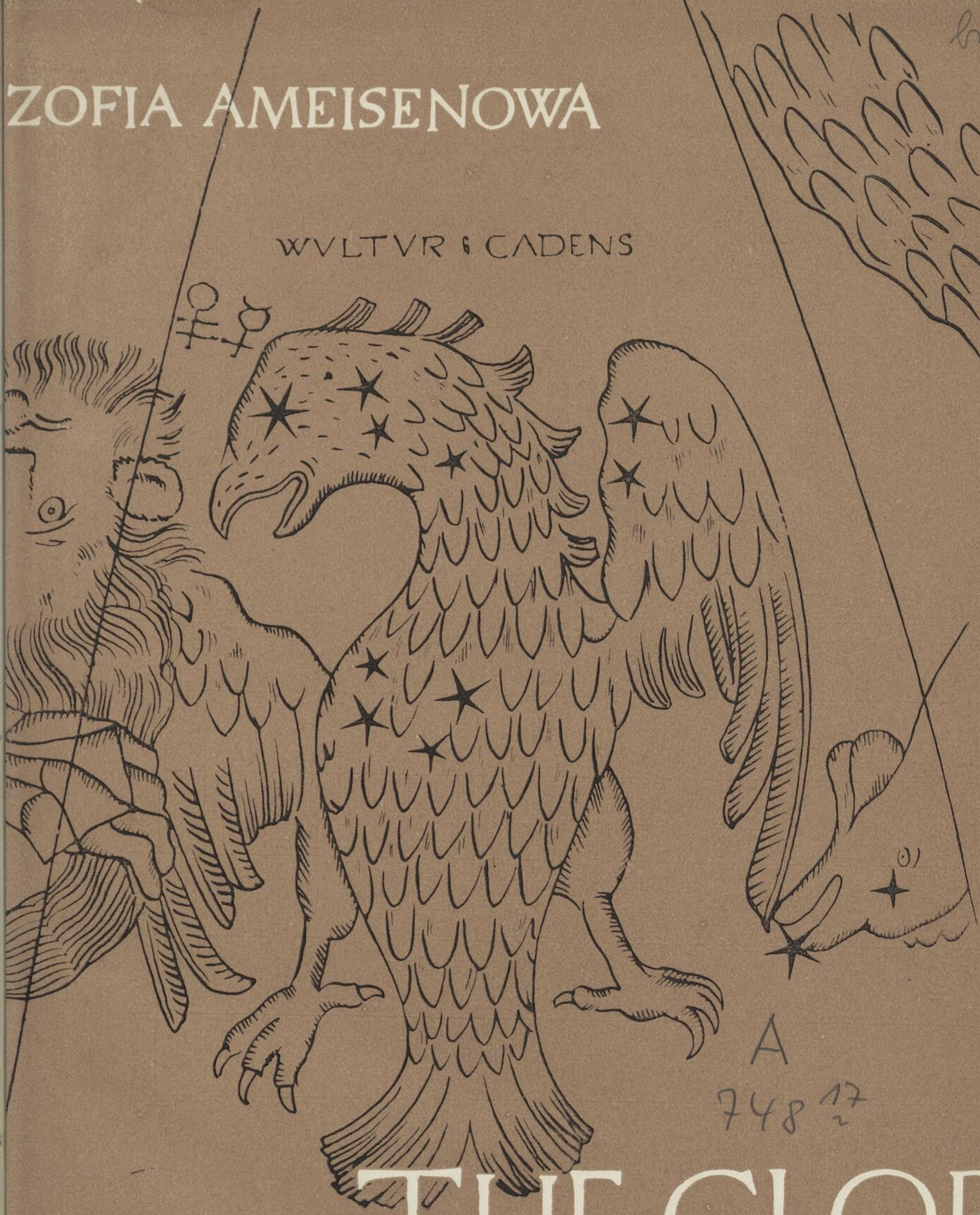
Ameisenowa
The Globe
of
Martin Bilica
of Olkusz

Ameisenowa

ZOFIA AMEISENOWA



THE GLOBE OF MARTIN BYLICA OF OLKVSZ AND CELESTIAL MAPS IN THE EAST AND IN THE WEST

THE GLOBE OF MARTIN BYLICA OF OLKUSZ
AND CELESTIAL MAPS IN THE EAST AND IN THE WEST

Dedicated to the memory
of F. Saxl

POLSKA AKADEMIA NAUK
KOMITET HISTORII NAUKI

MONOGRAFIE
Z DZIEJÓW NAUKI I TECHNIKI

XI

WROCŁAW — KRAKÓW — WARSZAWA
ZAKŁAD NARODOWY IMIENIA OSSOLIŃSKICH
WYDAWNICTWO POLSKIEJ AKADEMII NAUK

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BY

ZOFIA AMEISENOWA

TRANSLATED
BY
ANDRZEJ POTOCKI

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INTRODUCTION

The celestial globe [1] bequeathed by Martin Bylica to the University of Cracow, where he had once been a student and later a lecturer, is still little known in spite of its fame and although it has been studied and described by two scholars, both historians of astronomy, Ludwik Antoni Birkenmajer and Ernest Zinner [2]. The will of Martin Bylica, who died in 1493, leaving this treasure to the University, has been lost — unless, as is possible, it still remains undiscovered in some Hungarian archive.

The globe is not even mentioned in the comprehensive and exhaustive two-volume publication on terrestrial and celestial globes of E. L. Stevenson [3]. This is all the more surprising since

[1] I wish to express my most sincere gratitude to all whose kind aid has helped in writing this study. In the first place I should like to thank Dr. T. Kleberg, Director of The University Library at Upsala, who very generously loaned to me in Cracow numerous valuable publications without which it would have been impossible for me to have completed this study. I am also greatly indebted to Dr. Gerhard Schmidt of the Institute of the History of Art in Vienna for the searches that he made on my behalf in the University Archives, in the National Library, and together with Father N. Rieth in the Archives of the Dominican Monastery in Vienna. I am very grateful to the Director of the National Library in Vienna for permission to reproduce the celestial maps from the manuscript No. 5415 and to Director Dr. Grötsch in Dresden for the photograph of the Arabic globe in the Science Museum. My very special gratitude is due to Mr. W. Gumuła for the photographs that he made of the globe with such consummate skill and precision.

[2] L. A. Birkenmajer, *Marcin Bylica z Olkusza oraz narzędzia astronomiczne, które zapisał Uniwersytetowi Jagiellońskiemu w r. 1493*. Proceedings Pol. Ac. Sc. and Let., Section of Math. and Science, Series II, No. 5, Cracow 1893, pp. 63—94.

E. Zinner, *Leben und Wirken des Johannes Müller von Königsberg genannt Regiomontanus*, München 1938, pp. 116—122.

E. Zinner, *Deutsche und niederlaendische astronomische Instrumente vom XI—XVIII Jahrhundert*, München 1956, pp. 168—171 and 292—297.

[3] E. L. Stevenson, *Terrestrial and Celestial Globes, their History and Construction*, New Haven 1921.

Stevenson describes the superb gilt terrestrial globe, known as the Jagiellonian Globe, that was constructed about 1510 and on which the momentous words *America noviter reperta* were inscribed for the first time. Similarly the globe of Bylica, this most beautiful and outstanding celestial globe bequeathed to posterity by the late Middle Ages in the West, is mentioned neither in the original Italian version of Fiorini's fundamental work nor in its later German translation by S. Günther [4], though L. A. Birkenmajer's excellent monograph on the globe was published two years earlier. Even so meticulous a historian of astronomy as was Hauber knew nothing about the globe of Bylica and he omits it in his book [5] in the chapter devoted to globes, although he describes the then little known globe of Stöffler of 1493 which is now in the National Museum at Nuremberg. All these omissions show once again how frequently foreign scholars are apt to think that *slavica non sunt legenda*.

L. A. Birkenmajer described and explained in detail the construction of the globe of Bylica, while E. Zinner established with much probability the identity of the constructor of this astronomical instrument. However, neither L. A. Birkenmajer nor E. Zinner showed much interest in the forty eight figures representing the constellations which are engraved on the spherical surface of the globe or in the artistic and iconographic pedigree of this decoration, though the engravings form an integral part of the globe and are of great significance for the history of culture, science, and art. The aim of the present study is to supplement the investigations of L. A. Birkenmajer and E. Zinner by giving the reader as much information as possible concerning the appearance of this splendid instrument as well as its history, the intellectual climate in which its archetype was created, its relations with similar earlier and later globes, its scientific importance, and its artistic value.

L. A. Birkenmajer and E. Zinner published only illustrations showing the whole instrument. Even scholars in Poland, not to mention those from other countries, could not discover for certain, what was engraved on the surface of the globe because of the rings partly covering the sphere. The only available illustrations were the twelve signs of the Zodiac reproduced in a rather popular and not always accurate article written before the last war by J. Grzy-

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[4] M. Fiorini, S. Günther, *Erd- und Himmelsgloben, ihre Geschichte und Konstruktion*, Leipzig 1895.

[5] A. Hauber, *Planetenkinderbilder und Sternbilder*, Strassburg 1916.

wiński for a once widely read almanac [6]. There seem to have been two different reasons why, in spite of its fame, the globe of Bylica was never fully studied. In the first place such a study belongs simultaneously to two fields of knowledge, the history of art and the history of science. Secondly, there are the purely technical difficulties of photographing the constellations engraved on the shining spherical surface. For many years there was no photographer in Cracow who was capable of, or wanted to undertake, this difficult task. The modern technique of photographing engravings on polished curved surfaces by filling the incised lines with a fluorescent substance and taking photographs in ultraviolet light is still unknown to photographers in this country. Consequently more conventional techniques of photography had to be applied and this was neither simple nor easy. It was not till 1958 that after a number of attempts, Mr. W. Gumuła, photographer at the Department of the History of Art of the Jagiellonian University, obtained the first satisfactory photographs of the engravings on the globe. These photographs, published here for the first time, have made possible the completion of this study which was started as early as 1939. As the reader will be able to see, they show very clearly all the engravings on the sphere and have enabled me to compare, in minutest detail, the globe of Martin Bylica with other celestial globes and maps dating from the beginning of the fifteenth century to the end of the second decade of the sixteenth century. The photographs have also supplied the necessary evidence for establishing finally the place where the globe was constructed, a question which has hitherto remained unsettled.

L. A. Birkenmajer was of the opinion that the globe had been constructed by an Italian, or perhaps a Dalmatian, named Ghazulus Ragusinus of whose life and works nothing is known. On the other hand E. Zinner believed that the globe had been made by an Austrian named Hans Dorn. I would like to emphasize that, though starting from entirely different positions and having at my disposal a different evidence, I have arrived at the same conclusion as E. Zinner.

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[6] J. Grzywiński, *Zodiak na globusie niebieskim Marcina Bylicy* [in:] *Kalendarz I.K.C.* 1933, pp. 53—59.

1. THE CONSTRUCTION OF THE GLOBE

The globe of Martin Bylica (Fig. 1) is entered in the old inventory of curiosities of the Jagiellonian Library under the number 73. It was brought to Cracow in 1494 from Buda after the death of its previous owner and was taken over by the University together with the other astronomical instruments of Martin Bylica. The legacy of the former student and bachelor of the Jagiellonian University, who later became court astrologer to King Matthias Corvinus and parson at Buda, was so highly valued that on October 10, 1494 Joannes Sacranus, the then Rector of the University, excused all the students and masters from their work in order to enable them to see these beautiful and then uncommon instruments [7]. In his *History of the Jagiellonian University* H. Barycz writes:

> Not only books but also astronomical and geographical instruments were deposited in the Library of the Collegium Maius. Almost all these instruments were acquired in the course of the fifteenth century [8].

Until 1953, that is, for 460 years, the globe of Bylica was kept at the Jagiellonian Library. This is mentioned by all those who have written about the globe. In 1953 the globe was transferred to the Museum of the Jagiellonian University where it is preserved at present [9].

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[7] The accurate date was fixed by L. A. Birkenmajer, *op. cit.*, p. 145, note 242.

[8] H. Barycz, *Historia Uniwersytetu Jagiellońskiego w epoce humanizmu*, Cracow 1933, p. 679.

[9] Contrary to general belief the globe is no longer at the Jagiellonian Library but has been transferred to the Museum of the Jagiellonian University. It is perhaps worth mentioning here that a museum of globes has been set up in Vienna as a section of the National Library. This museum assembles not only the globes belonging to the Library itself, but also those from other Viennese collections and from the collection of the Coronelli Society of Friends of Globes. This information is given in L. Kinauer, *Die Globensammlung der Oesterreichischen Nationalbibliothek*. Biblos 1957, pp. 147—156.

Bylica's globe is the largest, the most decorative and, with regard to its design, the most elaborate of all the metal globes constructed in Christian Europe before 1500. So far as its artistic, cultural, and historical value is concerned, the globe equals the famous globe of Cardinal Nicholas of Cues, which is still preserved in the collection of the hospice at Cues on the Moselle. However, though the globe from Cues is extremely valuable and of the greatest significance for the history of art and science, it is made of wood and glued cloth whereas the constellations on it are drawn in ink [10]. The globe of Bylica surpasses the instrument that belonged to Cardinal Nicholas Cusanus not only by the size and the material from which it is made, but also by the complexity of its design as well as the precision and mechanical excellence of its construction. It will be very interesting for us to compare the constellations shown on these two celestial globes, all the more so as each represents, as will be demonstrated later, a different iconographic tradition.

The instrument of Bylica consists of five main parts: the base, a horizontal plate, the sphere, the rings surrounding the sphere, and a vertical plate at the top with a kind of astrolabe on one side and a vertical sundial on the reverse. Moreover, another sundial is placed on the horizontal plate. The height of the globe form base to top is 1210 millimetres, while the circumference and the diameter of the sphere are 1254 and 399 millimetres respectively. These dimensions are all the more impressive when it is remembered that the diameter of the largest of the ten Arabic medieval metal globes preserved till our times is somewhat less than 230 millimetres [11]. The highly polished sphere of the globe of Bylica is made of one block of a brass alloy which in the Middle Ages was called *orichalcum*. With time the globe became patinated to a dark bronze colour. Through a circular hole near the point marking the South Pole, where no images were engraved, the excess metal was taken out from the inside of the sphere till the desired thickness of wall was reached. Then the hole was closed by a tightly fitting plate [12]. The base of the whole instrument consists of four gothic curved legs

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[10] J. Hartmann, *Die astronomischen Instrumente des Kardinals Nicolaus Cusanus* [in:] *Abhandlungen der Königl. Gesellschaft der Wissenschaften zu Göttingen*. Math. phys. Klasse, N. F. B. X. H. 6., Berlin 1919.

[11] M. Destombes, *Globes célestes et catalogues d'étoiles orientaux de Moyen-Age*, Firenze [1956], p. 7, No. 4.

[12] L. A. Birkenmajer, *op. cit.*, p. 68.

ending in the claws of some bird of prey, each claw holding a ball. At the point where these four supports meet there is a node like those often seen on the foot of gothic chalices. Above the node rises a prop terminating in a U-shaped fork on which the main vertical ring surrounding the sphere is fixed. This ring is immobile while the sphere itself can move freely. The sphere can revolve round its axis which passes through the two poles of the ecliptic corresponding, in accordance with the then prevailing belief, to the centre of the whole system. When the sphere revolves round its axis the circles engraved on its surface, i. e. the equatorial circle and the ecliptic, move under the fixed vertical ring. The hour ring is attached to the vertical ring and is divided into twelve hours the day and twelve hours of the night, the hours being subdivided into quarters.

The construction of the globe allows the main axis of the sphere passing through the poles to be set at any desired angle in relation to the square horizontal plate in which the sphere is mounted. Owing to this clever design the instrument can be used for various geographic latitudes. The northern hemisphere of the globe is surrounded by an adjustable graduated half-ring used for calculating angular elevations. The circular opening in the square horizontal-plate is divided into 360 degrees for readings the azimuths and has marked on it the four cardinal points with their usual subdivisions forming, „as it were — to use L. A. Birkenmajer's phrase [13] — a rose from the eight winds bearing the eight Latin names". It was the belief of some ancient writers that the daily rotations of the sky were caused by blowing winds [14].

In the southern corner of the horizontal plate there is a horizontal sundial with a compass protected by a lid. The sundial was recently described in detail by T. Przypkowski [15].

The northern corner of the plate is occupied by a heraldic shield with engraved on it the emblem of Martin Bylica, a complicated ornament composed of several elements of various origin. At the bottom of the shield there is a stylized wild rose with five petals.

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[13] *Op. cit.*, p. 63—69.

[14] W. Voss, *Eine Himmelskarte vom Jahre 1503 mit den Wahrzeichen des Wiener Poetenkollegiums als Vorlage Albrecht Dürers* [in:] *Jahrbuch der Preussischen Kunstsammlungen*, B. 64, H. 3/4, pp. 110—111 quoting Lucretius, V. 510—534.

[15] *Zabytkowe kompasy magnetyczne na instrumentarium astronomicznym Marcina Bylicy z Olkusza z lat 1480—1487*, Kraków [1957].

Exactly the same flower is marked on Bylica's astrolabe from 1486 and on the title page of the manuscript that once belonged to Bylica and is now entered at the Jagiellonian University Library as No. 580. Above the rose there is the zodiacal sign of Sagittarius shown in profile looking to the right. The top lefthand corner (Fig. 2) is engraved with a fivepointed star and a bundle of sun rays shining from behind gothic style clouds on the Archer, under which sign of the Zodiac Bylica was probably born. The shield is adorned by a hat with double tasselled ropes, the mark of the high ecclesiastical rank of the Prothonotary Apostolic, one of the titles held by Bylica. In this way the heraldic shield of Bylica combined his family emblem, the rose, with the emblems of the two important posts, which he held in his capacity of high ecclesiastic and leading astrologer. The star in the corner of the shield is the fortunate star that led the son of a humble burgher of Olkusz and the poor bachelor of Cracow University to fame and wealth, which made him the oracle of a great king and humanist in a foreign country and a friend of scholars, poets, and nobles.

The instrument was constructed in 1480, since this date is engraved on the horizontal plate in an ornament of ribbons on which the instruction for using the sundial is inscribed (Fig. 3).

The polished surface of the sphere has engraved on it the equator, the circle of the ecliptic, twelve meridians crossing the ecliptic at intervals of thirty degrees, the zodiacal signs, and the two polar circles. The Milky Way is shown in the form of a ribbon thickly strewn with spots. Besides the twelve signs of the Zodiac the sphere is engraved with the images of thirty six constellations of both hemispheres that will be described in detail further on in this study. The most important stars marked within the constellations are differentiated with regard to brightness in such a way that the stars of the first magnitude have eight arms, those of the second magnitude seven arms, of the third magnitude six arms, and so on. The names of the constellations and of the most important stars are inscribed alongside. The inscriptions are in capital letters in the Latin or Arabic version. Some names are slightly distorted, for instance Cassepia instead of Cassiopeia, Andromada instead of Andromeda, or Prochion instead of Procyon. In some constellations the more important stars or characteristic asterisms are marked, in the Arabic fashion, by separate names, such as Cor Leonis or Cauda Leonis.

