

Ancient Constellations

with research on Hipparchus, Aratus and their followers and
contributions to the art-history of the celestial sphere

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translation by Hugh Thurston

c. Hipparchus' sphere.

While one has not burdened oneself at all so far with the art-historical meaning of the statue, one has already shown considerable interest in its astronomical meaning.

The above-mentioned well-known astronomer and historian Bianchini of the 17th century reported in his *Storia universale* that his older contemporary Cassini attempted measurements of stars on it and noted that the first star of the Ram differed by about 10° from its present position, that moreover the eye of the Bull was distant 40° from the first point of the Crab, and that the positions of these constellations agree with Ptolemy, whence the sphere has to thank the Antonine era for its origin. Bianchini left a monograph on the sphere in manuscript (see the below-mentioned paper by Günther-Fiorini et al.).

After that the statue was mentioned, copied and wondered at almost solely in connection with the sphere. Lately the astronomer Heiss, at the end of the preface to his *Atlas coelestis novus*, Berlin 1872, maintained that on account of the position of the vernal equinox on it the sphere could not be later than 300 B.C. This declaration by an astronomer was one more reason for me to test the sphere for its astronomical value.

The pictures on plates III to VI are from photographs of the plaster cast made in the Viennese archeological-epigraphical seminar. I could put this cast, separated from the statue, on a turn-table and photograph all sides, which could not be done with the original.¹

The sphere, which rests on the shoulders of Atlas at an angle of 67° to the horizontal, has a circumference of 2.04 meters and thereby a diameter of about 0.65 meters, not precisely measurable because of mutilation. It lies on the shoulder of the statue with the greater part of the Antarctic Circle, which is incomplete. At the North Pole, according to Foulkes' drawing, a large piece was chiseled away as early as 1739, but the Pighius drawing too has the same defect. This gap encompasses almost half of the interior of the Arctic Circle and the northern tropic. For the rest, the marble is well preserved and scarcely damaged.

The reliefs stand out sharply from the background and the delicate details of attic relief carving are absent.

The equator, both tropics, and both polar circles, all precisely parallel, are carved in thin linear stripes, as are the two circles through the poles and the equators and the solstices which have come to be called colures.

Also a stripe of three concentric circles with transversals delimiting the "signs" of the ecliptic.

Between and on these circles there are in high relief the figures of the following constellations.

A. North of the ecliptic:

¹ From a reproduction of the sphere through a newly projected drawing I have recanted, since on account of astronomical relations precision must fail. I have satisfied myself over this oversight with a repeat of Foulkes' drawing. How inaccurate even this is, is shown, for example, by the position of the right arm of Perseus and the polar circle (See plate III).

(Plate III) 1. The Dragon, chiseled, only the head and 2/3 of the body are preserved. The missing Bears and the rest of the Dragon are completed there with the help of Gemme repeated from Imhoof-Blumer and Keller's *Tier-und Pflanzenbildern* [Animal and plant pictures] whose astrothetically correct positions suggest a sphere as basis.

2 & 3. Fragments not yet understood. One in all probability a throne, the other a puffy elevation, both on the edge of the piece broken away.

4. (Plate VI) Boötes, a young man in exomis holds a knotted $\lambda\alpha\gamma\omega\beta\lambda\sigma\nu$ in his right hand, stretching far out to the right, head and raised left arm, of which only the first part is preserved, turned backwards, upwards, to the left (toward the Bears).

5. (Plate III) Cepheus, bearded man in a long [I don't know the word] sleeved chiton, like the stage costume of the kings on monuments influenced by tragedies (putting his feet in shoes?) Phrygian cap, with outspread arms waving toward the night. Right of his face an inexplicable lump on the surface of the sphere.

6. (Plate IV) Charioteer, young man in a long charioteer's costume (sleeved chiton) holding a whip in his right hand, with knees bent to the right, looking upwards, the left arm bent to the body (to hold the reins?).

7. Perseus, naked youth, clad only in a cheamys (chamois?) which covers his left arm next to the shoulder, wings on his feet, in his left hand the head of the Gorgon with its face turned away, hurries with great strides and deeply bent left knee, head turned back, swinging a sword with his right hand.

8. Andromeda, clad in a double belted sleeveless chiton with a shawl, feet naked, with outstretched arms waving to the right, right hand raised, the left apparently fettered to the sky.

9. Cassiopeia. Scarcely half as large as Andromeda, sits toward the right on a low stool with a curved latticed back, clad with a long sleeveless chiton (and jacket?), head turned back, arms outspread.

10. (Plate III) Swan, with outspread wings, half flying, outstretched neck, feet, the left incomplete, grasping to the left – (Plate VI).

11. Lyra, seen from behind, the case with a finely-patterned tortoise shell, six of the seven strings recognizable near the peg.

12. Engonasin, naked beardless man, kneeling on his right leg toward the right, arms outspread, looking somewhat upwards .

