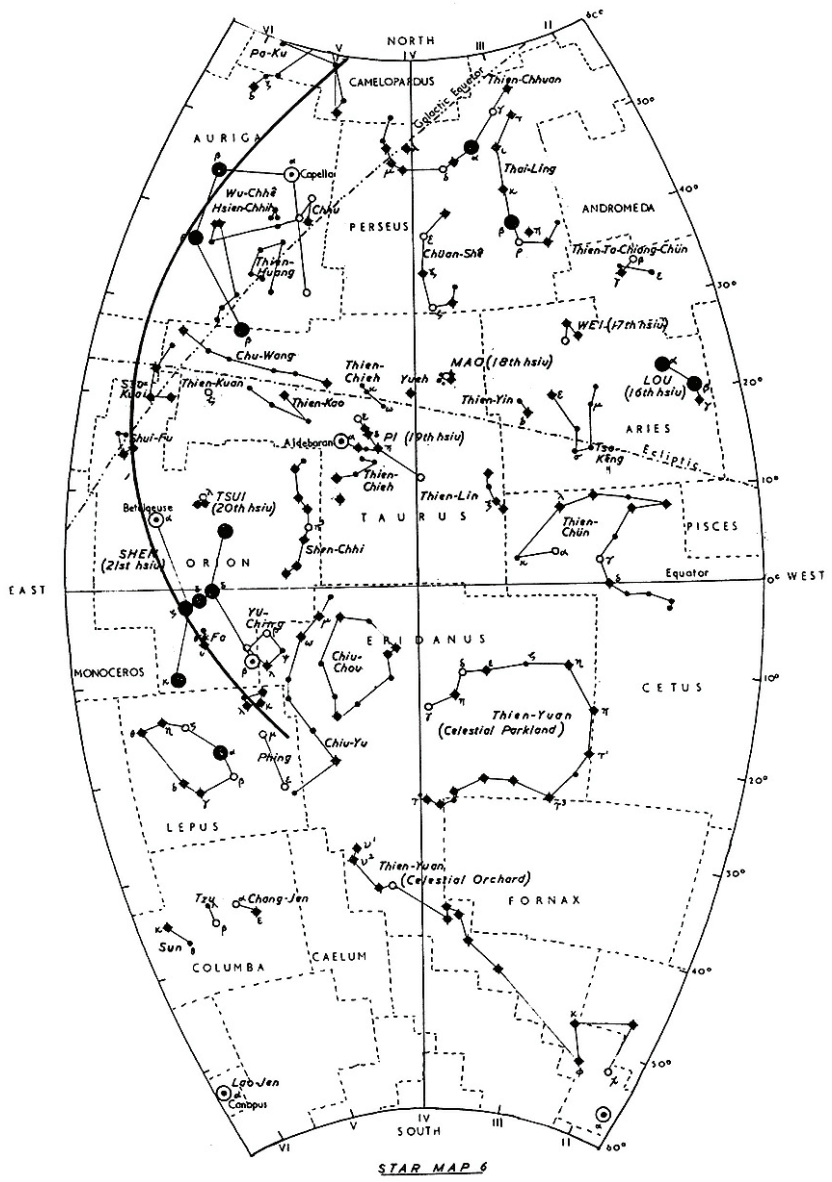
formed the skeleton of the luni-solar (later sidereal) year, used to establish empirical intercalations. However none of the asterisms indicated by Hartner is known in the Avestic literature, while the reference to Persepolis as a primary observation place for an "Old Avestan" calendar, hence truly Iranic Oriental, seems improper. Also, the astronomical data in Lenz-Schlösser 1969 are much questionable from a modern computing point of view, as it will appear from a study that De Meis is completing at present.