The fifteen brightest stars are denoted not only by conspicuous ornamental eight-armed asterisks but also bear their somewhat Arabic names. The stars in question are the following: Arcturus; Vega, the Eye of the Lyra, called here in the Arab manner Vultur Cadens; Capella on the arm of Auriga (Heniochus); Aldebaran that is α Tauri, called here Aldebora; Regulus called here Cor Leonis; Denebola called here Cauda Leonis; Spica in the sign of Virgo; the star in the mouth of the Southern Fish usually called Fomalhaut; Betelgeuze called here Iugula Orionis; Rigel on the foot of Orion; Sirius in the mouth of Canis Maior; Prokyon; Canopus on the ore of Argo Navis called here Markeb; Suel in the constellation Argo Navis; and the last star of Eridanus, that is, α Eridani called here Achernar.

The globe was used not only for astronomical observations and didactic purposes but also for astrology. This is shown clearly by the symbols of the planets placed beside many brighter and major stars or clusters of stars. The symbols indicate the astrological „nature" of these stars that were believed to remain each under the influence of some particular planet with specific properties, a specific „nature". It is to be remembered that astrology, alongside of opulent prebends, was an important source of Bylica's revenues. Moreover, it was astrology that was his main title to fame among his contemporaries. As an example of this part of his activities I reproduce here the horoscope that Bylica cast in 1483 for Matthias Corvinus king of Hungary (Fig. 4). A copy of this horoscope has been preserved on page eight of Ms. 3225 at the Jagiellonian Library.

After long and tedious computations L. A. Birkenmajer established the time when the arrangement of the constellations on the globe could correspond to the actual arrangement of the stars in the sky. Since the coordinates of stars change as a result of precession, i. e. the retrograde motion of the equinoctial points, a mathematician can calculate, from the positions of the stars on a celestial globe, if the uranometric distances were computed correctly when the instrument was designed. Birkenmajer's calculations indicate that the arrangement of stars on the globe corresponds to their actual position in the sky as it was in 1586 and not in 1480, that is 106 years later than the date of construction of the instrument. From this result Birkenmajer concluded that the position of the stars on the globe was set for 1424 according to the Alfonsian Tables [16].

[16] L. A. Birkenmajer, *op. cit.*, pp. 77 and fol.

The Tables, which are a catalogue of stars, were computed collectively by a group of Arab and Jewish astronomers from Toledo working in 1252 at the court of Alfonso the Wise and at his order. The Tables had a serious error in the uranometric distances amounting to 1°55′. The constructor of the globe did not know about this, though he was a university colleague of Johannes Müller of Königsberg, called also Regiomontanus, who discovered the error.

According to L. A. Birkenmajer the astronomer supervising the mechanic who made the globe could not have used the translation of Ptolemy's *Almagest* which had been made from the Greek original in 1451 by George of Trapezunt secretary to Pope Nicholas V, since its „editio princeps" did not appear until 1528. Nor was the constructor of the globe acquainted with the printed edition of *Epitome in Ptolemaei Almagestum* published in Venice in 1496.

The author of the globe probably used Ptolemy's catalogue of stars in the Latin translation made in 1175 by Gerard of Cremona, court physician and astrologer of Frederick Barbarossa. He might also have used an anonymous Latin version of emir Eugene's version translated from Arabic in the twelfth century [17]. The use of this source by the constructor would explain the numerous Arabic names on the globe. As will be shown later, Arabic influences are visible not only in such names as Dubhe, Rigel, Caput Algol, Markeb or Suel, but are also revealed, and for the present discussion this is of paramount significance, by the appearance of the constellations which differ greatly from the classical Greek types.

2. THE CONSTELLATIONS

Let us now consider the constellations engraved on the Globe of Bylica. I shall describe them here in the order accepted by Ptolemy in Books VII and VIII of his famous *Syntaxis Megale* which, owing to Arabic distortion was called in the Middle Ages the *Almagest* [18]. I shall begin with the northern hemisphere and then go on to consider the signs of the Zodiac and the constellations of the southern sky. All the human figures on the globe are shown from behind, with the

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[17] M. Steinschneider, *Die arabischen Bearbeiter des Almagest*, Bibliotheca Mathematica 1892, pp. 53—62.

[18] *Ptolemaeus Handbuch der Astronomie* übersetzt und erklärt von K. Manitius, Leipzig 1912, B. II pp. 1—119.

heads frequently in profile. The reason for this is that the observer looks at the surface of the sky as if from inside, at least such is the explanation suggested by Voss [19]. The tradition of representing the constellations in this manner is very ancient, since already in the *Almagest* Ptolemy used such definitions as „on the back of Orion" etc. Also on the celestial globe from the Farnese collection, now at the National Museum of Naples, the figures are shown from behind (Fig. 5).

1. Ursa Minor, the Little Bear (Fig. 6). The position of the Little Bear in the coils of the Dragon is astrothetically correct. The star α Ursae is marked on the tail as a star of the second magnitude and near it is the inscription Cauda. The Arabs called this star *al-jady*, that is, the Kid, and according to its position defined the direction of the Kaaba at Mecca. On the globe of Bylica the Great and the Little Bears have very long tails characteristic of the figures of these constellations on Arabic celestial globes, as for instance on the globe at the Science Museum (Matematisch-physikalischer Salon) at Dresden. This globe is dated about 1300 and on it the Little Bear is correctly surrounded by the coils of Draco, whereas the Great Bear, as on the globe of Bylica, is placed outside the coils of the Dragon.

2. Ursa Maior (Fig. 7). The Great Bear is one of the constellations with the longest history. It was already mentioned by Homer together with the Pleiades, the Hyades, and Orion [20]. The Great Bear on the globe is shown from the left flank, walking on all fours. The characteristic features of the animal, such as the ears, the snout and the powerful paws ending in sharp claws, are drawn realistically.

Altogether the figure of the Bear includes twenty seven stars, one of which bears the inscription Dubhe and the symbol of the planet Venus.

3. Draco, the Dragon (Fig. 6). The hole through which the axis of the world passes is surrounded by the powerful coils and wriggles of the serpent-like body of the Dragon. The figure has a mammalian head and two enormous yawning jaws with two rows of sharp sawlike teeth. On the head of the Dragon there is the standing figure of Hercules. This manner of representing the Dragon is derived directly from

[19] Voss, *op. cit.*, p. 94.

[20] *The Iliad* XVIII 483—489.

Arabic celestial globes. In numerous illustrated manuscripts of the star catalogue of aṣ-Sūfī the Dragon has a similar head. Also on the northern hemisphere of the celestial globe at Dresden the coils of the serpent-like body are twisted in the same kind of arabesques.

4. Cepheus (Fig. 8). Near the pole where the Dragon's coils are twisted, a strange figure is engraved in no way resembling the naked heroic athletes and demi-gods with whom the phantasy of the Greeks filled the skies. It is Cepheus king of Ethiopia and husband of Cassiopeia, who in this instance is shown as a man in the pose of a dancer with the left arm raised and bent at the elbow and the right extended downwards. He is dressed in a kind of tunic, cut at the sides reaching half way down his thighs and gathered with a belt at the waist. His head with long shaggy curls dropping to the shoulders is covered by a pointed cap. In the Middle Ages caps of this kind were often intended to indicate men from the East but they were also a frequent head-dress of personified constellations. This medieval form of the ancient Phrygian cap is seen on the head of the figure personifying the planet Mars in the Latin translation by Hermann the Dalmatian of the manuscript of Abu Mašar's *Introductorium in astronomiam* [21].

5. Boötes, the Oxman or the Ploughman (Fig. 9). Unlike Cepheus the figure of Boötes has retained its ancient nakedness. The Ploughman stands turning his back so that not even his profile is visible. His left hand is raised and in the right he holds a shepherd's crook on which there are four stars. Arab astronomers called Boötes the „Guardian of the Sky"; in the Latin translations of their writings this name is given as Custos Ursae, since the constellation constantly revolves round the Great Bear. The star of the first magnitude within this constellation marked by the symbols of Saturn and Mars is Arcturus, that is, β Boötis.

6. Corona. Corona Borealis is placed near the right hand of Boötes and is here denoted as Corana. It is shown in the form of a gothic open crown decorated with a leafy gothic ornament.

7. Hercules or Engonasin, the Kneeler (Fig. 10). This constellation is one of the most interesting and the most important of all shown on the globe of Martin Bylica. The ancient hero is presented here as a young knight kneeling on his right knee. His head turns to the

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[21] F. Saxl, H. Meier, *Verzeichnis illustrierter astrologischer und mythologischer Handschriften des lat. Mittelalters*, III. *Die Handschriften in englischen Bibliotheken*, London 1954, Bibl. Nat. Ms. 7936, Fig. 33.

left and is shown in profile. He has a striking Roman nose and long hair dropping in curly rings. In his raised right hand he brandishes a curved eastern sword resembling the sword on the celestial globe preserved at Dresden and in the catalogue of stars of aṣ-Sūfī [22] (Fig. 12). However, whereas in Arabic representations of Hercules his left hand is empty, on the globe of Bylica he holds in it the skin of the Nemean lion, which according to Greek mythology was for him an impenetrable shield and the most secure armour. In the representations drawn by the ancients, and in these of the Carolingian period which were directly dependent on antiquity, the lion skin was shown hanging over the left forearm, but here it is reduced to the maned lion's head, with ears erect, tongue hanging out, and a long tail ending with a tuft of hair. Nevertheless, this is the first time that the skin was restored to Hercules since, from the end of the twelfth century, the sky on celestial maps and in illustrated star catalogues had been filled with figures of Greek mythology distorted by Arab astronomers, who did not know or did not understand the myths and religion of Greece. This means that, contrary to previous opinion, the lion skin of Hercules was restored for the first time on the globe of Bylica and not on the maps of 1503 executed for the College of poets and mathematicians in Vienna [23].

Though the lion skin was already restored in 1480, the artist who engraved the constellations on the globe left the other attribute of Arabic origin, the curved sword. The last truly ancient representation of Hercules, naked, bearded, the lion skin in one hand and a knotted club raised in the other, had been the one on the wooden celestial globe of Cardinal Nicholas of Cues (Fig. 11), still preserved in the collection of the hospice at Cues. That globe, unnoticed and unappreciated by historians of art in spite of J. Hartman's excellent study [24] describing it from the point of view of the history of science, is valuable not only for the human figures which constitute the last link of classical traditions preserved carefully in Carolingian times. It is also most valuable on account of the artistic pen-and-ink drawings executed on the glued cloth surface of Nicholas of Cues globe,

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[22] H. L. Schjellerup, *Description des étoiles fixes composée au milieu du dixième siècle par Abd-ar-Rahman aṣ-Sūfī*, Saint Pétersbourg 1874, Plate I.

J. M. Upton, *A Manuscript of the Book of the Fixed Stars by Abd-ar-Rahman aṣ-Sūfī* [in:] *Metropolitan Museum Studies*, Vol. IV, Part 2, 1933, Fig. 11.

[23] Voss, *op. cit.*, p. 64; Saxl, *Verzeichnis* B. II, 1927, p. 36.

[24] J. Hartmann, *op. cit.*

which reflect the fully conscious interest in antiquity manifested in France of the thirteenth century. A definite relationship of style is apparent — for example in the figure of Cassiopeia — between the drawings on the globe of Cardinal Nicholas and the famous album of Villard de Honnecourt, who obviously was susceptible to the influences of classical art and tried consciously to bring out, by specific drawing techniques, the relief of the musculature of the human body. On the celestial globe from Cues these tendencies are most evident in the zodiacal constellation of Aquarius. While the constellation figures on the globe of Cusanus are, in a way, the result of the French Pre-Renaissance of the second half of the thirteenth century, the attempt at classicizing the figures of Hercules and Boötes on the globe of Bylica are the first forerunners of the true humanist Renaissance in central Europe and of the tendencies that later were manifested with such vitality in the works associated with Conrad Celtes [25]. However, the other details of the figure of Hercules on the globe of Bylica are in direct contradiction to the classical models where Hercules was shown as a naked and bearded athlete in the prime of manhood. Here he is shown as a slender young man, armour-clad from neck to toe. The hand holding the magic lion skin is in a gauntlet and the feet, of which the left is placed on the head of the dragon, are clad in long pointed sollerets. I shall describe this rich and beautiful armour further on, together with other costumes and attributes. Obliquely across the back of this figure runs the inscription Hercules and below the waist there is engraved the symbol of the planet Venus.

8. Lyra, Testudo, Aquila Ruens, called here Vultur Cadens (Fig. 13).

In Arabic the asterism is called an-nasr āl-Wāqī and this is the reason why the star of the first magnitude in this constellation is even today called the Vega. The manner in which the constellation was represented throughout the ages is rather ambiguous. On the globe of Cusanus it is drawn as a lyre with seven strings while in the illustrations to the star catalogues of Arab astronomers it is sometimes a turtle and sometimes an eagle. On the globe of Bylica the Lyra is shown as a splendid eagle. This truly royal bird bearing the inscription Vultur Cadens is shown from the front with outstretched wings, the head turned to the left and the Vega marking the position

[25] Z. Ameisenowa, *Some Neglected Representations of the Harmony of the Universe* [in:] *Essays in Honour of Hans Tietze*, Paris—New York 1958, pp. 349—364.

of the eye. There can be no doubt that the constellation is represented here in the oriental fashion. This is indicated not only by its name, but also by the characteristic styling of the silhouette of the bird.

9. Cygnus, the Swan (Fig. 14). This constellation is also represented, in accordance with the Arabic iconography of star groups, not as a swan but as a hen. Consequently the inscription beside it is Gallina.

10. Cassiopeia. Of all the figures on the globe the artist was least successful with that of Cassiopeia. He probably did not know the Greek myth about Cepheus's wife, who boasted that she was more beautiful than the Nereids. Her boast enraged Poseidon so much that he caused a storm in which the lives of many sailors were lost. Cassiopeia is here engraved as an unattractive woman sitting on a gothic throne with a back. On her head she has a long kerchief covering most of the face shown in profile. Her dress is long, reaching to the ankles with a belt at the waist and long narrow sleeves. The figure bears the inscription Cassepia.

11. Perseus (Fig. 15). In Arabic the constellation is called Hamil rās al-ghul, the Bearer of the Demon. On the globe of Bylica the naked figure of the hero, the killer of the sea monster that enslaved Andromeda and the slayer of the Medusa with snaky hair and deathly gaze, is engraved on the background of the dotted ribbon of the Milky Way in between Cassiopeia his mother-in-law and Andromeda his wife. The hero is shown from behind brandishing above his thickly haired head the broad curved sword with which he accomplished so many brave deeds. His left arm is bent at the elbow and in his hand he holds by the hair not the snake-covered head of Medusa, as does the Perseus of Benvenuto Cellini, but the bearded head of a demon. The ears of the demon's head are shaped like the wings of a bat and the wide open mouth displays two rows of sharp teeth. The bare feet of Perseus are not winged, as was the tradition in antiquity and with representations derived from classical images. Except for the nakedness and the sword nothing is left of the Greek myths in this figure; though on the woodcut in the Venice edition of Hyginus's *Astronomicon* published by Erhard Radolt in 1492 Perseus is shown in his fully classical appearance.

12. Auriga, Heniochus or Erichthonius, the Charioteer, and Capella or Haedus, the Goat (Fig. 16). This constellation as shown on the globe was formed by combining two others: the Charioteer and the Goat. Mythographers identified the goat that nursed Zeus

with this constellation, and in his poem on stars Aratos calls it the Holy Goat Αἴξ ἱερή [26]. The Charioteer is here presented as a naked young man with head turned to the left in profile. On his head is a fantastic hood with a collar the long end of which waves gaily in the wind. The collar forms a kind of cape with a notched border covering the shoulders and the back. In his hands the Charioteer holds the reins which are his characteristic attribute. Over his left shoulder, on which stands the Goat here named Hedus, there is a star of the first magnitude, the Capella or α Aurigae.

13, 14. Ophiuchus, Serpentarius or Anguitenens and Serpens, that is the Serpent-holder and the Serpent (Fig. 17). The Serpent-holder is shown from behind; he is naked and stands on the Scorpion's body between Hercules on the left and the Milky Way on the right. At the waist he is encircled by the coils of the Serpent which bind also both his arms. This personification of Ophiuchus does not resemble the Arabic representations which show him holding the serpent in both hands though not tied by its coils. The figure of Laocoön from the Thermae of Titus at Rome was not unearthed till 1506, but the classical tradition must have been alive in the Middle Ages [27]

15. Sagitta, the Arrow. The Arrow is represented here in accordance with its name and requires no comment. It is placed above the head of the Dolphin.

16. Aquila. This constellation reflects the doubts of the designer of the figures on the globe about the identity and appearance of the Swan, the Lyre and the Eagle. Since in place of the Lyre he drew the Eagle and in place of the Swan the Hen, he defined Aquila as Vultur Volans and placed it at the point where the Milky Way is widest, near the Arrow.

17. Delphinus. The Dolphin is shown here simply as a fish with its mouth open and sharp teeth like the teeth of a pike.

18. Equuleus, the Little Horse or Foal. Equuleus is shown here as the fore-section of a horse without wings.

19. Pegasus, the Horse (Fig. 18). This constellation is drawn as a winged fore-section of a horse with a big mane and a very realistic head. The mouth is open, the teeth are visible and the tongue sticks out from between the thick lips. The artist did not even forget about the bristly moustachelike hairs on the nose of the animal. The hooves,

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[26] Aratos, *Phaenomena* V, 163. Ed. J. Martin, Firenze 1956, p. 35.

[27] R. Förster, *Laokoon im Mittelalter und in der Renaissance* [in:] *Jahrbuch der Preussischen Kunstsammlungen*, B. XXVI, pp. 146—178.

the wings and the tufts of hair on the legs are drawn with admirable precision, demonstrating the engraver's faculty for observing nature and his ability to overcome the then prevailing schematic and conventional rules for drawing animals.

20. Andromeda (Fig. 19). Andromeda is shown naked and in chains with which she was bound to the sea-rock. The figure is placed below Pegasus between her deliverer and husband Perseus, on one side, and her mother Cassiopeia on the other. The artist did not follow the Arabic tradition here since the Arabs represented this constellation differently and placed the second Fish of the Zodiac at the level of her waist. On the globe of Bylica only the head of one of the Fish is engraved below the raised left arm of Andromeda. Her nude figure is somewhat dumpy and not very attractive, though this is not so much the fault of the engraver but, as will be shown, of the original from which the engraver copied the drawing.