13. Northern Crown, thick laurel wreath with a fillet, both ends tucked in.

14. Ophiuchus. Naked beardless man seen from behind with both outspread arms holding a snake, which rears up high on the left, while the head of the man looking up is turned toward it.

15. Eagle. Sitting upright with half-outstretched wings.

16. Dolphin.

17. (Plate IV) Pegasus, only the front half ($\pi\rho\omicron\tau\omicron\mu\eta$) shown.

B On the ecliptic band, the figures mostly going outside it – (Plate IV)

18. Ram, leaping to the left, head turning back.

19. Bull, front-half shown, sunk on the right knee, head bowed.

20. Twins, two naked youths waving toward the left, each with an arm round the neck of the other, the left raising the left arm in a gesture of speaking(?)

21. Crab, a normal-sized crab with claws outstretched and feet shown – (Plate III)..

22. Lion, turning to the left with raised curled tail.

23. Virgin, seen from behind in a long sleeved chiton with a shawl, with long wings, holding in the left hand an ear of corn, the right slightly raised – (Plates V, VI). .

24 and 35. Balance and Scorpion; the latter, for the most part covered by the left hand of Atlas, holds in its great claws a balance, of which part of the beam and a scale is visible.

26. Archer, only the front half visible because of the southerly position, bearded centaur standing to the right – (Plate VI).

27. Goat-fish (ibex), only its horns and part of its head visible.

28. Waterman, naked beardless man, grasping a small vessel by its rim with the right hand and pouring to the left.

29 Fish, the more northerly in upright position, the more southerly lying on its back. From its tail a ribbon goes to the head of Cetus – (Plate IV).

C South of the ecliptic:

30. Watersnake with mixing jug (beaker) and raven. The snake, with three coils, has a crest, and so is depicted as male. The mixing jug stands upright, indeed on a step-shaped support. The raven pecks at the snake – (Plate V).

31. Argo, the stern of a richly decorated sailing ship with a mast, a flag-pole which bears slantwise on a ἀφλ ∞στων and double steering-oar besides which there is visible a thick cable on the deck near the right steering-oar, as well as a hook-shaped instrument on the poop.
32. Sirius (Dog) with halo on its head, outstretched tongue, leaping up to the left.
33. Centaur with animal, bearded, striding to the left, holding in the left hand a spear-shaped instrument (Φυγσοξ) touching with his right hand stretched out in front of him a panther (?) lying on its back.
34. (Plate VI) Sacrifice basin, with three feet, above with shell-shaped cavity and a handle, chambered, lying across to the left
35. (Foulkes) Southern Crown, thin laurel wreath between the forelegs of the archer and the sacrifice basin, the ends of the fillet fluttering outwards.
36. Cetus. Monster with scaly neck, dog's mouth, crest, two fin-like forelegs and giant snaky fish tail, swimming to the right – (Plate IV).
37. Eridanus (river). Narrow winding band between Cetus, Orion, Argo's steering-oar and the south pole.
38. Orion. Beardless man squatting to the left, clad in the exomis, sword on the left side, the raised left arm is wrapped in a pelt (jacket?), the head is turned backwards glancing upwards, the right arm swings high swinging a thin λαγωβον
39. Hare, running to the left under Orion's feet.

Although individual stars are not given, it must be determined from the relation of the constellations to the circles whether one can attribute astronomical exactness to it, as Heiss maintains, that is it was prepared following the pattern of a celestial sphere, or whether it is a purely decorative addition to the statute by the artist.

If one looks at the sphere as a whole one makes first the unwelcome discovery – brought to my attention by the Viennese astronomer Dr. Schram, whose good support I enjoyed in the investigation of the sphere – that the equinoctial colure (See Ram and Virgin on Plates VI and VI) does not go exactly through the intersections of the ecliptic and equator, or alternatively the ecliptic and equator do not meet in the intersection with the colure but in both cases several degrees to the east (as seen from outside, from the inside to the west). Whether the colure or the ecliptic is wrong will be considered later. We cannot expect absolute exactness from the sphere.

If the ecliptic is wrong that prevents any conclusion about the epoch of the sphere being drawn from the position of the equinox. But it is not determined whether the colure or the ecliptic is at fault. But we cannot make any sure conclusion about the date from the precession because the marble is too coarse for delicate measurements. From a circumference of 204 cm comes 17 cm for each sign (= 30°). In a century, however, the equinox moves about 2/3°, about 3 mm on our sphere, and one can at best distinguish an interval of 200 years, even on the assumption that the artist worked astronomically exactly. Now however, an error is made in the equinox. Consequently this basis for determining the date of origin of the sphere fails.

We had better follow another path. Through the fame of the Phenomena of Aratus and the work of the mechanician Leontios (7th century A.D.?) on the origin of Aratus' celestial sphere it seems that the sphere underlies the most beautiful of all descriptions of the heavens. If one compares the positions of the constellations on the sphere with Aratus' descriptions, one finds striking differences, of which I present only the following:

Aratus says (v. 69 ff) that the tip of the right foot of Engonasin lies exactly on the head of the Dragon, however, on the sphere it is the left foot that is on the Dragon's head. The sphere is correct. Aratus has slipped, as Hipparchus showed right at the start of his critique of the Phenomena.