Fig. 1
Roaf 1992, p.202

Fig. 2
Baumeister 1887, N. 1107

Fig. 3
EUA III 270

Fig. 4
By Marco De Meis



STAR MAP 6

Fig. 5
Salvo De Meis, Ho Peng Yoke

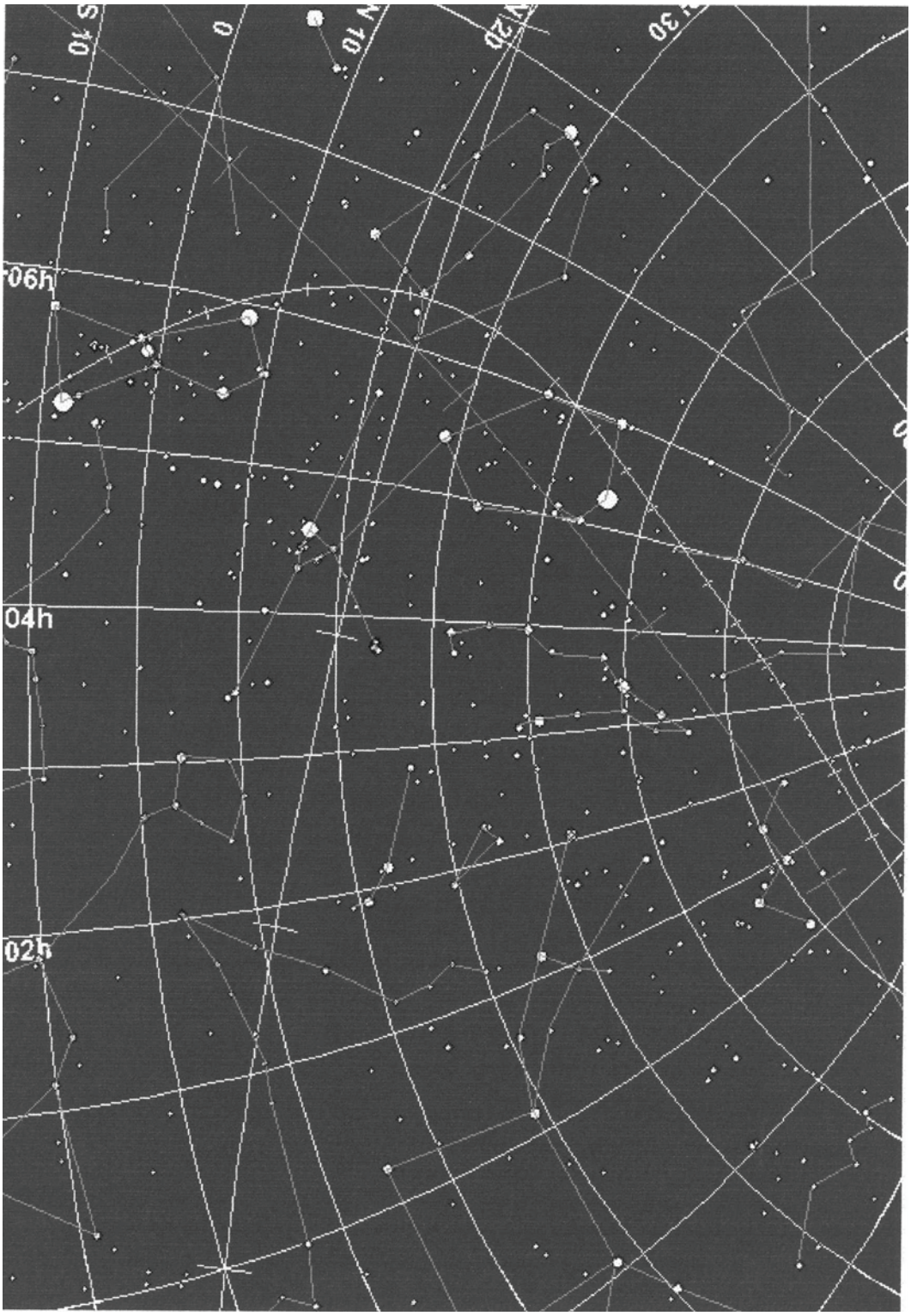


Fig. 6
By Salvo De Meis

Fig. 7
Sky and Telescope, Jan. 1992

Fig. 8
C. Flammarion 1913, modified

Fig. 9
Baumeister 1887, N. 1063

Fig. 10
Mc Donald 1905

Fig. 11
Paris. Cabinet des Medailles

Fig. 12
Die Welt der Antike, 1964 fig. 26

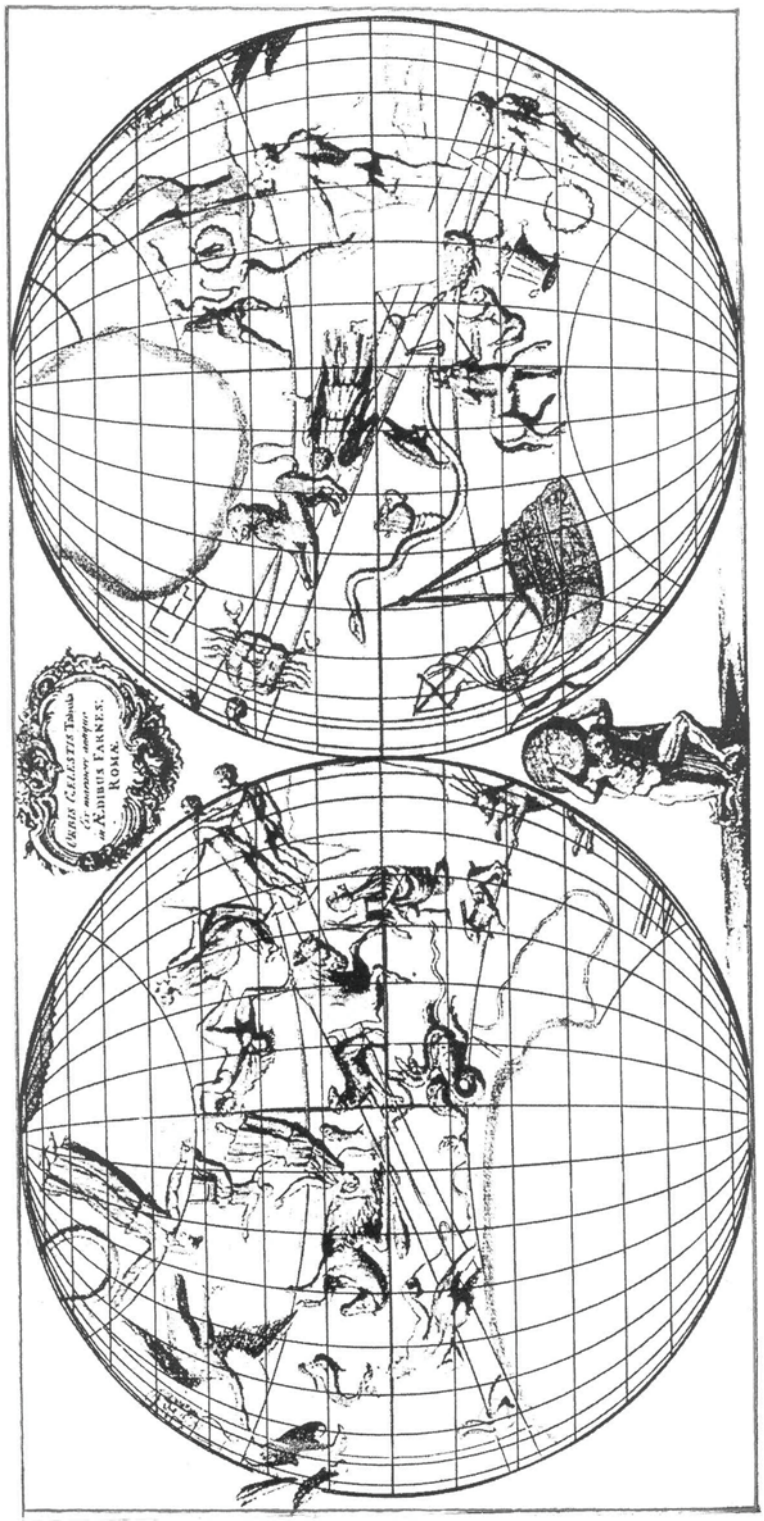


Fig. 13
Maass´ Aratus and additions by Salvo De Meis

Fig. 14
Drawing from Bianchini, in Tabarroni 1956

AB Sectio circuli Ascensionis rectae per cornu Arietis
DE Circulus Aequinoctialis
FGH Tropicus Cancri
ZX Explicita
3 Andromeda
9 Piscis Boreus
10 Aries
11 Taurus
X Sectio verni Aequinoctii praecedens primum in Cornu Arietis gradibus 7 ½ aetate Ptolemaei

Fig. 15
Baumeister 1887, N. 1088

Figures

1. Δαρ[ε]ικός, with Dareios in kneeling schema. Above, Lion-Bull combat.
2. Tetradrachm of Seleucus.
3. Gold stater of Philip II.
4. Silver denarius of Augustus, with image of the comet.
5. Caesar's comet in the sky; coordinates framework with Chinese constellations.
6. Caesar's comet in the sky, new orbit determination.
7. Antiochian coin by Quadratus.
8. Coins by Antoninus Pius representing the Zodiac.
9. Tetradrachm from Samos.
10. Augustus with globe.
11. Coin representing Pythagoras and globe.
12. Coin representing Hipparch and globe.
13. Atlante Farnese: celestial coordinates superimposed on Maass' Ararus
14. Atlante Farnese: Drawing from Bianchini.
15. Tetradrachm representing the Lion-Bull combat.

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