21. Triangulum or Deltoton, the Triangle (Fig. 20). This constellation, which bears the inscription Triangulus is marked above the sign of Aries.

Let us now consider the signs of the Zodiac. The manner in which they are engraved on the globe of Bylica is by no means schematic, since some of them are related to classical traditions, while others manifest Arabic influences.

22. Aries, the Ram (Fig. 20). The Ram lies with tucked legs on the head of the Whale. The head is turned backwards in the same way as in the illustrations to manuscript copies of the star catalogue of aṣ-Ṣūfī. The curly fleece is stylized very meticulously and with much talent so that almost every hair is engraved separately. On the head of the Ram are marked the symbols of the planets Saturn and Mars.

23. Taurus, the Bull (Fig. 21). According to both the Western and Eastern tradition the sign of the Bull has retained throughout thousands of years the same unchanged form of a fore-section of a bull with bent fore legs and enormous horns on the inclined head. On the Bull's forehead are five stars and among them one of the first magnitude. They are the Hyads and the brightest of them is Aldebaran here named Aldebora. Above the Hyads, over the ear and on the neck of the Bull, there is another cluster of seven stars of the fourth and the fifth magnitude, the Pleiades. Both these star clusters are already mentioned in the *Iliad* (XVIII, v. 486).

24. Gemini, the Twins (Fig. 22). The Twins on the globe are drawn in the manner most frequently adopted in the Middle Ages

in the West. They are shown as two boys holding each other in their arms. Mythographers identified them with the children of Zeus and Antiope, the twins Amphion and Zethos. On the globe of Bylica they are shown as youngsters both raising their left hands.

25. Cancer, the Crab (Fig. 23). The Crab is presented as an enormous crayfish with a fish tail, protruding eyes, three pairs of legs, and long pincers. Directly below the Crab, on the southern hemisphere, the engraver placed Prokyon showing it as a small dog with hanging ears. The dog has a collar with a ring for the lead and tongue hanging out.

26. Leo, the Lion (Fig. 24). The sign of the Lion is so realistic and so accurate in detail that it looks as if it might have been drawn from nature. After all, at the end of the fifteenth century this was not entirely impossible, since many royal courts of that time had zoological gardens and the town where the globe was constructed was the seat of a magnificent court. The Lion is turned so that it shows its left flank, it has a streaming mane and in its mouth two rows of long sharp teeth. The paws are armed with powerful claws, and the beast's muscular body crouches for a leap. The long tail is wound around the left hind leg and ends with a soft tuft. On the shoulder of the animal, at the point marked Cor Leonis, there is a star of the first magnitude known today under the name of Regulus. At the end of the tail there is another star of the first magnitude, which bears the inscription Cauda Leonis and is now named Denebola.

27. Virgo, the Virgin (Fig. 25). The Virgin is a winged young girl standing in an upright position, her head turned to the right, and the face with fine delicate features shown in profile. Her plaited hair is wound tightly round the small head. At the shoulders she has powerful wings reaching almost to her ankles. This figure of the Virgin is probably derived from the Greek representations of Nike, Nemesis or Dike, such as the marble statuette from the Dattari collection [28] which, though it dates from the time of the Roman Empire, was quite certainly a copy of a Greek original. This ancient type of Virgo had been adopted already by artists of the Carolingian period, which is demonstrated by the ninth century manuscript from the monastery of Prüm now preserved in the National Library of Madrid [29]. The Virgin is dressed in a robe fitting

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[28] A. Schlachter, *Der Globus*, Berlin 1927, Fig. 2.

[29] W. Neuss, *Eine karolingische Kopie antiker Sternzeichenbilder im Codex 3307 der Biblioteca Nacional zu Madrid* [in:] *Ztf. des D. Vereins für Kunstwissenschaft*, 1941, Vol. VIII, pp. 113—140, Fig. 5.

closely at the top and wide below the waist. The dress is creased into sharp folds and the hem traces a freakish pattern disclosing the slightly raised left foot. The left arm is drooping and in her hand the Virgin holds the constellation called the Corn Ear or Spica containing a star of the first magnitude also called Spica. The right arm is bent at the elbow so that her hand with fingers long and slender at the tips is in front of the Virgin's face.

28. Libra, the Balance (Fig. 26). The sign of the Balance was the last constellation introduced into the catalogues of stars. It was still unknown to Ptolemy, and in the *Almagest* the place of this sign is occupied by the claws of the Scorpion. On the globe of Bylica the Balance is drawn with one scale higher than the other.

29. Scorpio, the Scorpion (Fig. 27). The representations of the Scorpion in the West and in the East were very similar. It was drawn without a head, with several pairs of legs like the Crab, with claws, and with a long curved tail ending in a projecting deathly sting. It is exactly in this way that the Scorpion on the globe of Bylica is presented.

30. Sagittarius, the Archer (Fig. 28). The figure of the Archer is very characteristic. He is shown as a centaur galloping to the right at full speed and drawing his bow to shoot an arrow. Two noteworthy features associate this figure of the Archer with its representations in the illustrated star catalogues of aṣ-Sūfī. In the first place, the artist did not understand the meaning of the ancient chlamys on the background of which the outer stars of this constellation were marked. The chlamys on the shoulders of the classical representations of the Archer was changed by the illustrators of Arabic astronomical manuscripts into long ribbons with waving ends streaming in the wind from the turban, as shown on the miniature in the manuscript at the Metropolitan Museum [30] in New York (Fig. 29) and on the miniature in the Leningrad Codex [31]. The other detail not found in western representations of the Archer is the belt cut into a trifoil ornament separating the human and the equine parts of the centaur's body. A similar belt is very clearly shown in the illustrations to the famous manuscript star catalogue of aṣ-Sūfī [32], written in 1437 for the astronomical observatory of Ulug Begh at Samarkand and now

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[30] Upton, *op. cit.*, Fig. 40.
[31] Schjellerup, *op. cit.*, Plate III, Fig. 30.
[32] Paris, Bibl. Nat., ms. arab. 5036.

preserved in Paris. Though the ornament of the belt worn by the Archer on the globe of Bylica differs somewhat, the same intention as in Arabic representations is apparent at first sight. It is also obvious that the designer of the figures that served as the archetype for the engravings on the globe must have been familiar with Arabic images of the Archer (Fig. 29) and Centaur.

31. Capricornus, the Sea Goat (Fig. 30). The Sea Goat is shown here in its classical form of a half-goat and half-fish monster. It has a fantastic, twisted, scale-covered tail with a caudal fin at the end.

32. Aquarius, the Water Bearer (Fig. 31). The Water Bearer, like the Capricorn, is represented according to classical tradition. He is a young naked man carrying a pitcher with a stream of water pouring from it, slung by the holder on his right forearm. The head of Aquarius is turned left so that his young face is seen in profile. In the left hand he holds a rolled up piece of cloth. The only similar figure of the Water Bearer with the cloth in the left hand and the water vessel slung on the right forearm that I have seen is the one on Dürer's famous celestial maps of 1515, the first woodcut maps of the heavens. On all the other celestial maps and globes which I shall discuss more fully further on in this study, even on those typologically associated with the globe of Bylica and with Dürer's maps of 1515, Aquarius holds the pitcher under his arm. This makes the arrangement of the right arm less logical and the composition of the figure less artistic.

33. Pisces, the Fish (Fig. 32). The Fish are the last sign of the Zodiac. They are shown with their heads facing in opposite directions and joined with a ribbon tied to their tails.

THE SOUTHERN HEMISPHERE

34. Cetus, the Whale (Fig. 33). The Whale is shown as a monstrous fish of greater breadth than length, thicker at the head, and tapering towards the tail. It has the head of a terrestrial animal with pointed ears, and its body is covered by large scales. Arabic illustrations show the Whale as a monster with the fore-section of a terrestrial mammal and a fish tail, and in this resemble somewhat the Whale represented on the globe of Bylica.

35. Orion (Fig. 34). The legend about the giant Orion, the lover of Eos, killed by an arrow of the jealous Artemis, who fell in love

with him and then placed him in the heavens, is one of the oldest in Greek mythology, dating from pre-Homeric times. Homer mentions him in Book XI of the *Odyssey* (Nekya) in connection with Odysseus' journey to Hades. The characteristic weapon of Orion, a famous hunter, was a knobby club held in the right hand, while in the left he should hold, as in the case of Hercules, a lion skin [33]. On the globe the club is the only remaining element of Orion's traditional equipment. The rest of his attire is altogether fantastic. Orion is shown standing, his knees slightly bent, on the constellation of Lepus. Like Hercules he is clad in steel armour. But while the youthful Hercules is bareheaded, Orion wears the same oriental cap as Cepheus (Fig. 8). Orion's figure is shown from behind and he has an enormous straight sword hanging slantwise from his belt. Near the hilt of the sword are four stars of the second magnitude, a star of the first magnitude bearing the inscription Rigel shines on the left foot shoed with a solleret, and another star of the first magnitude named Iugula Orionis is marked on the right shoulder. Throughout the Middle Ages the greatest confusion prevailed both in the West and in the East with regard to Orion's other attribute, the lion skin. On the globe of Bylica Orion holds a torch flame downwards and on it seven stars are marked. On no other representation, whether classical or Arabic in tradition, have I seen Orion with a torch in his hand.

36. Eridanus, or Fluvius, the River. There were three different ways of illustrating this constellation. Sometimes it was shown as the figure of a river god lying reclined against an amphora with a stream of water flowing out of it. Such are the illustrations in astronomical manuscripts of the Carolingian period, for instance in the manuscript [34] of Madrid, mentioned above, or in the Codex from St. Quentin, now in Rome (Cod. Vat. lat. 645). In other versions Eridanus resembles the erect naked figure of the Water Bearer pouring water from a jar. Finally, in Arabic manuscripts Eridanus is simply a winding ribbonlike river strewn with stars, and in the same way this constellation is represented on the globe of Bylica. A fragment of the River can be seen near Orion's left foot (Fig. 34). The last southernmost star of the first magnitude in this constellation is called Achernar, that is α Eridani.

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[33] K. Kerenyi, *Die Mythologie der Griechen*, 2nd ed., Zürich 1956, p. 204.
[34] Neuss, *op. cit.*, p. 135, Fig. 35.

37. Lepus, the Hare. The Hare is drawn very realistically and placed directly under the feet of Orion (Fig. 34).

38. Canis Maior, the Greater Dog (Fig. 35). Canis Maior has the appearance of a large wolf with a characteristic lean body and erect ears. Sirius, a star of the first magnitude, is visible in its wide open mouth.

39. Procyon or Canis Minor, the Lesser Dog. Canis Minor, on the other hand, is a harmless lap-eared animal, a collar on its neck and a hanging tongue. It is shown running, beneath the sign of the Twins.

40. Argo Navis, the Ship (Fig. 36). The Ship, the largest constellation of the southern sky, was represented in many different ways. Sometimes it was a large ship, sometimes only the bow of a ship or merely a small boat. Here it is a galleon of the Italian type with a castle on the top mast, a large sail drawn up on the yard, and a rope ladder. Similar ships can be seen on fifteenth century Italian engravings. On the hulk of the ship directly below the battlement protecting the deck there is a star of the first magnitude bearing the inscription Markeb, now called Canopus. Another star with the inscription Svel, now called α Argo, is marked on the wide spadelike oar.

41. Hydra, the Watersnake (Fig. 36). This constellation cuts across almost half of the southern sky, stretching from the northern hemisphere and ending over the head of the Centaur. On the globe it bears the inscription Idra.

42. Crater, the Bowl (Fig. 25). Near the Hydra there is a metal kettle with a handle which bears the inscription Crater.

43. Corvus, the Raven. The Raven is drawn sitting on the coils of the Watersnake.

44, 45. Centaurus and Lupus or Fera, the Wolf (Fig. 37). The Centaur and the Wolf or Wild Beast are shown together. The equine part of the Centaur's body is divided from the human trunk by a belt cut into a trifoil gothic ornament forming a toothlike pattern similar to the belt worn by the other Centaur in the Zodiac, the Archer. He is turned to the right showing the face in profile, and his long hair is gathered by a band. With his right hand he holds the Wolf by the hind legs piercing the beast's throat with a spear held in the left. A small shield with four stars marked on it floats in the air in front of the Centaur and on the hoof of his right fore leg there is an isolated star of the first magnitude.

46. Ara or Puteus, the Altar. Ara is engraved below the Centaur as an altar or a small pedestal with flames rising from it (Fig. 37).

47. Corona Australis (here Austialis), the Southern Crown. The Southern Crown is not, as its northern counterpart, open at the top, but is a domed imperial crown of the Habsburgs. This detail has also been noted by Przypkowski[35] quite independently of my own observations. The Southern Crown is engraved below the Archer (Fig. 28).

48. Piscis Australis, the Southern Fish. On the globe the Fish of the southern sky bears the inscription Piscis Meridionalis. Into the wide open mouth of the Fish flows a stream of water which has its source in the vessel held by Eridanus.

3. THE SYMBOLS OF PLANETS

As has been shown, all the constellations mentioned in the star catalogues of Ptolemy and aṣ-Sūfī are to be found on the globe of Bylica. The designer took much care to place the stars forming or associated with these constellations as correctly and as precisely as was possible in the Europe of 1480. Mention has been made above that the arrangement of stars on the globe did not correspond to the actual state of the heavens and the reasons for this have been explained. However, the first owner of the globe, and it seems certain that it was Martin Bylica and not King Matthias Corvinus, could find on it any star listed in the Catalogue of Ptolemy and could define the order of its magnitude. He also could use the globe for teaching students and for explaining the figures that, according to a very ancient tradition, the stars and asterisms formed on the firmament. But this is not all. L. A. Birkenmajer[36] notes briefly that the particular asterisms and the brighter stars on the globe are marked by the symbols of the planets. There can be no doubt that for Martin Bylica these symbols were of vital importance. For the globe was not merely an illustration of the catalogue of stars *(Almagest)* but also a practical exposition of astrology, and though the astrological comments were reduced to symbols only, they were, nevertheless, easily discernable for any expert astrologer. Martin Bylica, one of the best known astrologers of the fifteenth century, in whose prophecies all the powerful men of his time firmly believed, could obviously make out which planet exerted its influence

[35] Przypkowski, *op. cit.*, p. 258.
[36] L. A. Birkenmajer, *op. cit.*, p. 70.

on the particular stars and asterisms forming the various parts of the constellations. He could tell at a glance when the nature of stars was martial, saturnine, or jovial, and when they were submitted to the influence of Venus. Today when using these words we often do not realize their original strictly astrological sense, so strongly was this sense oblitered in the later ages of „enlightenment". When someone is described as being jovial the immediate association is with his gay and frank character and not with the planet Jupiter. Similarly when speaking of a melancholic person we do not necessarily think that the person's birth occurred under the influence of Saturn. When on the globe the designer placed the symbols of Mars and Saturn beside a group of stars of the third magnitude in the constellation of Aries he wanted to indicate, and his intention was plain to a fifteenth century astrologer though unintelligible to the modern man, that „the nature of the Ram is fiery and bitter, its colour is yellow, and its taste bitter". On the other hand astrologers looking at the sign of the Lion said that „the nature of the Lion is fiery" and that of the „Scorpion watery and phlegmatic" [37].

For fifteen centuries the *Opus Quadripartitum* or the *Tetrabiblos* of Ptolemy was the „bible" of astrologers. Although the first translation of this work from the Greek original was made by Melanchthon (first edition in 1539), it was known to Arabs from an Arabic commentary written by ʿAli Abu Hassān ibn Ridwān who lived in Cairo in the tenth century [38]. In the thirteenth century, by order of Alfonso the Wise of Castile, the commentary of ʿAli (in the Middle Ages in the West he was called Haly), was translated into Latin together with many other writings of Islamic astronomers and astrologers. These writings became the source of all astrological knowledge in the West. A detailed study of the symbols of planets marking on the globe of Bylica the particular constellations and the asterisms or stars within the constellations that are defined as *caput*, *cor*, *venter*, or *cauda*, and were considered to be of special significance for astrological prophecies, as well as a careful collation with the *Opus Quadripartitum* of Ptolemy, in particular with Chapter VI of Book I, has led me to the conclusion that the globe was designed by someone

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[37] K. Dyroff, *Aus der grossen Einleitung des Abu Ma'šar* [in:] F. Boll, *Sphaera*, Leipzig 1903, pp. 491 and fol., „Über die Naturen der Tierkreiszeichen". It is not the aim of this study to enter on the bypaths of astrology. The interested reader is referred to R. Eisler, *The Royal Art of Astrology*, London 1947.

[38] G. Sarton, *Introduction in the History of Science*, Vol. I., pp. 729—736.

well acquainted with Ptolemy's astrological theories as contained in Haly's commentary, since the written text expresses verbally what the globe shows in symbols. This means that the globe was not only a scientific astronomical instrument but also served astrological purposes [39].

L. A. Birkenmajer demonstrated that in casting his astrological horoscopes Martin Bylica favoured a method, very popular at the end of the fifteenth century, based on writings of Abraham ibn Ezra, a Jewish astronomer and astrologer who worked in Toledo and in Italy and died in 1162 [40], and whose works Bylica could have known from a Latin version translated by Peter of Abano (†1273). However Bylica's preference for Ibn Ezra can in no way change the fact that some fundamental astrological principles, such as the „nature" of planets, their colour and taste, the day and night „houses" of planets, as well as their properties and influence on the signs of the Zodiac and on other fixed stars, were all, at the time when the globe was being designed, regulated by the principles contained in the *Quadripartitum*. It was pointed out by L. A. Birkenmajer, who has been quoted here many times, that the *Quadripartitum* had been used for the first time in Poland by an anonymous writer on astrology, living at Cracow, in a manuscript treatise of 1407 now preserved at the Jagiellonian Library (Ms. no. 333) [41]. The high repute in which Ptolemy's principles of astrology were held throughout the fifteenth century is best evidenced by the magnificent manuscript copy of Haly's commentaries, that had been written and illuminated in 1400 at Prague for King Wenceslaus and later belonged to King Matthias Corvinus, the patron and benefactor of Martin Bylica. It is not known how the manuscript, now kept in the National Library at Vienna (Ms. no. 2272), came into the hands of Matthias Corvinus, but it must have been in his library since it was bound for him in an ornamental cover with his own blazoned superexlibris [42].

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[39] The correlation of the globe of Bylica with the *Quadripartitum* was made according to a German translation based on the 2nd ed. of Melanchthon of 1553; Cl. Ptolemaeus, *Tetrabiblos*, Buch I, II ins Deutsche übertragen von M. E. Winkel, Berlin [1923].

[40] L. A. Birkenmajer, *op. cit.*, pp. 110—111, note 14.

[41] L. A. Birkenmajer, *op. cit.*, p. 116, note 70.

[42] K. Holter, K. Oettinger, *Les principaux manuscrits à peintures de la Bibliothèque Nationale de Vienne*, [in:] *Bulletin de la Société Française de Reproduction de Manuscrits à Peintures*, 21 année, Paris 1938, No. 16, pp. 82—83.