In giving the position of the northern tropic, Aratus has the left shin and the left shoulder of Perseus at the same position. On the sphere, however, the left sole is on the northern tropic, the left shoulder nearer the Arctic circle. Here too, Hipparchus confirms the correctness of the sphere.

Aratus v. 487: "on the same circle lie the Horse's hoof, the neck of the Bird, together with the upper part of head and shoulders of the Snake-man". On the sphere, however, the tip of the Swan's beak scarcely touches the tropic and the shoulders of the Snake-carrier are considerably further towards the equator. This difference is not accidental; here also Hipparchus' correction agrees. The head and neck of the swan lie further north. He reproaches Aratus with ignorance of Ophiuchus.

Why here the Farnese Atlas agrees with Hipparchus not quite exactly but only in general will be explained later. The sting of the scorpion lies on the southern tropic according to Aratus v. 565. On the sphere, however, it lies quite below the tropic. Hipparchus says about this and the previous statements by the poet [Greek quotation page 31 lines 19 & 20]. If these examples on the one hand show the impossibility of a connection between the sphere and Aratus' poem (which we would have concluded anyway because Aratus did not know the colures) they give on the other hand an absolutely certain basis for the relation of the sphere to Hipparchus and thereby for the chronology of the monument. It must have originated after the appearance of Hipparchus' criticism of Aratus and Eudoxus, whose statements all earlier astronomers and grammarians, e.g., Attalus, unknowingly took over or tried to correct. If we investigate the positive relation of the sphere to Hipparchus' Astrothesie, we find quite amazing agreement often in the smallest detail, with a few easily explainable deviations.

[There follows a wordy description of hour circles. Resuming at last sentence on page 31:]

These "hour intervals" (as Hipparchus called them) "Stundenkneise" [hour circles] is (he here, as often, free translation of Manitius) Hipparchus noted in an appendix to his critique of Aratus and Eudoxus, and did this undoubtedly for the first time, as in the main these tendentious writings give the impression of a youthful work. These hour intervals move with the equinoxes; since the celestial pole moves, they are not valid after two or three hundred years. Ptolemy, although he knew about precession, was wary of using them for he saw well that a simple calculation could not easily be made without fresh observations²

The positions of the constellations on the hour circles shown on the sphere, i.e., the colures, agree with Hipparchus' statements. On the first hour interval, namely the solstitial colure, on which the summer solstice lies, is found according to Hipparchus the star on the tail of the Great Dog. On the sphere, the tail of the Dog, in which Ptolemy mentions a star, comes with punctilious accuracy on the colure. Still, it could be chance. Let us take now the other semicircle of the colure, the one with the winter solstice. This determines according to Hipparchus the northern of the three bright stars in the body of Eagle [Greek quotation]. In fact, 3 bright stars do lie in the body of the Eagle in recent star-maps. On our sphere the colure cuts the body of the Eagle just at the start of the right wing (Plate VI), the northernmost of them remains thus somewhat back from the circle and is not cut by it, since the Eagle has its claws toward the north.

We do not know yet whether the other colure registers correctly because its position with respect to the ecliptic is not suitable; we can check it with the hour stars [Greek quotation, page 32 lines 25 to 28]. Both statements agree; the thyrsus staff of the Centaur (Plate VI) ends just in the middle of the breast where the colure cuts it. Even more striking is the agreement for Boötes. Just like the tail of Sirius on the other colure, so here the tip of the foot of Boötes lies on the line, so that the middle star in the foot comes to lie about three time-minutes west of the circle (Plate VI). We achieve our agreement in two ways. First, the colure was settled exactly according to Hipparchus, and the artist used an exactness amazing for work in marble. Second, the ecliptic, which as noted above, does not cut the colure at the equator, is displaced with the respect to the middle line of the same. The pictures themselves need not be displaced but the artist might have been mistaken about the points of intersection or have deviated intentionally, presumably because too many lines come together at the same point (See Plate VI).

The pictures in fact seem not to be displaced except for the Virgin (cf. Manitius pages 204/5) for the ear in her hand is according to Hipparchus only 6° from the autumn equinox, i.e., from the equinoctial colure,

² The star in the muzzle of Sirius is according to him (VIII, 3) 12 1/2° from the equinoctial colure; in Hipparchus' time, as can clearly be seen on our sphere, the distance is about 20°. One sees from this that the used precession (cf Manitius p 284 note 12.) Incidentally the observation of Manitius is correct: Hipparchus had not yet discovered precession when he wrote this paper, otherwise he could not criticize the statements of Eudoxus about the stars on the colures without much ado.

while on the sphere it is 15° distance, so clearly displaced; if one attributes the error to the displaced ecliptic, it agrees with Hipparchus' statement. On the other hand, the Ram is not displaced with it, otherwise it would be moved further west and the head would not lie on the colure. According to Hipparchus (III 5 18) the foremost of the three bright stars in the head lies three time-minutes from the circle. The sphere agrees with this. The vernal equinox lies for Hipparchus at the apex of the triangle over the Ram (Plate IV) that one must supply on the marble, since it was undoubtedly originally signified through painting. Starting with the colures I tried to mark the other 20 hour circles on the plaster cast, which certainly cannot be carried out exactly because of the two hands of Atlas. The comparison, however, shows a good result. Almost everywhere the positions of the constellations on the colures agree with Hipparchus' statements. Since however the facts are to be checked on the monument itself, not on the copy available to me, I must renounce the enumeration of further agreements here.