On the globe of Bylica the symbols of planets placed near the various parts of the constellations and by bright stars, where their „κρᾶσις καὶ ἐνέργεια" concentrate, state briefly, as if in a translation into a shorthand of planetary symbols, the hermetic knowledge contained in the first book of the *Quadripartitum*, a book based on Greek and more ancient oriental astrological sources.

4. THE GLOBE OF BYLICA AS A WORK OF ART

The engravings on the sphere of the globe of Bylica are so heterogeneous in form and substance that they cannot be covered by some one formula as is, for instance, applicable in the case of the globe of Cardinal Nicholas of Cues. The representations of the constellations were established in ancient Greece two thousand years before the globe of Bylica was built, where they were conceived by the imaginative mind of the Greek people who animated all surrounding objects and who could even anthropomorphize star groups. On the globe these figures are shown in the distorted manner of Arab astronomers and, even then, not in the purely Arabic shapes but in a form modified by European artists.

The only factor that to some extent brings together these contrary tendencies is the late Gothic style of forms, as well as the clothes, weapons, and other details. This style is approximately conformable with the fashion prevailing about 1480 when the globe was constructed, whereas the general appearance of the figures corresponds to the Southern German graphic art of the fifteenth century. However, it must be emphasized that the late Gothic stylization of forms is only partly a common factor connecting the particular figures of the constellations on the globe, since the duality of forms is apparent also in the artistic tradition and not only in the origin of the figures and the iconographic patterns. The designer of the globe was restricted by the necessity of reproducing accurately his originals, and these were in no way uniform and had been developed outside the cultural circle to which he belonged. From this brief statement we may see why, while some animal figures, as for instance the Lion, the Horse, the Bear, and both Dogs, are so splendidly and so realistically alive as if they were drawn from nature, there are other figures, as the Eagle or the Hen, that look as if they came directly from the pages of an oriental manuscript or an escutcheon.

With regard to construction and general appearance the globe of Bylica is a magnificent work of art. The arrangement of the particular parts is so skillful and well designed that the strong base forms a secure support for the enormous sphere mounted in the square plate, while the light plate of the astrolabe and sundial at the top crowns elegantly the whole structure. The height and breadth of the particular elements is carefully balanced, the grace of the proportions being stressed by making some parts solid and others in openwork, and by framing some elements in straight and others in curved lines. The general effect is thus harmonious and beautifully proportioned, which is not always the case with the squat and short-legged globes of later date. The ornamental character of the instrument is greatly enhanced by the material from which it is made, the bronze alloy that has lasted for nearly five hundred years almost undamaged. The engravings were made with a burin. The contours of the figures are marked by heavy deep lines, whereas the details such as hair, the fur of animals, the feathers of birds, and the scales of fish are drawn with fine delicate lines that taper to a hair's breadth at the ends.

The naked human figures of Boötes, Perseus, Auriga, or Aquarius are represented very plastically. The hands of male figures are rather rough and heavy, but by contrast all the more delicate and fine are the Virgin's slender long fingers. The figure of the Charioteer turning his laughing face at the goat on his shoulder is full of playful charm and so is the lively silhouette of the Water Bearer. The engraver was badly handicapped by the necessity of presenting the human figures according to the tradition of the *Almagest*, that is from the rear. Because of this, in almost all cases, he had to show faces in a quarter profile and thus could hardly give them any expression. Another difficulty restricting the artist's freedom was the need to arrange the figure in the traditional poses and gestures without which the stars forming the asterisms could not be included in the traditional shape of the constellations. All this, and also the highly inconvenient spherical surface, made the work of the engraver very difficult and gave him no chance to express himself fully. In spite of the difficulties, and the handicap of the double heritage of the classical and Arabic traditions, he succeeded in creating a masterpiece. Notwithstanding the restrictions imposed by the original, with tools as primitive and as simple as a burin, the artist managed to conjure up on the enormous sphere this whole

extraordinary heavenly zoo with countless details and accessories and stars.

The details of the decoration and the accessories of the figures merit special mention. The armour of Hercules and Orion (Fig. 10 and 34), engraved meticulously and with astounding accuracy, are of the Italian type worn about 1460. They are narrow in the waist and consist of gauntlets, elbow pieces, pauldrons, breastplates, a tasse protecting the stomach and the hips, cuisses over the thighs, knee pieces held by straps and buckles, greaves for the shins, and sollerets [43]. The two ancient athletes have changed into medieval knights in full tournament or battle outfit, but Orion wears a cap which in the fifteenth century was still regarded as characteristic for men in the East [44]. Men's coats reaching to the thighs, cut at the sides and gathered with a belt at the waist, like those on the globe, were common in German graphic art from the middle till the end of the fifteenth century. The hood with a collar forming a kind of a short cloak cut toothlike at the border, which was worn by the Charioteer, was a garment still common in the fourteenth century on both sides of the Alps. In Germany it was called *die Gugel* from the Latin name *cuculla*, a cowl. In the second half of the fifteenth century such cowls were a characteristic garment of jesters and can be seen, for instance, on an engraving of the monogramist E. S. [45]. The kind of hair-dress, arranged in two plaits wound round the head above the forehead, worn by Virgo can also be found frequently on engravings of the same monogramist E. S., which were very popular in the third quarter of the fifteenth century [46]. Likewise the styling of feathers, fish scales, and the fleece or fur of animals is characteristic for this period. All this leads to the conclusion that the details of the design on the globe of Bylica are analogous to these of contemporary graphic art in Germany. Since, at the same time, not only the iconographic tradition but even formal details were borrowed from Arabic manuscripts, the common factor unifying the heteregeneous elements of the ornamentation is the late Gothic style of Southern Germany expressed through the medium of graphic art, in particular in engravings. This conclusion is in harmony with

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[43] M. Davenport, *The Book of Costume*, New York 1948, Vol. I, No. 452-453.

[44] E. g. „the man with an owlet". M. Lehrs, *Kritischer Katalog des deutschen, niederländischen und französischen Kupferstichs im XV Jhrt*, Tafelband I, No. 30.

[45] Lehrs, *op. cit.*, Tafelband II, No. 138.

[46] Lehrs, *op. cit.*, Tafelband II, No. 294.

the date 1480 marked on the globe and with Zinner's opinion that the artist who made the Globe was an Austrian, in fact a Viennese.

5. THE ARCHETYPE OF THE GLOBE OF BYLICA

In his basic monograph on the astronomical instruments of Martin Bylica L. A. Birkenmajer puts forward the theory that the globe was

> of Italian origin and might have been connected with the mysterious Dalmatian, Joannes Gazulus Ragusinus... from whom in 1462 Janus Pannonius had ordered instruments for himself [47].

We hardly know anything about the life and the work of Joannes Gazulus, and L. A. Birkenmajer based his theory on the distortion of some Latin names of constellations, such as Prochion, Austialis, Idra, which allegedly indicated the Italian origin of their author. As will be shown, some traces of Italian influence can be seen on the globe of Bylica but, since it is probably its archetype that came from Italy they must have been indirect. In the two studies quoted in the introduction Zinner demonstrates that the globe of Bylica was constructed by Hans Dorn, a Dominican monk who died as a very old man in 1509 at the monastery of his order in Vienna. As will be shown further on, the opinions of both these scholars were to some extent correct. The globe was in fact constructed by Hans Dorn, who made it either at Vienna or in Budapest where he resided for many years at the court of Matthias Corvinus. But the map of the heavens shown on it was transferred onto the spherical surface directly, or indirectly via a German copy, from an Italian celestial map, which itself was a copy of an Arabic map.

All this shows clearly how complicated and how interesting is the cultural and historical background of the globe of Bylica. But there are also other aspects enhancing the significance of this instrument. It was constructed in the epoch which in Central Europe marked a transition from the Middle Ages to Humanism, and it emanated from the intermediate generation of astronomers belonging to the Viennese school, who lived in the period from 1430 until approximately the end of the fifteenth or the beginning of the sixteenth century. Moreover, the globe is closely related to the same

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[47] *Op. cit.*, p. 71.

typological family as three other very important monuments in the history of culture and science; the celestial maps executed about 1440 in Vienna, the celestial maps devised in Nuremberg in 1503 in the humanist circles remaining under the influence of Conrad Celtes, and the woodcut celestial maps designed between 1512 and 1515 by Albrecht Dürer. All the above statements will be fully discussed, compared and supported by adequate evidence in this chapter. F. Saxl has described two celestial maps drawn on parchment, which he found in the manuscript *De composicione spere solide*, preserved in the National Library in Vienna (Ms. 5415, Zinner No. 4540) [48]. In another paper written by F. Saxl and E. Panofsky [49] there is, lost in a footnote, a brief remark (which I came on only when this work was well advanced) associating the globe of Bylica with the maps in Vienna. Its authors mention „a celestial globe of 1480 preserved in Cracow... similar to the Vienna miniatures in every respect". Indeed, a remarkable conformity and similarity is clearly apparent when the Vienna maps (Figs 38 and 39) are compared with the constellations on the globe, though there are, too, some small but characteristic differences in details. Saxl demonstrated [50] that the maps were drawn about 1440 in Southern Germany. There seems to be no risk in stating that the manuscript containing the maps (Vind. 5415) was written in Vienna, since on fol. 33 verso there are the coats of arms of Austria and Vienna and since it includes the writings of the Viennese astronomer Joannes of Gmunden. Besides the two maps the manuscript in question contains (fol. 217—251 v., Zinner No. 10238) a series of very interesting representations of constellations illustrating the text entitled *Tabula stellarum fixarum*. Though the evidence for the Austrian origin of the manuscript is convincing Saxl, by analysing the style of the types, draperies, nudes, garments, and the manner of drawing, reaches the conclusion that the illustrations in the Vienna manuscript (Vind. 5415), i. e. the maps as well as the constellations, are exact copies of a Northern Italian original made by an artist from South Germany. But Saxl found also, just as I have done in regard to the globe of Bylica, that the Vienna maps

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[48] F. Saxl, *Verzeichnis astrologischer und mythologischer illustrierter Handschriften des lateinischen Mittelalters*, II, *Die Handschriften der Nationalbibliothek in Wien*, Heidelberg 1927, p. 152.

[49] F. Saxl, E. Panofsky, *Classical Mythology in Medieval Art* [in:] *Metropolitan Museum Studies*, Vol. IV, 1933, II, p. 240, Note 14.

[50] *Verzeichnis*, B. II, pp. 25—32.

were related to, and influenced by, the Arabic manner of representing constellations.

Several questions arise at this point. Is it the Vienna maps that inspired the designer of the globe, or were there more maps of this kind? Who was the owner of the maps in the fifteenth century? If there were any other maps, did they differ from the Vienna ones or were they exactly the same? Were there any other celestial globes at that time and, if so, what did they look like and what happened to them? Let us now try to find as complete an answer as possible to all these questions.

In his numerous studies copiously quoted here, especially in his *Classical Mythology in Medieval Art* published in 1933, Saxl outlines the history of the transformations introduced by Arab astronomers into the manner of representing constellations. He describes, too, how these orientalized iconographic patterns penetrated and spread to Europe through Sicily and Spain. The adoption directly from Byzantium of the classical types of constellations by Moslem Arabs at the very beginning of their organized political existence is well illustrated by the paintings on the vault of a chamber in caliph Ahmed's palace, Kuseir' Amra, built in 858—862, where fragments of a painting showing the starlit sky have been preserved [51].

Probably in the East as in the West, the catalogues of stars were illustrated not only by representations of the particular constellations but also by celestial maps of both hemispheres. However, unlike the Arab astronomers, the authors of celestial maps in Carolingian and Romanesque manuscripts of European origin took no care to establish accurately the arrangement of constellations and the precise position of stars within constellations. On the other hand, Arab astronomers attached little significance to aesthetic considerations or to exact copies of mythological themes or attributes, though they took much care to define accurately and with scientific precision the actual positions of constellations and stars [52]. This tendency became even more marked when aṣ-Sūfī (903—986) revised Ptolemy's catalogue of stars and corrected it in accordance with

[51] F. Wickhoff, A. Musil, *Kuseir 'Amra*, Wien 1907, Textband p. 212; Tafelband Fig. XL and XLI.

F. Saxl, Appendix in: K. A. C. Creswell, *Early Muslim Architecture*, Vol. I, Oxford 1933, pp. 288—293.

[52] Saxl — Panofsky, *op. cit.*, pp. 239—241.

the results of his own observations [53]. Since the end of the twelfth century curiosity in the achievement of Arab astronomers spreads throughout Christian Europe. The illustrated star catalogues of aṣ-Sūfī reached Europe through the cosmopolitan courts of Sicily and Spain. A Latin translation of this catalogue, made in 1188 at Palermo for William II (†1189) and beautifully illustrated with miniatures, is still preserved in Paris in the Bibliothèque de l'Arsénal (Ms. 1036) [54]. The constellations in both the Arabic and the Latin versions of the illustrated manuscript star catalogue of aṣ-Sūfī differ greatly from the traditional Greek representations, a circumstance that I have stressed here with regard to the globe of Bylica. The most famous classical celestial globe preserved till our times is the Farnese globe (Fig. 5) now at Naples, which is a Roman copy made in the Augustan period from a Greek original [55]. Its surface shows the figures of forty eight constellations carved in relief. Most figures are shown from the rear, but the stars are not marked. The same can be observed in the case of most Carolingian and Romanesque illustrated copies of the *Aratea* and of the *Scholia* by Germanicus to the poem about stars of Aratos of which the most beautiful specimen is the manuscript No 3307 now preserved in Madrid [56]. On the other hand, in the manuscript copies of the star catalogue of aṣ-Sūfī and in their illustrated Latin translations (e. g. Ms. No. 1036 at the Bibliothèque de l'Arsénal) the stars are marked and differentiated with regard to their magnitude and brightness, which demonstrates the scientific intentions of aṣ-Sūfī himself and of the Sicilian artist who illustrated his works.

The Vienna maps (Figs. 38 and 39) also show the positions of stars which are, moreover, marked by the numbers corresponding to their place in Ptolemy's catalogue. What are the similarities and differences between the manner of representing constellations on the globe of Bylica and on the Vienna maps? The maps, drawn about one generation earlier than the globe, had been copied accurately from an Italian map designed probably as early as about 1430, whereas the engravings on the globe were an independent transposition of a similar archetype into the northern Gothic style. However,

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[53] Schjellerup, *op. cit.*, pp. 4—5.

[54] Saxl, *Verzeichnis*, B. III, 1. *Die Handschriften in englischen Bibliotheken*, p. XXXII, Note 41 and Fig. 17.

[55] A. Thiele, *Antike Himmelsbilder*, Berlin 1898, Chapter II.

[56] Neuss, *op. cit.*, *passim*.

the relative arrangement of the constellations, their position with regard to the ecliptic, and those iconographic patterns that were transferred from classical antiquity in the form given them by the Arabs, are more or less the same on the maps as on the globe. In the case of some figures on the globe the direct influence of the Arabic manuscripts of aṣ-Ṣūfī is clearly apparent, in particular with regard to the figure of the Archer (Fig. 29) and of the Centaur (Fig. 37). The differences in costume and other details between the Vienna maps and the globe are very conspicuous. The engraver of the globe gothicized the costumes and the stylization of draperies, whereas the author of the Vienna maps copied his Italian original with great fidelity. There are, however, other differences which did not arise from the transformation of Italians forms. They are, as follows: the Southern Crown on the globe is a closed imperial crown, whereas on the Vienna maps it is open; the appearance of the Great Dog and of the Ship Argo differs in both cases; the Bowl on the globe is shown as a metal kettle and on the maps as a large wooden pail; on the globe Orion holds a torch with the flame downwards and on the maps the object in his hand is unrecognizable and might even be a lion skin; the Water Bearer on the globe has the pitcher hung on his forearm, while on the maps he holds it under his arm, and Boötes on the globe is naked, whereas on the map he wears a coat.

The most interesting of all the figures on the globe is that of Hercules. On the Vienna maps he is still defined in Arabic fashion as Falceator and is shown as a kneeling man holding high above his head a sword as curved as a sickle, but on the globe Hercules again, according to classical tradition, holds in his left hand the skin of the Nemean lion; and since the engraver restored this attribute he must have known enough about Greek mythology to correct the change introduced by the Arabs. Greek myths were absolutely unintelligible to the Arabs and Hercules was for them merely a „kneeling man with a sickle". It is to be stressed, moreover, that the inscription on the globe describes Hercules by his proper name. There is nothing strange in this fact when it is remembered that already in 1454 Georgius Peurbach, professor of the Vienna University, who was too the master of Hans Dorn, introduced into his lectures the works of Virgil and Juvenal [57]. Saxl supposed [58] that Dürer was the first to restore to Hercules the appearance attri-

[57] G. Bauch, *Die Reception des Humanismus in Wien*, Breslau 1853, p. 13.
[58] Saxl, *Verzeichnis*, B. II, p. 36.

buted to that hero in classical antiquity. However, the return to classical forms in the manner of representing constellations distorted by the Arab astronomers, which characterized the humanist revival of antiquity, started much earlier, and the first traces of this revival were apparent already in 1480 on the globe of Bylica. The process must have been a gradual one and the changes did not take place suddenly. The next step in this evolution was marked by the maps of 1503 that were drawn in the circles remaining under the influence of the powerful individuality of Conrad Celtes. Let us recall here one more detail which is significant because it occurs both on the globe of Bylica and on Dürer's maps, though it is absent on the northern hemisphere of the Vienna maps and of the maps of 1503. The detail in question is the vessel held by the Water Bearer (Aquarius, Fig. 31). On the Vienna maps (Fig. 38) and on the maps of 1503 (Fig. 40) the Water Bearer holds under his arm an inclined amphora from which water flows out. On Dürer's map (Fig. 42) and on the globe (Fig. 31) the vessel is hung by the handle on the right forearm of Aquarius. The detail, though seemingly slight, must have some inner significance and special justification, since it reccurs on two occasions separated by an interval of thirty five years, whereas it does not appear in two other cases.

Since it has been established that the four monuments of astronomical science just discussed are the European versions of some Arabic map that has been lost, the iconographic pattern on the globe and on Dürer's maps must be derived from one variant, whereas the Vienna maps in Ms. No. 5415 and the maps of 1503 were drawn from another. We even have absolutely convincing evidence that in the fifteenth century there were two other celestial maps which belonged to Regiomontanus (†1476), the most eminent astronomer of the fifteenth century, a friend of Martin Bylica and a companion of Hans Dorn. The two maps were mentioned twice, in 1512 and 1522, in inventories of the library belonging to Regiomontanus; in one place they were defined as *Facies stellarum fixarum in pergameno depicte in duabus tabellis* and in the other as *Imagines celi.* In 1938 Zinner [59] pointed out that the maps of Regiomontanus which are no longer extant, might have been used as models by Dürer when, between 1512 and 1515, he designed his famous woodcuts that were also entitled *Imagines coeli.* Saxl supposed that the Vienna maps

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[59] E. Zinner, *Johannes Müller von Königsberg*, p. 257 and p. 264.

(Vind. No. 5415) served as the prototype for the maps made by Dürer [60]. It now appears that neither the Vienna maps nor those of Regiomontanus were the direct prototype for Dürer's woodcuts. However, one may certainly presume that one or other of them — and most probably it was Regiomontanus's maps — served indirectly as Dürer's model.

6. THE CONSTRUCTOR OF THE GLOBE

The credit for bringing out of oblivion the memory of Hans Dorn, who in the second half of the fifteenth century was a famous maker of astronomical instruments, must go unquestionably to Ernest Zinner, for he was the first to investigate the evidence and to demonstrate that Dorn was the constructor of the globe of Bylica [61]. How completely the memory of Hans Dorn has been lost even in Vienna, where he lived and worked, is shown by the searches that Father N. Rieth, archivist of the Dominican Monastery there, carried out on my behalf. None of the Vienna Dominicans had even heard of Dorn and no sign of his existence was found either in the archives or in the *Liber mortuorum* of the monastery. It is from my inquiry that the monks heard for the first time how famous a mechanic lived in the fifteenth century and died in 1509 in their monastery. Zinner based his very summary biography of Hans Dorn on only two pieces of information: 1) At the British Museum there is a horizontal sundial dated 1491 bearing the signature of Hans Dorn, and 2) in a booklet entitled *Tabulae eclypsium Magistri Georgii Peurbachii. Tabulae Primi Mobilis Joannis de Monte Regio*, Vindobonae 1514, on fol. 5aa the author Georgius Tannstetter, a well known humanist called also Collimitius, mentions Hans Dorn among Peurbach's pupils. Tannstetter's brief note runs:

> Joannem Dornum eorundem instrumentorum elaboratorem artificiosissimum. Hic postea ordinem fratrum predicatorum ingressus ibidem varia instrumenta ex aere, noviter vero sphaeras solidas tres mirae magnitudinis diligenter elaboravit. Vixit hic frater Joannes in monasterio fratrum predicatorum usque in annum Christi 1509, ubi magno confectus senio quievit in pace.

This information of Tannstetter's though very short, is of paramount importance for studies on the globe of Bylica. We learn

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[60] Saxl, *Verzeichnis*, B. II, pp. 31—34.

[61] Zinner, *op. cit.*, pp. 120 and fol.

from it that Hans Dorn made three exceptionally large globes, and undoubtedly the globe here described is the largest of all the globes constructed before 1500 that have been preserved till our times. Tannstetter's note leads us right into the centre of the problems and personalities associated with the constructor of this globe and with the first owner of the instrument, who was undoubtedly Martin Bylica himself. It leads us, too, into the intellectual climate in which this magnificent instrument, that still excites our admiration today, was created. The biography of Hans Dorn was reconstructed by Zinner from the most meagre sources. During his life that talented constructor must have had close contacts with Regiomontanus, with the court of King Matthias Corvinus, and consequently with Martin Bylica.

¶Hi duo ultri celeberrimi Astronomiã nobilissimã disciplinã e memoria hominũ pene obliteratã magnifice restituerũt. Reliqrũt post se uiros doctos & excellẽtes in astronomia Magistrũ Henricũ seldner. Magistrũ Eberhardũ schleisinger. Magistrũ Ioannẽ de phortzñ philosophũ Astronomũ & Theologũ insignẽ. Magistrũ Ioannẽ de kupfersperg. Ioannẽ dorñ eorundem instrumẽtorꝝ elaboratorẽ artificiosissimũ. Hic postea ordinẽ fratrum predicatorꝝ ingressus/ibidem uaria instrumẽta ex ære: nouiter uero sphæras solidas trẽs mirę magnitudinis diligenter elaborauit. Vixit hic frater Ioannes in monasterio fratrũ predicatorꝝ usqꝫ in annũ christi. 1509. ubi magno confectus senio quieuit in pace.

CHRISTANNVS MOLITORIS EX CLAGENFVRT Artium & philosophiæ magister nostri studii Astronomus insignis. Qui prognosticis suis magnam sibi gloriã præ cæteris suæ ætatis astrologis cõparauit. Scripsit in astrologia certa opuscula: quæ apud doctos magno in precio habent. Obiit Vienne ex peste Anno Christi. 1495. Habuit discipulos multos. Inter quos magister Ioannes fabri ex Weyssenburg non parũ ꝓfecisse uidet. qui & Christoferũ fabri eius cognatum Artium & philosophiæ magistrũ in astronomica disciplina egregie instituit.

IOANNES MVNTZ EX PLABEIRN Artiũ magister. Sacræ theologiæ baccalaureus formatus: & ecclesiæ cathedralis Viẽnensis canonicus: in Astrologia ita excelluit: ut nulli sua ætate secũdus iure estimari potuit. Scripsit ꝓgnostica a stellis sumpta: q̃ præ aliis oĩb9 tũc in precio erãt. Obiit aũt hic uenerãdus uir Viẽnæ Anno Christi. 1503. Tertio nonas Decembris In ecclesia cathedrali sepult9.

IOANNES STABIVS AVSTRIACVS Vates & poeta. Cæsareæ maiestatis Cosmographus & historicus. Vir omnifariã eruditus: & in nouarũ rerũ inuẽtionib9 fœlicissimi ingenii. Cui9 perraris inuẽtis Inuictiss. & illustriss. Cæsar Maximilianus quotidie oblectatur. Et eius Stboriiq; (de quo paulo infra dicã) ingenia miratus: lectiones publicas in astronomia & mathematica Viẽnæ nouo stipẽdio instituit. Inteꝛ cætera nobilissima ei9 inuẽta mathematica hæc a me discipulo suo collecta sunt.
Horoscopion uniuersale in lineis helicis Opus mirandum.
Horoscopion item uniuersale in lineis columnaribus.
Instrumentum ascendentis cum domibus & stellis fixis ad diuersas eleuationes.
Instrumentum horometrum ad omnia climata cum uario usu.
Cõpositio Metheoroscopii pro accipiẽda lõgitudine ciuitatis ignota/cõpẽdiori uia q̃ Ptolemæus hẽt.
Compositiones uariarum proiectionum uniuersalium Ptolemæi pro toto globo.
Variæ chartæ chorographicæ propria peregrinationis lustratione depictæ.

Reproduction of fol. 5aa with Tannstetter's information about Hans Dorn

Hans Dorn was probably born in Austria about 1430 and was of about the same age as Bylica and Regiomontanus. He studied astronomy at Vienna under an eminent professor of that University, Georgius Peurbach, the author of the famous treatise *Theorica nova planetarum* [62]. At Vienna Dorn must have met Regiomontanus who studied there from 1450 and later became professor of that University. From the middle of the fifteenth century Vienna, like Cracow, became an important centre of astronomical and astrological studies [63]. It follows from Zinner's detailed studies on the work of Peurbach and Regiomontanus that Peurbach lectured not only on the theory of astronomy but also instructed his pupils on the methods of making astronomical instruments. There was nothing new in this approach, since Ptolemy had already described in the *Almagest* the techniques of constructing globes. Of the three contemporaries, Joannes Regiomontanus, Martin Bylica, and Hans Dorn, each specialized in a different direction. Regiomontanus was first and above all a scholar of world-wide fame, the last great pre-Copernican astronomer, and also a constructor of astronomical instruments. Martin Bylica chose for himself the field of astrology, the pseudo-science that achieved such an enormous significance in the fifteenth century. Finally, Hans Dorn selected the practical art of constructing astronomical instruments. In their lives these three contemporaries (Dorn was born about 1430, Bylica in 1433, and Regiomontanus in 1436) met many times, and on various occasions they followed a common path. Martin Bylica, the pupil of the well known Cracow astronomer Andreas Grzymała of Poznań, lectured at Cracow University from 1459 to 1463. In 1464 he was in Rome where he met and later became a faithful friend of Regiomontanus, at that time already a scholar of considerable repute [64]. In 1466 the two astronomer friends were summoned to Hungary and offered chairs at the newly founded Academia Istropolitana at Presburg, now Bratislava. The short life of that university lasted only five years, from 1467 to 1472. After the death of the Primate Joannes de Vitéz, the great humanist and bibliophile who was the chief protector of the Istropolitan

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[62] L. A. Birkenmajer, *op. cit.*, pp. 132—134.

[63] H. Barycz, *Wiedeń a Polska w epoce Renesansu i Reformacji*, Poznań 1953, pp. 11—14.
Zinner, *op. cit.*, pp. 12—57.

[64] A. Birkenmajer, *Życiorys Marcina Bylicy z Olkusza*, Polski Słownik Biograficzny, Vol. III, pp. 166—168.

Academy, Regiomontanus left Hungary and settled in Nuremberg where he soon became engaged in animated scholarly activities. Martin Bylica remained in Hungary at the court of Buda where as astrologer he became the inseparable companion of King Matthias. He accompanied the king in all his campaigns, taking part in the Czech campaign in 1482 and in the war against Austria and the siege of Vienna in 1488 and 1489, tirelessly casting horoscopes for all the royal undertakings. The esteem of King Matthias for Bylica must have been very great since, when Vienna was captured in 1489, the professors of Vienna University asked him to intervene on their behalf with the king and to plead for a confirmation of the privileges of the University. As early as in 1476 King Matthias decided to set up a university at Buda, and in the course of time he was to realize this project. In the meantime Martin Bylica was constantly advancing in honours, titles, wealth, and the number of his prebends. Besides astronomy he must also have studied theology because from 1483 he used the title of Doctor of Theology and in 1487 became Prothonotary Apostolic. These facts are related by Alexander Birkenmajer in his biography of Bylica but, as the globe is dated 1480 and bears on it the insignia of Prothonotary Apostolic, the title must have been conferred at an earlier date. A. Birkenmajer mentions, mereover, that:

> Corvinus intended to build a separate astronomical observatory at the new university and that he paid for the making of the necessary instruments, in particular for the making of globes; possibly the same artist who made these instruments also constructed the globe of Bylica.

Indeed everything seems to indicate that the maker of the instruments for the university at Buda — they were later given away to various persons by King Vladislaus, successor of Matthias, and have been lost — was the maker of the globe of Bylica. According to Zinner [65] Hans Dorn resided for a long time at the court of Buda and arrived there not later than in 1476. His task was to continue the construction of instruments interrupted in 1471 after the departure of Regiomontanus. At Buda Hans Dorn must have met Bylica who ordered the enormous celestial globe himself or perhaps the globe was ordered by the King for his court astrologer. The latter possibility appears rather improbable on account of the presence on the globe of the very ornamental and complicated emblem of Bylica, which

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[65] Zinner, *op. cit.*, p. 122.

seems to indicate that the globe was made at his own wishes. At any rate, this ecclesiastic, parson at Buda and a prebendary holding other benefices, could well afford to pay for such an instrument. Dorn and Regiomontanus were colleagues at Vienna and Bylica knew them both. He was associated with each of them, though in different periods (1466—1471 and 1476—1490), at the court of King Matthias at Buda; and both Martin Bylica as well as Hans Dorn served the astronomical and astrological interests of their king.

The question now arises where and when did Dorn have access to celestial maps based on Arabic traditions that were so fashionable during the fifteenth century in Central Europe? Were they the now lost celestial maps once belonging to Regiomontanus? According to all probability Regiomontanus's maps were in all essential features similar to the maps in the Vienna manuscript No. 5415 and differed from them only in the details already discussed here. There certainly were many occasions on which Dorn could have access to the maps of Regiomontanus. He might have examined them at Vienna, or when Bylica and Regiomontanus arrived in Hungary from Italy, or finally after the death of Regiomontanus when in 1478 King Matthias sent him to Nuremberg to buy the books and the instruments left by the dead astronomer. In Nuremberg Dorn negociated with the municipal council, which was taking care of the estate left by Regiomontanus, till the spring of 1479. But nothing came of his efforts, since all the belongings of Regiomontanus were bought by Bernard Walther, and Dorn had to return to Buda empty-handed [66]. However, during his six months at Nuremberg Dorn obviously had the possibility of examining all the books of his dead colleague and with them the two *Imagines celi*, twice mentioned in inventories, that he had come to buy with the rest of the library.

Did Dorn only make the globe and did he commission the engravings from some other artist? The question is at present difficult to answer with certainty. Too little is known about his life and there is no information to indicate whether he worked alone or had assistants and whether he united the skill of a designer and constructor with the talents of an artist. However, in view of the well known versatility of men of those times, it seems more reasonable to suppose that the meridians, the grades, the figures of the constellations in their correct positions, the explanatory inscriptions, the symbols of planets, and

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[66] Zinner, *op. cit., loc. cit.*

the denotations of the brilliance of stars were all engraved by someone with a good knowledge of the then accepted principles of astronomy and astrology. After all the globe was not a decorative object but a scientific instrument. Did Bylica contribute in any way to the design of this globe? It seems very likely that he must have given some instructions in view of the astrological features of the instrument. In the light of what has been said above, Zinner's hypothesis that it was Hans Dorn who constructed the globe of Bylica seems entirely justified and confirmed by sufficient evidence. It is also in no way contradicted by the results of a stylistic analysis. Furthermore, the two Vienna celestial maps clearly manifesting Arabic influences, discovered by Saxl, reveal the amazing iconographic genealogy of the figures engraved on the globe.

Hans Dorn returned to his monastery in Vienna after the death of King Matthias and the horizontal sundial of 1491 now in the British Museum was made in Vienna. More evidence for the already well supported statement that Hans Dorn lived for some time in Buda and made astronomical instruments for King Matthias is found in letters of Thomas Dainer, secretary of the Nuncio in Buda, to Ercole d'Este Prince of Ferrara [67]. In the letter dated August 8, 1501, Dainer describes in detail how Vladislaus II gave away the astronomical instruments of his predecessor Matthias Corvinus, and mentions among other objects an astrolabe and a sundial. In another letter, dated September 15, 1501, Dainer explains that these instruments were made by a very old Dominican monk living in Vienna, who was obviously Hans Dorn. Since Ercole d'Este wanted to have similar astronomical instruments he instructed Dainer to find them for him. Dainer tried unsuccessfully to persuade a mechanic at Buda to copy Dorn's instruments but the man refused and nothing came of Dainer's efforts. Meanwhile, Thomas Dainer learned that a German professor of medicine, astrology, and poetry (Zinner quite correctly supposes that the professor must have been Conrad Celtes himself) showed to the Papal Nuncio two globes, one celestial and one terrestrial, not larger than two apples and similar to the globes in the Vatican library, but somewhat smaller. The continents recently discovered by Columbus were already marked on the terrestrial globe and the celestial one had on it all the constellations. The content

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[67] The letters are summarized by Zinner, *Leben und Wirken des Johannes Müller*, p. 121.

of Dainer's letters is not irrelevant for the present discussion and in the next chapter the globes belonging to Conrad Celtes and the maps drawn in Nuremberg in 1503 will be discussed. The impulse to draw these maps arose in the circle of Celtes's friends and colleagues, in particular through the initiative of the Nuremberg humanist Sebastian Sperantius and of Conrad Heinfogel the man who „*stellas posuit*" on the celestial maps of Albrecht Dürer.

7. CELESTIAL MAPS OF 1503

In 1943, when the second world war was still raging, two extremely interesting celestial maps (Fig. 40 and 41) were found at Hamburg in a private collection, but the name of the owner was not revealed. The maps were drawn on parchment and were dated 1503 [68]. As has been mentioned earlier, in 1454 Georgius Peurbach introduced lectures on classical authors into the curriculum at Vienna University. In 1461 Peurbach, a pupil and the successor of Regiomontanus, lectured on Virgil's *Bucolics* and in 1471 Wolfgang Hayden of Vienna made accessible to his students the works of Horace [69]. In the middle of the fifteenth century Viennese scholars were acquainted with the works of Italian humanists: Filelfo, Leonardo Bruni, and Boccaccio's *Genealogiae deorum gentilium*. These facts indicate that it was the astronomers who were the first to introduce Humanism to Vienna University as early as the middle of the fifteenth century. It is not surprising, therefore, that the work of a man, who was a pupil of Peurbach and a colleague of Regiomontanus, shows traces of the advance of Humanism and of the revival of Greek mythology. On the globe of Bylica Hercules again holds the skin of the Nemean lion of which he was deprived by the Arabs, while Boötes, still wearing a coat on the Vienna maps, is completely naked. But the years between 1480 and 1490 coincided with the wars waged between the Habsburgs and Matthias Corvinus. Vienna University declined and the humanists were forced to retreat from their intellectual positions. This unfavourable state of things changed entirely when Conrad Celtes was given the chair of poetry at Vienna. Earlier between 1489 and 1491, Celtes „studied, taught and made love" at

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[68] Voss, *op. cit.*

[69] Bauch, *op. cit.*, p. 13.

Cracow [70]; then, in 1491, he moved to Hungary where he wrote an elegy upon the death of Matthias Corvinus. It seems more than probable that Celtes, the pupil of Adalbert of Brudzewo, met and maintained close contact with Martin Bylica in Buda, though there is no direct written or printed evidence to support this assertion [71]. Already in 1492 Celtes inquired as to the possibility of joining Vienna University. In spite of the efforts of his friends [72], however he did not succeed at once since in 1494 he was professor of poetry at Ingolstadt. The efforts of the humanists to secure for Celtes a chair at Vienna University lasted three years and in 1497, by decree of Maximilian I, he was appointed professor at that University. At the same time Celtes founded the Sodalitas Litteraria Danubiana, a society of a kind very popular in Italy but, as has been shown by H. Barycz, with its organization modelled on the activities of a literary and scholarly circle existing at that time in Cracow under the patronage of Callimachus [73]. However, the activities of one of the greatest German humanists were not restricted to poetry, lectures on classical authors, rhetoric, and the writing of letters in the classical style. Celtes was the first to introduce at Vienna University the reading in the original and in the Latin translation of the *Cosmography* of Ptolemy and — to quote the words of G. Bauch, so far the best expert on these problems — „demonstrierte das Vorgetragene an Erd-und Himmelsgloben und an alten und neuen Karten" [74]. To the long list of Celtes's achievements we must add, moreover, the fact that he supplemented his lectures on geography and cosmography with practical demonstrations. This method, already applied at Cracow by the then famous Joannes Glogoviensis, was a great innovation in those days [75]. Celtes's two brass globes mentioned by Thomas Dainer in his letter to the Prince of Ferrara were thus used as very effective didactic tools. The students not only read the Greek

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[70] Bauch, *op. cit.*, p. 58.

J. Fijałek, *Studia do dziejów Uniwersytetu Krakowskiego w XV w.* Proceedings Pol. Ac. Sc. and Let. Section of Philol., Cracow 1899, Vol. 29, pp. 26—27.