All the more is our suspicion confirmed, that the artist, who worked with approximate precision, copied a sphere of Hipparchus or used one as a basis. Yet, deviations from the statements of the astronomer occur besides, with the hour circles. Particularly striking is the Balance, unknown to Hipparchus, in the claws of the Scorpion, presumably a borrowing from a zodiac calendar available to the artist. Further, the Southern Crown which (according to Geminus XIX pg 769) Hipparchus knew as κηρυκειου, is already at hand.³ The shape with the bands sticking out rigidly is so striking that only a re-working by the artist, not an addition, is to be accepted. In the youthful writings of Hipparchus that we have, the constellations do not occur at all; thus he altered later in his Astrothesie. Other deviations show up mostly as unconscious oversights and mistakes, for example, the band of the Fishes is attached to only one fish, whereby the artist erred through the many delicate bands that he had to chisel: River, water of the Waterman, ecliptic, equator. Instead of giving to the other fish, the band (Plate IV) goes to the ear of Cetus, where it is out of place. Rather there was a λζνον βοζεζου [north] and νοπζον [south], which were connected to a place through a particularly bright star. The mistake is all the clearer since another, the displacement of the point of intersection of the ecliptic, occurs in the immediate neighborhood. It is not wonder that in this confusion of lines and figures even a careful sculptor's chisel will occasionally fail. Further, the Twins are not exactly as in the statement of Hipparchus, who (I 102), as against Aratus' false account of the heads, said that the head of one twin lies 1/5 of a sign north of the tropic of cancer, the other about 1/3. On the sphere one lies with his head in fact 1/3 of a sign over the tropic, which does not however cut the head of the other (Plate IV). The sphere portrays the Snake-carrier in general following Hipparchus so that his shoulder is not, as Eudoxus wanted, on the tropic but apparently south of it. Yet the position of Ophiuchus is quite badly arranged. According to Hipparchus the right foot should not stand on the breast of the Scorpion and the right leg should be bent, thereby covering the rear part of the Scorpion. The maker of the sphere however had the Snake-carrier apparently with the left foot on the rear part of the Scorpion and the right foot quite widely outstretched. So instead of an oblique position as Hipparchus wanted, he is almost upright. The shoulders are much too far north and almost horizontal, while they should be further south and almost horizontal, in fact the right one 7° north of the equator, the left 15°.

Even the major defect in the sphere can be quite easily explained because the hand of Atlas is situated just here. While the other hand can be placed tolerably conveniently between Orion and Argo it would have quite spoiled the figure of the Snake-carrier if the same were not moved out further.

No displacement is found with the other hand, for Orion seems to agree excellently with Hipparchus Astrothesie, for his throat (κολλυρσβον) is as high as the north part of the Bull and his belt is shown lying on the equator. Moreover, Perseus lies too near the colure, while Hipparchus sets him with head and left hand 1/3 sign east of it.

More major deviations of the sphere from Hipparchus' Astrothesie can scarcely be shown. We may therefore see the monument as a reasonably exact representation of the Hipparchan sphere of the fixed stars. The often amazing exactness compels us to accept a direct re-working of a Hipparchan sphere. And is it not natural that an artist, who wanted to display Atlas with a celestial sphere, would choose the most famous and most widespread? Now it is a question of how we can reconstruct the Hipparchan sphere itself.

Ptolemy indicated at the end of book 7 that he had a celestial sphere with the Hipparchan Astrothesie, and we may thus accept that numerous examples existed. He said there, "Even the new constellations one

³ The catalog of Geminus, as Maass informed me, is a genuine Hipparchan re-working and agrees for the northern constellations with those found by him in Laur., etc., (cf. below page 46 note).

can in star-pictures⁴ ... as they are given in the Astrothesie made by Hipparchus on the sphere, and one will find that the Astrothesie as one observed it then and transferred it to the sphere is almost the same as today." One can easily deduce from this that Hipparchus had placed only the stars on the sphere; but how should they then be arranged? In any case, he must surround them with outlines and thereby delimit the constellations, and doubtless he himself has not done much more than that. Thus he marked the stars on a black ball with colors or through a needle and traced the contours of the figures.