[71] L. A. Birkenmajer, *op. cit.*, p. 53.

[72] Bauch, *op. cit.*, p. 58.

[73] Bauch, *op. cit.*, pp. 54 and fol.

H. Barycz, *Dzieje nauki polskiej w epoce Odrodzenia*, Warsaw 1957, 2nd ed., pp. 46—47.

[74] Bauch, *op. cit.*, p. 91.

[75] F. Bujak, *Wykład geografii Jana z Głogowy w r. 1494* [in:] *Studia gospodarczo-historyczne*, Lwów 1925, pp. 63—77.

original of the treatise but also attended lectures made more up-to-date by demonstrations on the globe. On the terrestrial globe the newly discovered continents were already outlined, and the celestial globe showed all the constellations. In his will Celtes offered both globes to Vienna University, just as Bylica left his instruments to the University at Cracow.

In Celtes' last will there is the following passage [76]:

> tunc enim clarissimus vir, philosophiae magister et poeta laureatus Chunradus Celtis ex testamento librosque plurimos et non vulgares atque eciam globos duos mathematicos facultati relinquit. Pro quibus cathenandis struitur ligneum in bibliotheca cancellum, ut cernatur.

Unfortunately the globes of Celtes, as so many other valuable scientific instruments, have been lost and by the eighteenth century they were no longer in existence. What was their appearance? The terrestrial globe was probably similar to the so-called Jagiellonian Globe of about 1510, which today is considered as the earliest in existence on which the word „America" was inscribed. The appearance of the celestial globe can be reconstructed with much probability from the celestial maps discovered by Voss in 1943.

We learn from the *Inventarium arcae ferreae Universitatis Viennensis* [77] kept in the Archives of that university that in 1754 the so-called chest of Celtes contained, besides some documents, a seal, a scholar's bonnet, and „ein messigener compass in futterall", but the globes were no longer there. We know exactly what was the appearance of some of the objects that were in the chest in 1754 because H. Burgkmair showed them on a woodcut illustration of 1504 to the poem *Rhapsodia, laudes et victoria de Boemannis* written by Celtes [78]. On this woodcut there is a professor's bonnet, a wand belonging to the faculty with an imperial eagle on it, a ring, the poet's laurel wreath, and in the top right-hand corner a reproduction of the seal with the inscription „Collegium Poetarum et Mathematicorum". It is the strangest seal ever adopted by a body associated with a university in Christian Europe. The usual custom was to choose some saint as patron, whereas the seal shows Mercury playing the flute and Apollo killing a serpent. These bizarre, partly medieval representations of gods (for instance, Mercury instead of

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[76] *Acta Facultatis Artium*, IV, 66b., 1509.

[77] *Cod.* 81, pp. 80—82.

[78] Voss, *op. cit.*, reproduces the woodcut on p. 144, Fig. 19.

feet has the paws of a bird) recur on many illustrations to the works of Celtes. These illustrations have been the source of much embarassment to more than one generation of historians of art and have recently been identified as the work of Hans Suess von Kulmbach. The manner of representing Mercury and Apollo on the seal is the same as on the maps of 1503 and this led Voss to the conclusion that the maps were made for the Collegium Poetarum et Mathematicorum in Vienna founded by Celtes. G. Bauch states explicitly that Celtes explained the principles of Ptolemy on globes as well as on old and new maps. It seems highly probable that these new maps were actually the maps of 1503.

The globes belonging to Celtes disappeared before 1754. Quite possibly they were borrowed from him by one of the members of the Sodalitas Litteraria Danubiana and were never returned to Vienna University. A. Rupprich, the editor of Celtes's letters published the full text of the last will of this humanist who died young in 1508. One adnotation on this document seems relevant to the present discussion [79]. It runs:

> Dominus Olomutzensis [Augustinus Moravus, the secretary of the king of Hungary] habet duas speras et cosmographiam Graecam Ptholemei.

It follows that Ptolemy's *Cosmography*, this important book that the great humanist used for teaching students, also disappeared sharing the fate of the two globes. In spite of the lasting material of which they were made the two globes have been destroyed, whereas the two maps of 1503, though only drawn on parchment, have been preserved till our time and may now possibly be the only indication of what Celtes's celestial globe looked like. These two maps (Figs 40 and 41) lead

> directly to the painter A. Dürer from the astronomer Johan Müller of Königsberg, known also as Regiomontanus, on whose catalogue of stars they are based and with whose lost maps they must have been related [80].

What Voss said in the above quotation about the maps of 1503 also applies to the globe of Bylica. On it the heavens are represented according to the catalogue of stars of 1424 and it is probably in some way related with the lost maps of Regiomontanus, since the figures

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[79] *Der Briefwechsel des Konrad Celtes*, herausgegeben von A. Rupprich, München, 1934, pp. 604—609.

[80] Voss, *op. cit.*, p. 89.

on the globe have much in common with the maps engraved by Dürer. Voss's remark just quoted fully explains why the two celestial maps discovered in 1943 are related to the globe of Bylica, though they were drawn in a different environment and twenty three years later. Celtes's deep interest in geographical and astronomical maps is well reflected by a passage in the introduction to his poem *Rhapsodia, laudes et victoria de Boemannis*, quoted by Voss [81]. At that time Celtes was in charge of the imperial library of Maximilian I and in this character he furnished the library according to his own and his master's tastes.

> Bibliothecam regiam instruxi, matheseos etiam libros ex ordine positis nuper a Maiestate tua coemptis cum globis non parvis et chartis utramque coeli et terrae superficiem designantibus.

It follows that alongside of Celtes's maps and instruments there was at the same time in the imperial library in Vienna another similar collection including two large globes, one of the heavens and one of the earth. But here let us recall that Hans Dorn, the maker of large globes, returned to Vienna in 1491 and that Collimitius stresses with admiration that Dorn made „sphaeras solidas tres mirae magnitudinis". One of these three globes belonged to Bylica, but the question may well be asked whether another one did not belong to the Emperor Maximilian I? None of the objects mentioned in the last will of Celtes or in the introduction to the *Rhapsodia* has yet been found. I have given this information about the lost maps and globes because when assembled in one place it may in future prove useful. The sudden reappearance in 1943 of the maps of 1503 proves that surprising finds are always possible.

The arrangement and the outlines of the constellations as well as the positions of the stars on the maps of 1503 (Figs. 40 and 41) are exactly the same as on the Vienna maps (Vind. No. 5415), but the style of the former was radically altered. The unknown artist in Nuremberg who drew the maps of 1503 had a very well grounded humanistic education and a deep knowledge of Greek and Roman mythology. He moved freely among the ancient myths and fully understood their essence, though he still distorted in the medieval manner some of their external forms. It is sufficient to compare the Vienna maps (Figs. 38 and 39), the constellations on the globe of Bylica, and the constellations on the maps of 1503 made for the College of

[81] Voss, *op. cit.*, p. 90.

Poets and Mathematicians (Figs. 40 and 41) to see that all three must have had a common archetype. Although on the Vienna maps and on the globe of Bylica the Arabic garments were changed to European, according to the Italian fashion of about 1440 in the former case and the German fashion of 1470—1480 in the latter, numerous Arabic names and other traces of Arabic influence and of the *Uranography* of aṣ-Ṣūfī still remained. On the other hand, in line with classical tradition, all the human figures on the two maps from Hamburg are naked. The designer responsible for Voss's maps was fully aware of the absurdity of clothing ancient gods and heroes in garments or armour of his own time. His Hercules is a bearded athletic man of the well known type perpetuated in antiquity by the figure of Hercules from the Farnese collection. The hero carries over his left arm the skin of the Nemean lion, in the right a heavy club, and is no longer shown as the „Falceator" brandishing the curved sicklelike sword. Similarly, Orion retains his classical attributes while Cepheus and Andromeda are shown naked. The only remaining trace of Arabic influence on these maps is the bearded head of a demon, the caput-al-ghul, instead of the snake-covered head of a Gorgon held by Perseus.

In the four corners of the map of the northern hemisphere there are represented the four elements of which the world is made. The elements are accompanied by the planetary and other gods. The top left-hand corner is occupied by the element of fire and the gods of the planets with a hot and dry nature, Mars and Apollo killing a serpent. In the top right hand corner there are the formidable Saturn with the scythe, Venus and the element of air. In the bottom left-hand corner Jupiter and Pluto are shown ruling, one over, the other under, the earth, Pluto is assisted by a train of infernal Furies and the three-headed Cerberus. Behind Pluto there is the only reminiscence of Christianity on this truly pagan illustration; the open gates of hell with sinners crying for mercy are shown in the background of an idyllic landscape. Finally, in the bottom right-hand corner Luna, identified with Diana the archeress, is shown in the company of Mercury ruling over the element of water. The circumference of the southern hemisphere is surrounded with a garland of twigs interrupted at regular intervals by the heads of the sixteen winds blowing from different directions. The analogue of this design on the globe of Bylica consists of inscriptions specifying the names

of the winds which, however, are not personified. The second circle running round the southern hemisphere is composed of a wreath of clouds drawn in the gothic style.

In the top left-hand corner of the map of the southern sky (Fig. 41) the artist placed the three Parcae and near them a herald holding a shield with the arms of Nuremberg. In the right top corner there is a quatrain written by Conrad Heinfogel, the same who *stellas posuit* on the woodcut maps of Dürer and on the maps of 1503. Near it the figure of Vanitas is shown clothed in a net of the same shape as is depicted in the phantasies of mythologists [82]. However, the most interesting ornamentation is placed in the bottom right-hand corner. The drawing is extremely characteristic for the intellectual atmosphere in which it appeared, that is, for the circles of Nuremberg humanists remaining under the charm and the influence of the great personality of Celtes, the leader of the German humanists. At the same time as the maps were being drawn Celtes visited Nuremberg in matters concerning the publication of his works, and though Voss maintains that he could never have approved the purgatory of the hell shown on the maps, it seems that these decorations reflect most accurately Celtes's profound interest not only in the humanities and in mythology but also in cosmology and astronomy. It is under the inspiration of Celtes himself that the two maps were conceived, in the same way as the representation of the harmony of spheres on the woodcut of Kulmbach, which I reproduce elsewhere, is the product of Celtes's mind. There can be no doubt that the influence of none other but of Celtes's spirit is most strongly impressed on the illustration seen in the bottom right-hand corner of the southern map (Fig. 46), the mind of the man whom his contemporaries accused of worshipping not God, Christ and His Mother, but heathen idols. The illustration shows Sebastian Sperantius, a great friend of Celtes's and a member of the Sodalitas Litteraria Danubiensis. He is portrayed when not yet old, sitting on a chair and holding in his hand an armillary sphere, an instrument once used for astronomical observations. Nearby a large astrolabe is attached to a tree. Sperantius, his eyes lifted and full of admiration, is looking where Urania, the Muse of astronomy, reveals herself naked, covered only by a cloak of long loose hair, on the background of a celestial sphere strewn

[82] H. Liebeschütz, *Fulgentius Mataforalis* [in:] *Studien der Bibliothek Warburg*, B. III., Leipzig 1926, Plate XI.

with stars. The portrait of Sperantius is signed with his full name and beneath it, written in Roman type, is the following quatrain:

> Quae regis ignivomos o diva Urania caelos
> Legibus aeternis vastum qui orbem moderantur,
> Calleat illorum Sperancius abdita quaeque
> Da, precor, et faustum tribuas per tempora Fatum.

Sperantius directs this prayer neither to the saints nor to God but to the Muse Urania, identified with Necessitas of the Stoics and with the Greek Heimarmene, who regulates the course of the world and shapes the fate of mortals. The prayer reflects best the climate prevailing among Celtes's associates in the Collegium Poetarum Mathematicorum at Vienna for which the charts were made. It reflects, too, the habits and sympathies of the corresponding members of the Collegium from Nuremberg and other centres. Astronomical studies were especially animated in Nuremberg where already in 1440, as is evidenced by the notes of Cardinal Nicholas of Cues, astronomical instruments were being made and traded in. Here Regiomontanus lived and worked from 1471 and was later succeeded by Bernard Walther who acquired Regiomontanus's collection, and here also Behaim constructed numerous globes.

In the bottom left-hand corner of the map of the southern hemisphere the *Ventorum descriptio* is inscribed in small capitals. It was composed by Dietrich Ulsen a physician and poet of Nuremberg and Celtes's faithful friend, whose name is listed on the memorial plate in Vienna founded by Cuspinianus to commemorate the foundation of the Sodalitas Litteraria Danubiana [83]. Thus the credit for making the maps discovered at Hamburg goes to Celtes's three closest friends: Sebastian Sprenz, Conrad Heinfogel, and Dietrich Ulsen. Unfortunately, it has been impossible to establish so far which of the Nuremberg artists drew the maps and the decorations on these maps. Approximately in the middle of the fifteenth century the astronomers Peurbach and later Regiomontanus contributed to the development of poetry by introducing into the faculty of arts at Vienna University the study of classical authors. This service was repaid to astronomers at the very beginning of the sixteenth century by the poet Celtes. In 1501 by decree of Maximilian I a new college was set up at Vienna University [84]. It was called Collegium Poeta-

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[83] Bauch, *op. cit.*, p. 77.
[84] Bauch, *op. cit.*, pp. 127—131 and 166.

rum et Mathematicorum and was intended for both poets and mathematicians. The College had two departments of mathematics and astronomy, and there were associated with it such famous men as: Stephanus Rosinus, the witness to the last will of Celtes; Joannes Stabius; Andreas Stiborius and Georgius Tannstetter-Collimitius, who preserved for posterity the name of Hans Dorn and who set up in the second decade of the sixteenth century the Sodalitas Collimitiana continuing the work of his predecessor.

Obviously the maps of 1503 published by Voss must have remained for some time at Nuremberg where lived their promotors and the advisers of the designer who made them. Dürer must have had access to these maps and he even, according to Voss, added the raven to Apollo and drew the excellent realistic eagle of Jupiter. However I have been unable to verify this statement since I have only seen photographs of the Hamburg maps.

8. DÜRER'S MAPS AND THE GLOBE OF BYLICA

Dürer started to work on his famous maps (Figs. 42 and 43) in 1512 — this is indicated by one of the variants (Geisberg 723) — and completed them in 1515. The maps have been studied by so many scholars from the viewpoint of both the history of science and of art that it would be pointless to discuss them fully again [85]. They were ordered by Stabius and were designed by Dürer in collaboration with Conrad Heinfogel, who was responsible for the astronomical side and also positioned the stars. The positions of the stars were fixed not according to the catalogue for 1424, as on the Vienna maps and on the globe of Bylica, but in conformity with the state of the heavens in 1499 and accounting for the corrections introduced by Regiomontanus in collaboration with Albrecht Dürer. It was also Albrecht Dürer who drew the figures of the constellations and the portraits of famous astronomers: the Greek author of a poem about stars Aratos, the Roman astrologer and poet Manilius, as well as two astronomers *sensu stricto* Ptolemy and as-

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[85] E. Weiss, *Albrecht Dürers geographische, astronomische und astrologische Tafeln* [in:] *Jahrbuch der Kunsthistorischen Sammlungen des allerhöchsten Kaiserhauses* B. VIII, Wien 1888, pp. 207—220.

Saxl, *Verzeichnis*, B. II, pp. 29—40.

Voss, *op. cit.*, pp. 95—103.

Sūfī. By placing the portrait of aṣ-Sūfī in one of the corners of his maps Dürer paid the first homage to the greatest Arab astronomer to whom astronomical knowledge before Argelander owes most. Simultaneously, Dürer unconsciously paid homage to all those anonymous Arab astronomers who created the scientific celestial maps, the forerunners of the ones that he used in making his own.

The present remarks on Dürer's maps are not without relevance in connection with the problems under discussion. Saxl [86] was of the opinion that Dürer's maps were based on the Vienna maps. When Voss discovered the maps of 1503 he assumed that they were the archetype used by Dürer for his woodcuts and this hypothesis was supported by other scholars, astronomers, and historians of science and art [87].

This opinion could be accepted as correct but for the globe of Bylica and the analogies between some figures on the globe and on Dürer's maps, analogies that do not appear on the other maps.

However, the globe of Bylica still reflected, though in a europeanized and gothicized manner the influence of Arabic celestial maps, whereas the woodcuts made by Dürer were fully the product of the Renaissance with regard to their astronomical, scientific, iconographic, and artistic aspects. Let us consider first the signs of the Zodiac. On the Vienna maps the hair of Virgo is arranged like the hair of a page, a hairdress fashionable in Italy between 1430 and 1440. The hair of Virgo on the maps of 1503 is dressed similarly. On the other hand on Dürer's maps the hair of Virgo (Fig. 42) is arranged in the same manner as on the globe of Bylica (Fig. 25); it is plaited and wound tightly round the head above the forehead according to the German fashion that even today is called *Gretchenfrisur*. On Dürer's maps and on the globe of Bylica the water-jug of Aquarius is gracefully hung by the handle on his right forearm, whereas on the Vienna maps and on the maps of 1503 the Water Bearer holds the vessel clumsily under his arm. Lyra on Dürer's map, though no longer called Vultur Cadens but Lyra, is represented as an ornamentally stylized eagle with four strings of a lyre on the breast. On the maps of 1503 the figure of Orion in the southern sky is shown naked, whereas Dürer and the engraver of Bylica's

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[86] Saxl, *Verzeichnis*, B. II, pp. 29—40.

[87] S. Burton, *Dürer and Early Star Maps* [in:] *Sky and Telescope* VI, 1947, p. 67.

E. Panofsky, *Albrecht Dürer*, Princeton 1948, Vol. II, pp. 167—168.

globe represented him as a knight clad in steel armour. The object in Orion's left hand on Dürer's map does not resemble the lion skin that he holds on the maps of 1503 but is more or less like the torch on the globe. The Crater on the Vienna maps is shown as a pail of wooden staves, of the kind made by coopers, and on the globe as well as on Dürer's maps it is a metal kettle with a handle. On the Vienna maps, on the globe, and on Dürer's maps, but not on the maps of 1503, the Centaur has in front a small shield floating in the air. A full list of differences separating Dürer's maps from the Vienna maps of 1440 and the maps of 1503, as well as a list of similarities associating Dürer's famous woodcuts with the globe of Bylica, would be too long for the scope of this work. The details mentioned above are entirely sufficient to demonstrate clearly that there must have been more than one set of maps derived from Arabic celestial maps of both hemispheres which were copied in Italy and later in Vienna, an important centre through which Italian artistic products passed on their way to central Europe. Furthermore, there can be no doubt that the globe of Bylica and Dürer's maps have many common features, if the classicized appearance of the maps is disregarded. Dürer drew the human bodies in the correct proportions showing vividly the muscles. All the human figures, except Orion and Virgo, are naked and most of the men have beards. For the first time Perseus holds the head of Medusa which is no longer defined as Caput Algol. Dürer not only unclothed the ancient heroes from their heavy medieval garments and armour; he also freed them from the attributes introduced by the Arabs who neither knew nor understood the Greek religion and myths.

The last link of this long chain of developments lasting one hundred years is represented by the maps (Fig. 44 and 45) in a treatise of Giovanni Antonio Rusconi entitled *Della Architettura, con cento sessanta figure, disegnate dal medesimo secondo il precetto di Vitruvio Libri X.*, Venezia 1590, published by J. Giolitti. The second edition of this treatise, that according to Schlosser [88] was written in the middle of the sixteenth century, appeared in 1660. The author, the municipal architect of Venice who frequently cooperated with Palladio, died in 1587. The ninth book of Vitruvius contains, as is well known, descriptions of constellations. Rusconi, who designed himself the drawings for the woodcuts illustrating his work, retained

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[88] J. von Schlosser, *Die Kunstliteratur*, Wien 1924, p. 373.

very faithfully the scheme of Dürer's maps, changing only, according to the fashion of the late Italian Renaissance, the hairdress as well as the dress of Virgo and introducing a few minor details and improvements. For instance, Lyra, on Dürer's maps still represented as an eagle, is here reproduced as a lyre with seven strings in accordance with classical tradition and as shown on the Farnese globe. The Charioteer of Rusconi no longer has the kid on his shoulder but holds reins in both hands.

To end this discussion about the globe of Bylica and its relation to astronomical maps a brief recapitulation of the conclusions reached so far seems necessary. According to all probability, and in conformity with the historical evidence and the appearance of the instrument, the globe was constructed by Hans Dorn, a fifteenth century astronomer and a well known maker of astronomical instruments. Dorn, who was a contemporary and a friend of Regiomontanus, resided, at the court of King Matthias Corvinus together with the first owner of the globe, Martin Bylica of Olkusz, Master of Cracow University, later parson and royal astrologer at Buda. The famous maker of instruments arrived in Buda in 1476 to continue the work on the equipment for the astronomical observatory at Buda, which had been interrupted on the departure of Regiomontanus in 1471. In 1478 King Matthias sent Dorn to Nuremberg with orders to buy the books and the instruments that Regiomontanus left at his death under the care of the municipal council there. During his visit to Nuremberg Dorn had the opportunity of examining the two celestial maps that had belonged to the dead astronomer but which are no longer extant. The appearance of these maps can be roughly reconstructed from the maps of 1440 discovered by Saxl in the Vienna manuscript No. 5415. The positions of the stars on the Vienna maps as well as on the globe of Bylica are set for the year 1424. The constellations shown on the globe of Bylica on the Vienna maps, and probably on the maps of Regiomontanus, which are no longer extant, are a transposition of Arabic celestial maps copied at the beginning of the fifteenth century in northern Italy. Dorn made the globe for Bylica at Buda immediately after his return from Nuremberg probably when still under the direct impression of the maps of Regiomontanus.

The maps of 1503 drawn by an unknown artist from Dürer's circle for the Collegium Poetarum et Mathematicorum constitute a further step in the journey back to ancient classical forms but they

still maintain the Arabic scheme. The final, and artistically as well as scientifically the most perfect, stage of this evolution is marked by the maps designed by Albrecht Dürer in 1515. Dürer's maps have common traits with the globe of Bylica, traits that appear neither on the Vienna maps nor on the maps of 1503. This seems to indicate that in the fifteenth century in Vienna and in Nuremberg there were several variants of the europeanized copies of an Arabic map. In the design of his maps Dürer applied correctly the principles of perspective, and Conrad Heinfogel who positioned the stars accounted for the corrections introduced by Regiomontanus. Consequently the image of the heavens on these maps is set for 1499 and not for 1424 as on the maps of 1503.

The globe of Bylica was dated by its maker and there has never been any question about this, but little or no information has been available about the scholarly circles with which the instrument was related. I hope that this study, carried out from the point of view of the history of science, art, and culture, may enhance the significance of the globe, not only as a treasure of precise scientific mechanics, but also as a cultural monument reflecting, as if in a mirror, the intellectual currents prevailing in scholarly and humanist circles at the end of the fifteenth century. Indeed, the globe is the most splendid example of the reception of Arabic astronomical theories by medieval Christianity. At the same time it marks the hesitant beginning in the realm of astronomy of a return to classical antiquity.

ILLUSTRATIONS

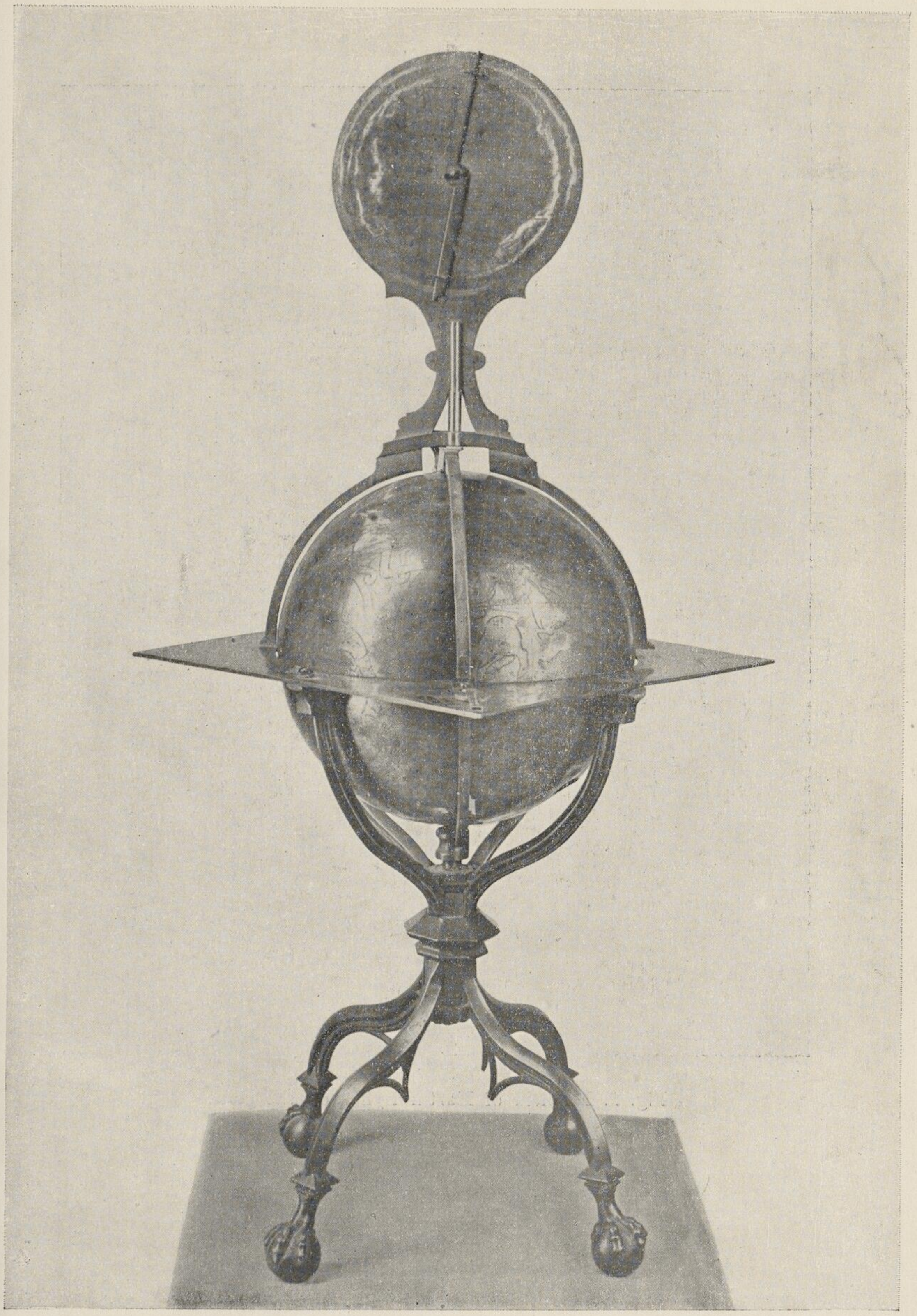


Fig. 1. The globe of Martin Bylica of Olkusz

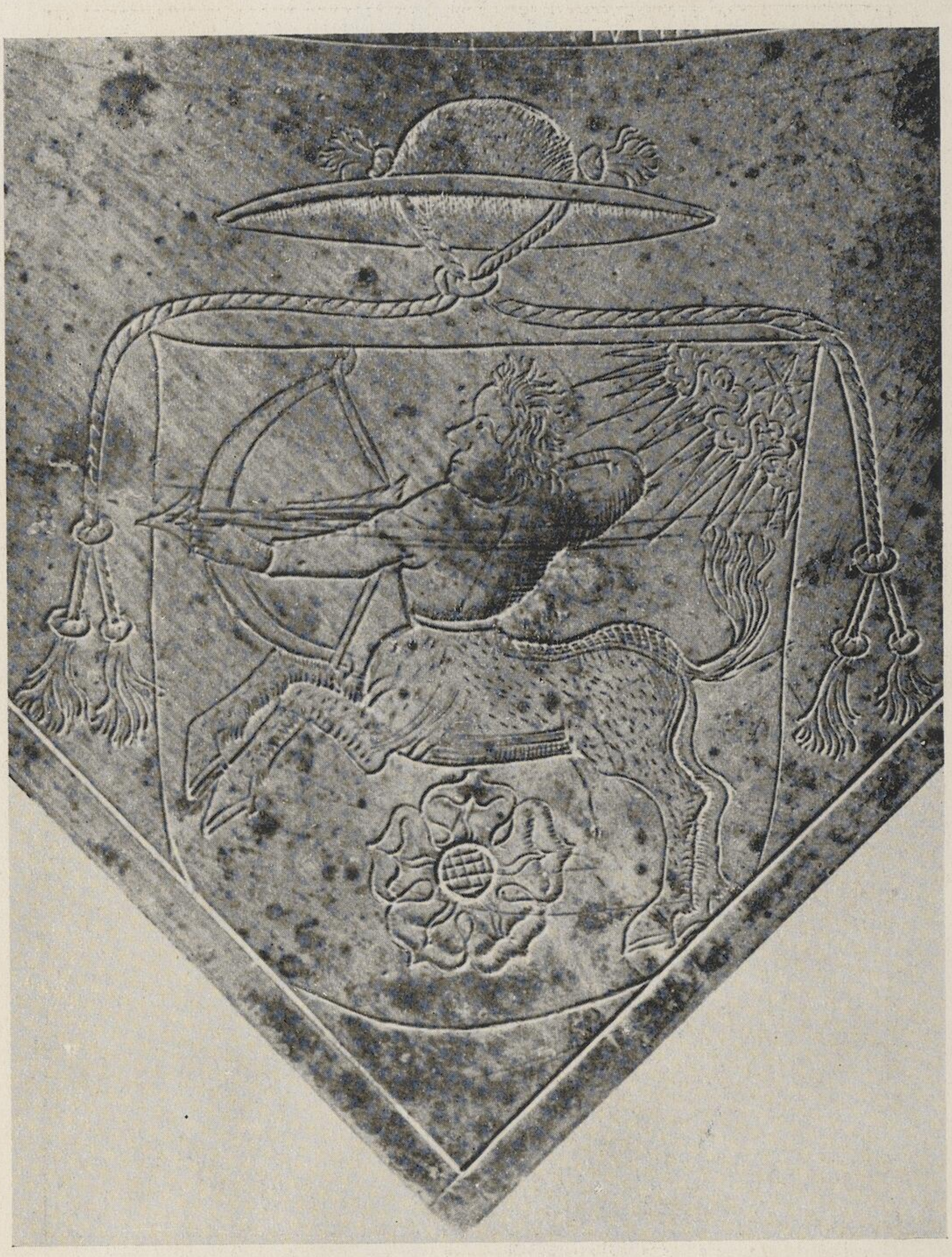


Fig. 2. Emblem of Martin Bylica on the globe

Fig. 3. The date on the globe

Fig. 4. The horoscope cast for king Matthias Corvinus of Hungary by Martin Bylica

Fig. 5. The Farnese globe

Fig. 6. The northern hemisphere of the globe of Bylica

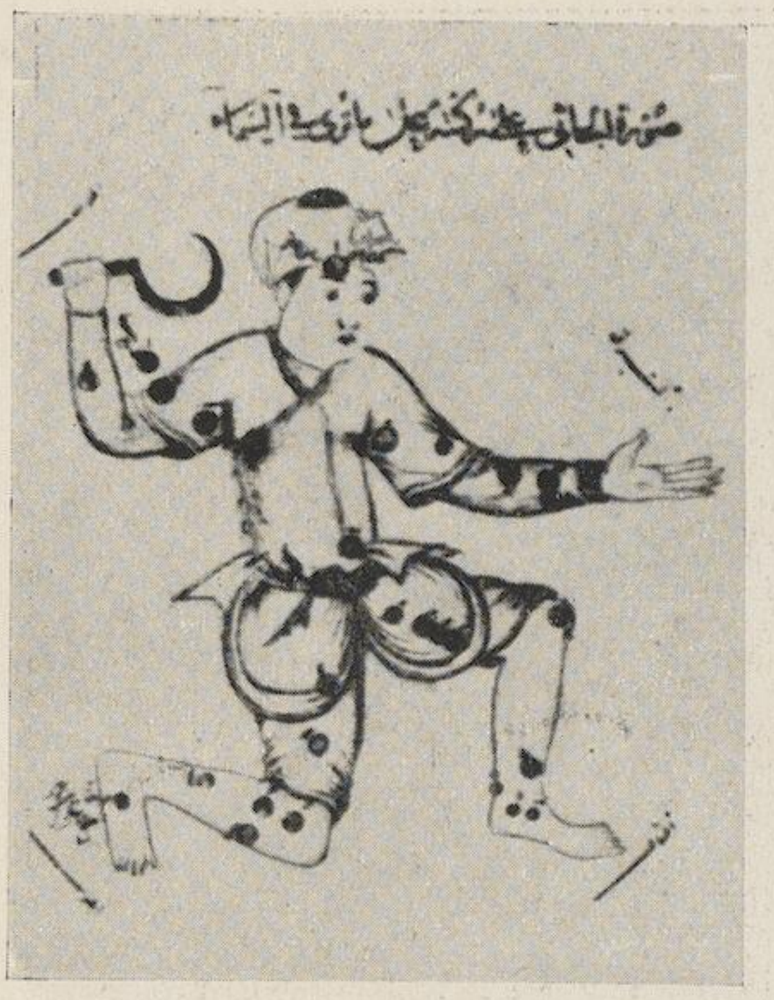
Fig. 7. Ursa Maior

Fig. 8. Cepheus

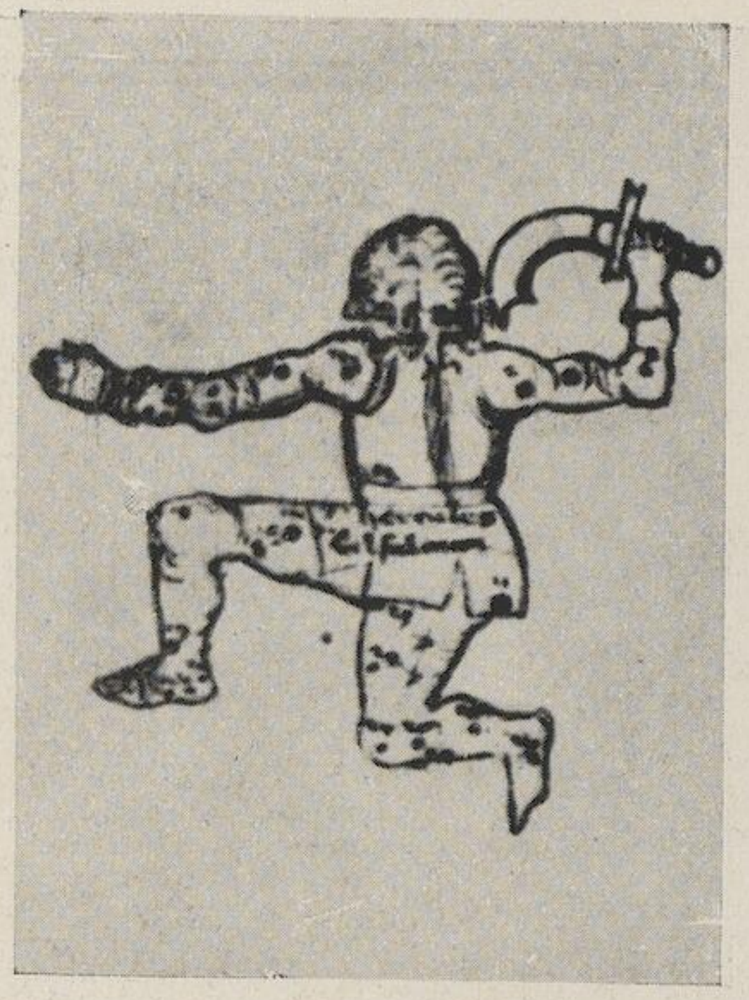
Fig. 9. Bootes

Fig. 10. Hercules on the globe of Bylica

Fig. 11. Hercules on the globe of cardinal Nicholas of Cues



a



b

c

Fig. 12. Hercules on the maps from the manuscript of aṣ-Sūfī, from the manuscript Vind. 5415, and on the Dürer's maps

Fig. 13. Lyra (Vultur Cadens)

Fig. 14. Cygnus (Gallina)