Ptolemy (II 94 Halma book VIII 3) prescribed for the preparation of a sphere [Greek quotation at the bottom of page 39 and top of page 40]. Ptolemy speaks here of a black or dark blue wooden ball on which he has placed the stars in light colours. The outlines of the constellations were only softly indicated in a darker colour than the background so that from a distance only the stars are visible. In antiquity the sphere always rested on a tripod, on which it could presumably be rotated. Hipparchus himself is shown with such a one on a coin of Nicea (see note on page 43).

Besides these wooden ones there were also metal spheres, which naturally were not used by astronomers, whose astrothesie varied now and then, but served as showpieces or for some such purpose.

In Syracuse two such metal showpieces were found as early as the time of Archimedes. One was clearly a planetarium, the other a sphere of the fixed stars. When Syria was conquered in the year 212 they were taken by Marcellus to Rome. He placed the fixed-star sphere in the Temple of Virtue; the planetarium – about which the people understood nothing – he took to his house. Here it was working during the lifetime of his uncle, and was shown to those visiting friends were interested in valuable heirlooms. So Furius Philus related, according to Cicero (*De re publica* I14).

Lucullus brought another magnificent sphere from Sinope; this was made by an otherwise unknown astronomer Billaros (*Strabo* XII 641). The existing innumerable Arabian celestial spheres patterned on the Greek ones are of bronze inlaid with silver or gold. There was also found a Greek bronze sphere, which might originate from Ptolemy, in the year 435 of the Hejira in Cairo. After its design Arabian Khalifs have even more magnificent ones prepared.

In any case the production out of bronze was a matter for an artist who must have been given the pattern by an astronomer; if he wanted to produce a sphere of genuine astronomical value for any wealthy amateur or for a public building. In the change to bronze the figures must be more prominent than when simply painted on a scientific globe, whether they are scratched on it, inlaid (as in the existing Arabian fragments and one roman) or even worked in relief. Hence the stars must also be more strongly marked perhaps by a peg or something similar. It is very probable that in Rhodes just as in Syracuse, such showpieces in bronze were made in the lifetime of Hipparchus. Even if the astronomer for heartfelt reasons despised these unscientific toys, he must take care that they are produced with more or less scientific accuracy. The Farnese celestial sphere is in line with such specimens.

Turning now to the latter, it is at once the assumption that the work belongs to the Hadrian epoch of art, as has already been determined from the figures themselves. Then the partly incomplete and clumsy treatment of the relief is striking, principally the irregularity in the working of the individual figures. While some are excellently copied, such as Argo, Pegasus, Lyra, the Bull, the Eagle, Boötes, the Twins, others are badly worked; e.g., Orion. The pelt covering his left arm seems to be misunderstood and looks almost like a modern addition.

The treatment of the drapery of some figures, with then stretched-out lappets and curved pads and schematic lines in the pleats shows the mannerism of bad relief work of this art period; e.g., in the careless treatment of the dress of the Virgin. Andromeda's dress is quite unsuccessful, her feet even more so. Another circumstance with this figure is noticeable as the positioning shows: the figure is turned around, for the left foot is shown as if one saw her from behind, while the front side of the figure is shown to us, snout, like the Virgin, the back. For this reason the chiton is also reversed, as it seems. This artist has clearly dithered between back and front views. The same striking phenomenon occurs with Cepheus, the back of whose head is turned to us because the arm is reversed (Plate III). With Perseus however, (Plate IV) a self-same reversal of the head occurs. Perseus is supposed to be shown running to the left, whereby however he looks backwards, i.e., towards Cetus.

The ability of the copyist miscarries this combined movement, for while the
<missing word> was probably carried out with great artistry, it is here quiet unsuccessful. He succeeded much better with the backward-turned Cassiopeia. She had to be portrayed in this way because

⁴ Here is clearly an anaxoluthon(?).

otherwise the outstretched arms, which the astrothesie requires, could not belong to the representation, for in profile the outstretched arms could not be shown.

The figures are for the most part shown in half profile (three-quarter view), partly in whole or half rear view, like the Virgin, the Waterman, the Twins; none in full frontal view. It was obviously not easy for the copyist to reproduce all these various and often forced positions correctly, when the mistakes. – Why were these varied positions chosen for the relief on the sphere? A definite reason for this is to be found not in the artistic representation but in practicality. In the sense of astrothesie all the figures should properly be seen from behind for the astronomer consider, when he placed the stars on the sphere, the pictures were all seen from inside, i.e., from the earth, which is considered to be inside the sphere. He always has the picture of the starry sky before his eyes and must think of himself as standing in the middle of the sphere of the fixed stars, not outside it. To anyone outside all the figures turn their backs except those in profile. In denominating parts of the body, once the sphere was introduced, the astronomer had therefore to take an ideal standpoint inside at the centre of the sphere, because one considers the star-pictures as turned towards the stargazer. Hipparchus himself, in connection with the oversights, that Aratus and Eudoxus had Ergonasia walk with the left foot, took the opportunity to discuss this fundamental fact (I, 4, 5-7). [Greek quotation near the bottom of page 36] And for the astronomer this was certainly the only possible way in which the contours of the constellations could be authoritatively depicted on the sphere. However, the artist, who wanted to produce a magnificent sphere in [two words that I don't know and can't find - *ciselierter* and *getriebener*] bronze could not possibly let all the figures turn their backs to the observer. On the other hand he could not alter the outlines of the figures in the least. Out of this double endeavor I can explain the peculiar depiction of the figures on the sphere.

Most of the figures representing animals and objects were naturally drawn in profile on the sphere and did not need to be altered; in the rear view were left the Virgin, the Crab, the Scorpion – the Virgin presumably because there were no stars on her head. Boötes, because he had to gaze on the Bears, is only slightly turned round. Fittingly the Waterman, the Twins, and Ergonasia are in left profile. The right foot of the snake-man, portrayed in similar profile, which was severely shortened by the first artist, is badly misunderstood by the copyist. The artist has Cepheus almost *en face* because of the outstretched arms; whence he placed him so far in profile that the copyist could misunderstand the arms. The same can be seen in the case of Andromeda. Also Cassiopeia had to turn back from the profile position of the body, so that the seat and gesture of the arms are made visible, and her head turned back from inside so that now without motive she sits half in profile and half in rear view.

A passage in the first book (11, 4) shows that Hipparchus showed her in profile; where he speaks of “the foot” of Cassiopeia, while the following *ἔν ποσα* delineates only the body.

As remarked, the outlines of the figures were given by the astronomer to the artist, who could not alter the stance, shape or size. Besides the just-mentioned variation in the views of the bodies there remained to him the provision of clothings, attributes and decoration in part. Here he must be very careful not to deviate too far from reality and he has guarded against going with these things outside the given surface, wherefore Cassiopeia for example must have a small seat. In this regard a deviation from Hipparchus' sphere is very striking; this showed the Archer with clothing (*εφαπτis* = *palerdamentium*)⁵

This is lacking on our sphere both on the Archer-Centaur and on the other Centaur. In this connection we should reflect that the artist portrayed only the front half of the Archer because it is quite near the south pole, whereby the *εφαπτis* could easily be dropped. One could also accept that articles of clothing were indicated only by paint on the marble, as was the case with Deltoton and, for example, is to be presumed for the arrow. The figure of Cepheus is very simply outfitted, with no shoes, no scepter, no sword, which exactly agrees with Ptolemy's description. However, otherwise, Cepheus is portrayed exactly according to Hipparchus' statement, namely his head projects beyond the ever-invisible circle (I, 7, 21–22). He has, in contradiction to Hipparchus' view, outstretched arms. In the above-cited passage Hipparchus mentions the perception of several astronomers, without rejecting it, that Cepheus was depicted with outstretched arms and thereby set in the arms the stars which were usually set in the shoulders. Either Hipparchus himself or the artist ended up with the portrayal of a traditional type.

⁵ On black-figure vases the Centaur is shown clad in brightly coloured clothing, for example in hunting scenes. Otherwise he mostly wears a pelt, always in Roman times.

—Especially simple is the representation of Andromeda and of the Waterman, who naked pours water out of his inconspicuous vessel. The artist of the supposed magnificent sphere has decorated Lyra and especially Argo in abundant fashion, and this is an important example of the exaggeration of the star-pictures through pictorial art. The stern of a ship with steering-oar, as was openly drawn on Hipparchus' sphere or star-map did not satisfy the artist who had to depict two steering oars to achieve perspective. Further, he would not forget the flagpole at the stern. One can doubt, because of the striking size of the pole and its rigging that an auxiliary mast (ιστος ακαιος γαλων) is meant, which as a rule would be erected on the prow of the ship. A further addition is the hook, which leans between the flagpole and the αφλατων (ακζοατολιον mistakenly Hipparchus, since this denotes denotes the outermost part of the prow.) I take this instrument to be a hook for landing.

Another interesting addition is the otherwise occurring cable for hauling the rudder home when entering harbour. Aratus said in his description of Argo (V. 351) that the steering oar must be loose, not hauled up, as it should be in a ship entering harbour. One can compare Argo with the drawn up hauled home rudder on the Ficoronic Ciste and the well-known relief at the Palazzo Spada. On the other hand on the sphere the steering-oar is not drawn up in spite of entering the harbour, which can only be for astrothetic reasons, for the most southerly star in the steering-oar, Canopus (not yet so named by Aratus) is presumably too far south to form a drawn-up rudder. Very striking is the agreement between the Hipparchan sphere and Aratus which suggests that this was a pattern for the sphere. — A further decoration of Argo is the three round shields along the freeboard, which are often found on pictured ships, for example on the relief from the temple of Preneste in the Vatican.

Ptolemy mentions these ασπιδισκαι and one star in each. He or his informant had therefore before his eyes a depiction decorated in the manner of the relief on the sphere. On the other hand, the remaining ornamentation on the side of the ship, the Triton with the rudder, the Nike, on which is a Kymation etc., are quite conventional without astrothetic significance. Such ornaments are often found on ships. Other depictions of Argo were decorated with pictures on the whole side of the ship on the pattern of royal Greek ships, as the detailed description of Valerius Flaccus and Ovid show. The technique used for these pictures of ships, which required a very durable cement for the colours gave rise to completely encaustic painting. The general custom was to decorate the ships with figures. This careful ornamentation of Argo on the sphere teaches us that the insufficient provision of the other figures was entailed by astrothetic considerations.

We must now try as much as possible to sort out the original shape described by Hipparchus and therefore to delimit exactly first what the artist of the sphere added, second what the artist of Atlas altered or mistook and, third, what the Roman copyist [altered or mistook].

There follows a survey of the types of starpictures that we can construct from Hipparchus extant writings, so that the agreement with the pictures on the sphere will be manifest.⁶

1. Greater Bear 2. Smaller Bear 3. Dragon (the situation of the Dragon between the Bears is from Hipparchus I.4 S 30/32, the same as on the copied Gemme, so that one can fill in the gap in the sphere with the help of the Gemme). 4. Boötes, on the northern tropic striding to the right, the left hand raised against the Bears, exomis, κσλλοροβον⁷, left-foot on the colure. 5. Crown 6. Engonasia, on the arctic circle, with the head toward the south, kneeling, naked, in profile. 7. Snake-man standing obliquely on the Scorpion between the tropic and equator, naked, left shoulder higher than right, left leg on the breast of the Scorpion, right leg on the rear part, and bent (συνεσταλμενον). 8. Snake 9. Lyra 10. Bird, half running, half flying, between the arctic circle and the northern tropic and the solsticial colure. 11. Cepheus with arms folded (on the sphere: outstretched), tiara (Asiatic royal barb), floating, not running, the head south of the arctic circle, the rest inside. 12. Cassiopeia, with outstretched arms sitting on a low stool in profile, on the arctic circle. 13. Andromeda, hovering with outstretched arms [see from behind]. 14. Horse. (Hipparchus speaks once of εμπροσφιοι ποδεζ of the Horse. Presumably in that passage (II 5 11 S 194 22) he used an expression familiar to him without thinking of the absence of the οπισφιοι ποδεζ; moreover as a glance at the sphere shows, there would not have been room for the hind part and the hind leg. 15. Arrow with notch

⁶ I have intentionally neglected to subjoin here the reference for each individual star-picture, for thereby lucidity would suffer. Those who would like to check will find the relevant passages assembled in Maritius. In brackets are the deviations from the sphere such as explanations () and supplementations [].

⁷ In Pollux I, 143 κιλλιβοροι is read as a synonym of κιλλιβαζ, a pole on the frame of a wagon.

(missing on the sphere, presumably it had been indicated by paint). 16. Eagle, on the solstitial colure. 17. Dolphin 18. Peseus with harp (sphere: sowlrd?) Gorgon in entwined position, (head to the northwest) legs to the south, left foot on the Bull or the Pleiades. 19. Charioteer, right foot 3 1/2° further south than the left, both almost exactly on the tropic 20. Watersnake with mixing jug and Raven, Snake with open mouth, mixing jog with stand and belly, underneath a right-angled triangle (this triangle nowhere mentioned but by Hipparchus (III 1 5-6) appears on the sphere as a step-shaped support for the mixing jug). 21. Centaur, with Thyrsus, on the colure. Under the origin front view of the shoulders. Right shoulder, right hand and foreleg under the claws. 22. animal, between the right hand of the Centaur and incense-burner with part of the Scorpion. 23. Incense-burner with βαϊζ, επιπυζον, χειλοζ . 24. Southern Fish 25. Sea-monster with great jaw and dorsal fin. 26. Orion, with pelt and χολλοβον, belt on the equator. (Hipparchus does not mention the sword, but Ptolemy does. The sphere explains excellently this striking fact, for since Hipparchus indicated it either not at all or as it can now be seen on the sphere (Plate IV), so it took up no particular space, but the relevant stars belong to the squatting body. The later astrothesie influenced by artistry apportioned the stars differently and counted the sword separately.) 27. River, begins at the left foot of Orion, from there west towards Cetus, then east, then south, and west (these meanderings are shown exactly on the sphere). 28. Hare 29. Dog, the most southerly star at the tip of the tail on the colure. 30. ["Vorhund" is unknown to me and not in the dictionary. It must be a rendering into German of Preyon πζο= vor, κμον = hund] 31. Argo, with a rudder ακζοστολων mast, deck, visible over the mast. 32. Crab 33. Lion, with hind feet together, leaping. 34. Virgin, with ear [of corn] in left hand, winged 35. Claws 36. Scorpion, with five tails on the chest, on its back on the souther tropic 37. Archer, as Centaur with εραπιτιζ . 38. goat-fish 39. Waterman with κλιζ, stream of water with 4 (σνστζοφαι) windings 40. Fishes, with a ribbon in which re knots 41. Ram 42. Bull, ' αποτομη, in which are Hyades and Pleiades 43. Twins, with πζοπουζ, heads north of the tropic — That is the range of types that can be produced from the bare text of Hipparchus and which the sphere illustrates and completes. The sphere as we now have it is the richer by two constellations, first by the southern crown, secondly by the balance in the claws of the scorpion. Otherwise the Hipparchan astrothesie remains unaltered, so we do not find the second Horse, which Ptolemy supplies.

In order to sharpen our conception about the original sphere of the Rhodian astronomer, we must once more visualize briefly which details can be attributed to a reworking under the following categories.

1. By the artist of the sphere, who presumably was alive in Rhodes during the lifetime of Hipparchus, the position and appearance of most figures was altered inasmuch as these, as far as they were not in profile, were turned from a rear view with a quarter, half, three-quarters or whole revolution. Besides this the artist decorated Argo and made a stand for the mixing jug out of the triangle. To the northern crown, whose astrothesie was a simple circle, he added a loop, but had to turn it inside in order not to go outside the perimeter of start picture. Just so he added, inter alia, the rays to the head of Serios and tortoise-shell pattern to Lyra.
2. The small dig, half of the Goat-fish and the hindquarters of the Archer were omitted by the artist of the atlas, who was probably not much later than Hipparchus. Snakeman and Scorpion were moved from their places in favor of the left hand of Atlas. Presumably the balance and the southern crown were formed by him from the astrothesie of Kerykeion, whereby he used another, unscientific sphere. Doubt remains whether he or the Roman copyist added the two unexplained fragments near the arctic circle; on the other hand it is safer to assume that he altered the inclination of the axis of the sphere as it is set on Atlas to the horizontal plane. This should be 54° for Rhodes but is now increased to 67° [The elevation of the pole at Rhodes is 36° not 54° ???]
3. In the transformation to marble of the Farnese Atlas, which we can fix before 150 A.D., the ecliptic, the Virgin, the Twin, and to some extent Perseus were shifted, the ribbon of the Fish incorrectly registered, further the harp of Perseus changed to a sword (?), many figures were turned, the left foot of the Swan indistinctly reproduced, individual details like the mantle of the Archer, the arrow, the triangle above the Ram, the Thyrsos pin of the Centaur reproduced only painting, which was carried out over the whole sphere⁸

⁸ Dilthey brought to my attention the analogy of the spheres which often, even if not in the Farnese case, were produced for instructional purposes, with the pictorial chronicles produced with the same aim, which were likewise painted.

If we seek Hipparchus' model for his type we must presume for individual pictures certain older spheres, namely with regard to the description of Argo in Aratus, which requires a familiar type, as we saw.

Pictorial representations of constellations other than those in the zodiac occur in Euripides who decorated the tent of Ion (1147 *ff*) with fabric which displays the sky above with Helios and Selene, the Pleiades, Orion with a sword, the Bears and the Hyades. Anakreon was the first to tie Boötes into the pictorial display. Certainly Eudoseus had manufactured a sphere similar to Hipparchus'; however, we have no conception of what it looked like.⁹

We do not come beyond Hipparchus with our sphere because he established a quite new system of the fixed stars and limited the figures according to his judgement, e.g., Perseus and Orion. He created in part quite original types which he himself devised or arbitrarily formed from older ones. Thereby we have on this sphere-relief for the unprejudiced viewer something forced, ungracious, lifeless, uncertain. One wonders at first over the lack of character, especially of the human figures. It must be explained by the fact that they are mostly not traditional art-types but sketches in the service of science, for which the stance and the position of the limbs were given by a quite unartistic principle. Particularly formed are Cepheus, Perseus, Orion, Andromeda, the Centaur with the animal, the Snake-man, Engonasia, while the compulsion is not so clear in the animal figures and they are in part excellently portrayed. The influence of older art-types occurs especially in the Twins, Boötes. The Centaur, the Virgin and Serios (see above chapter IV).

These remain unexplained on the sphere the two above-mentioned fragments, the first a half-round set-up, quite indistinct, about 4 square cm in size, which cannot belong to any constellation, the second the throne-shaped object, which is also hard to maintain in its original form. It seems doubtful to me that it portrays a throne, but it can be compared with the presentation for example of the coins of Overbeck, coin-table III. A constellation for the throne is not to be thought of because no constellation was ever situated in this part of the sky.¹⁰

It must be therefore be an addition that does not belong to a constellation, and therefore cannot go back to Hipparchus but is contemporary with the combination of the sphere with the Atlas. A throne in the sky can have only one god, first of all Zeus, and Zeus was in fact shown inside the zodiac in Roman coins.

(the material of astronomical interest ends here).

⁹ Above on page 18 it was shown how uncertain the tradition of a celestial sphere of Anaximander is, and in any case we cannot assume such an early registration of constellations on the converse surface of a sphere.

¹⁰ Passeri, without giving any reason, calls it the seat of Cassiopeia.