Fig. 15. Perseus

Fig. 16. Auriga

Fig. 17. Ophiuchus

Fig. 18. Pegasus

Fig. 19. Andromeda

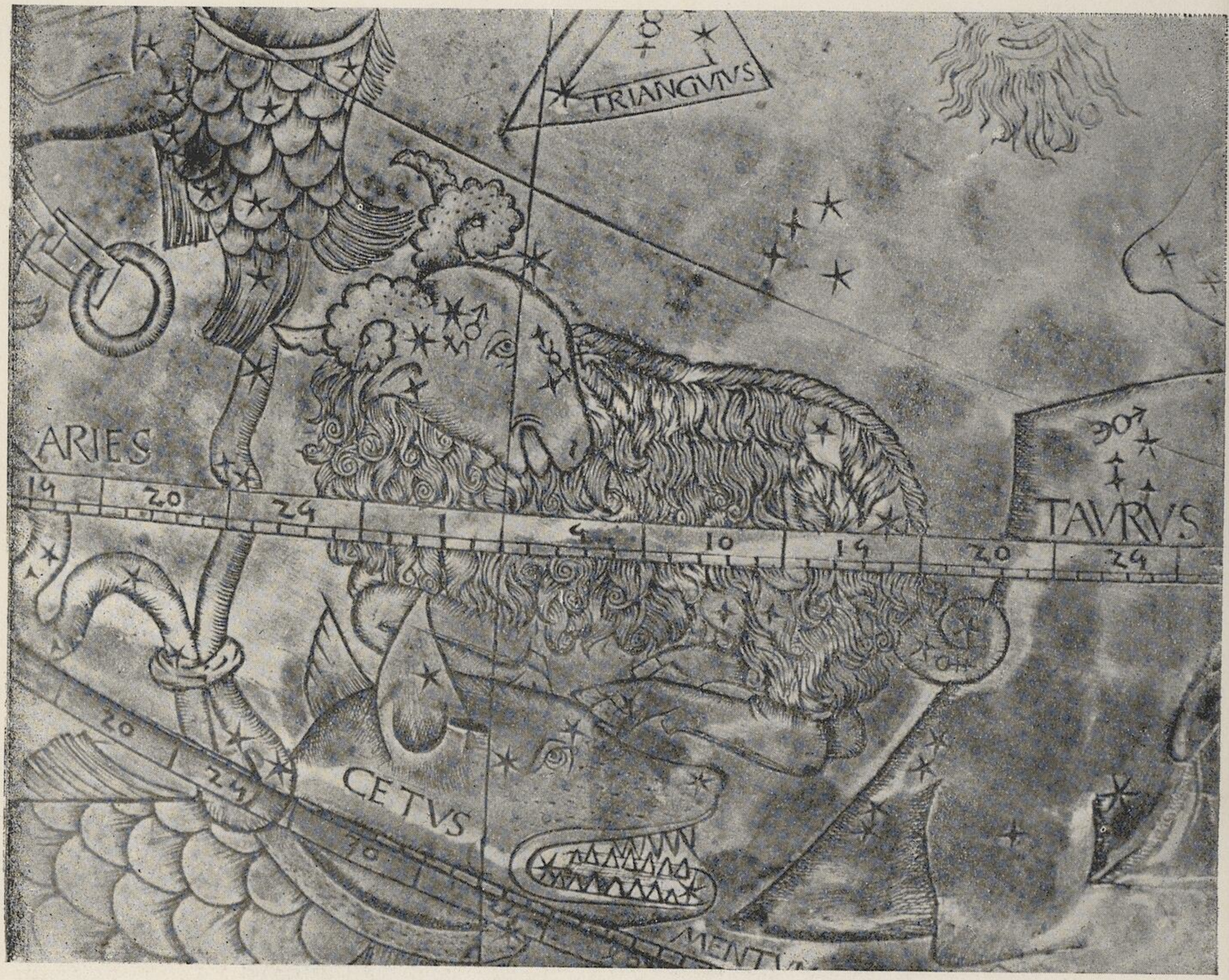


Fig. 20. Aries

Fig. 21. Taurus

Fig. 22. Gemini

Fig. 23. Cancer

Fig. 24. Leo

Fig. 25. Virgo, Spica and Crater

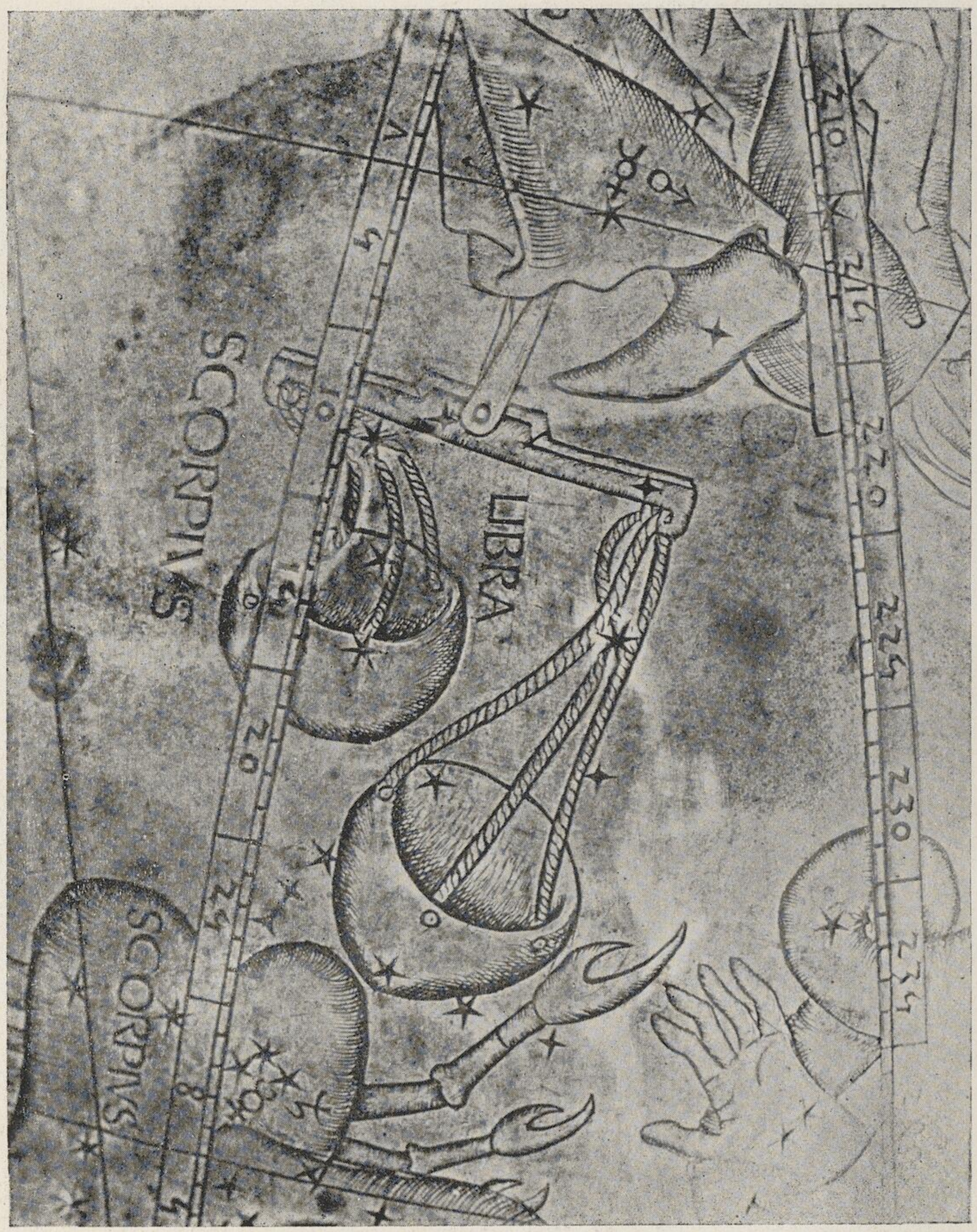


Fig. 26. Libra

Fig. 27. Scorpio

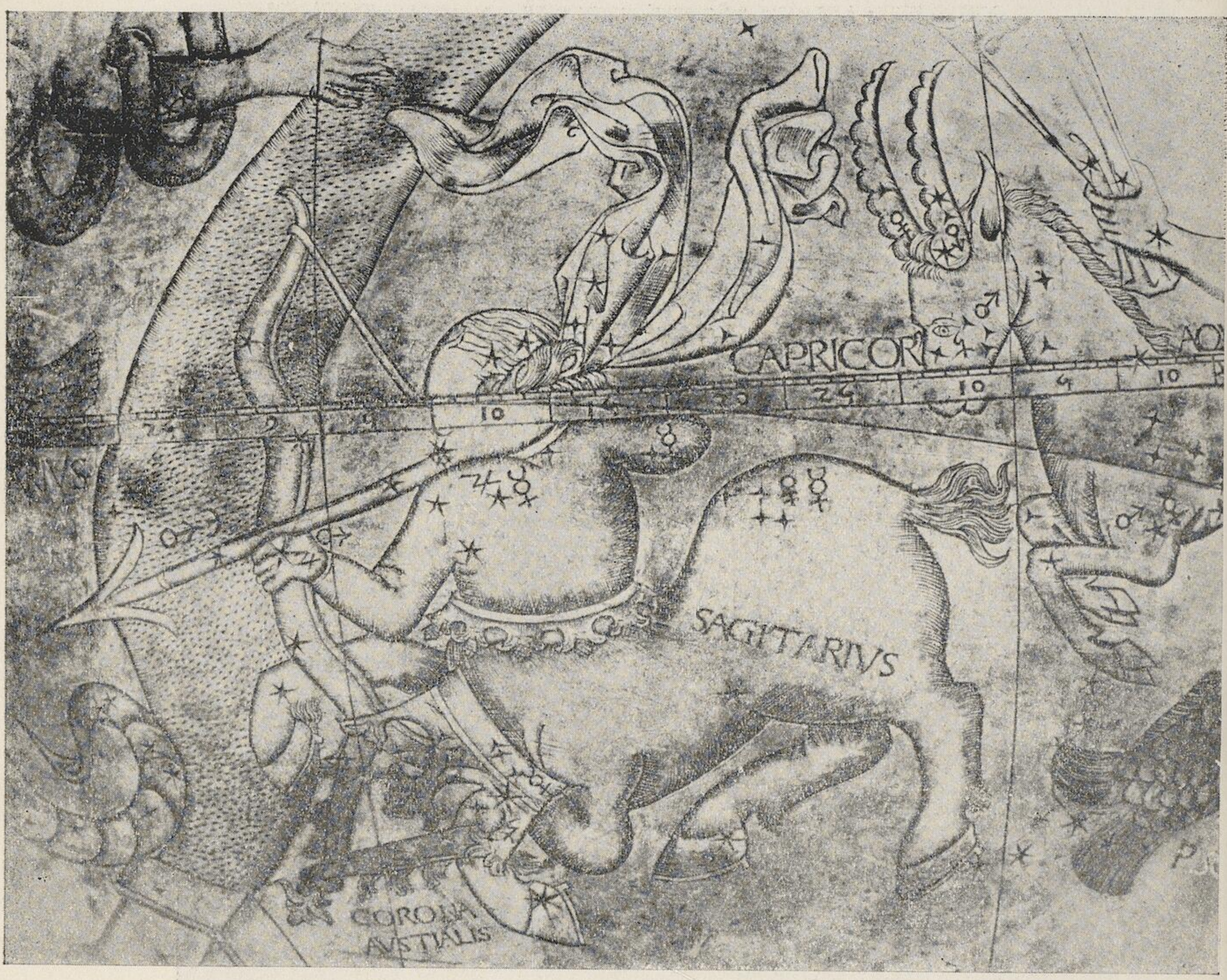


Fig. 28. Sagittarius

Fig. 29. Sagittarius from the manuscript of aṣ-Ṣūfī's *Uranography*

Fig. 30. Capricornus

Fig. 31. Aquarius

Fig. 32. Pisces

Fig. 33. Cetus

Fig. 34. Orion

Fig. 35. Canis Maior

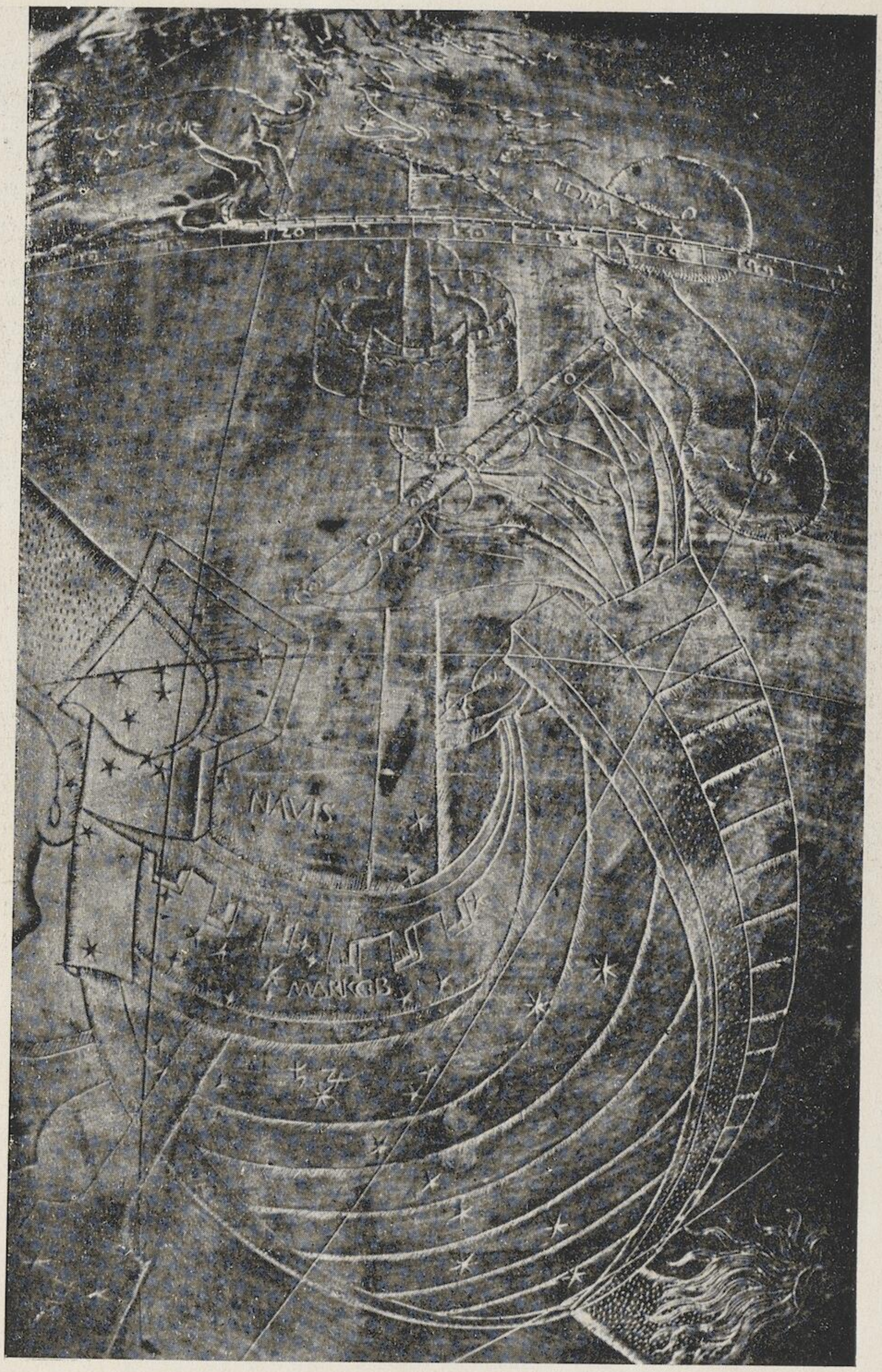


Fig. 36. Argo Navis and Hydra

Fig. 37. Centaurus and Fera

Fig. 38. The map of the northern heaven from Ms. No. 5415 in the National Library in Vienna

Fig. 39. The map of the southern heaven from Ms. No. 5415 in the National Library in Vienna

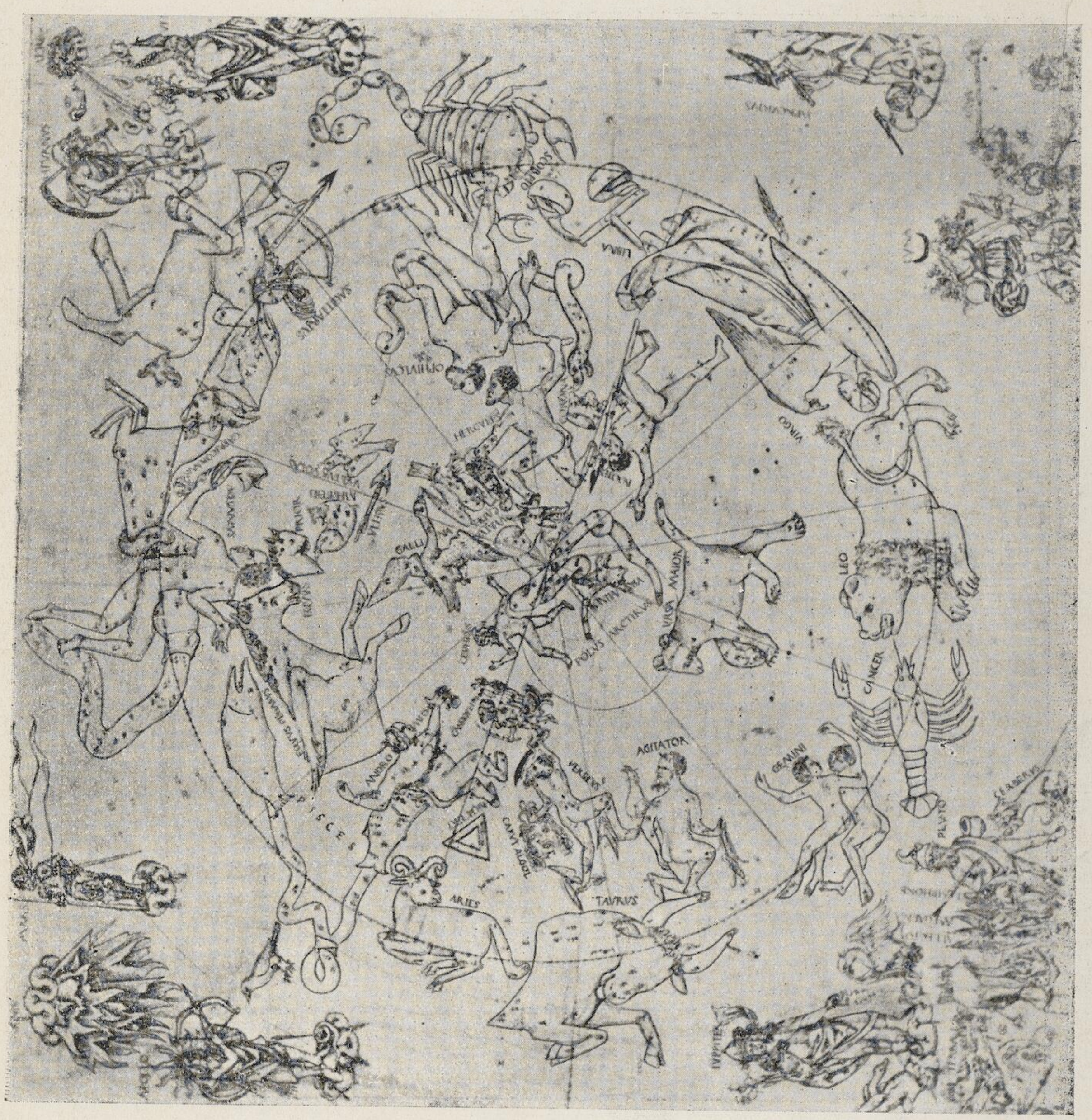


Fig. 40. Celestial map of 1503, northern hemisphere

Fig. 41. Celestial map of 1503, southern hemisphere

Fig. 42. Dürer's map of the northern heaven (1515)

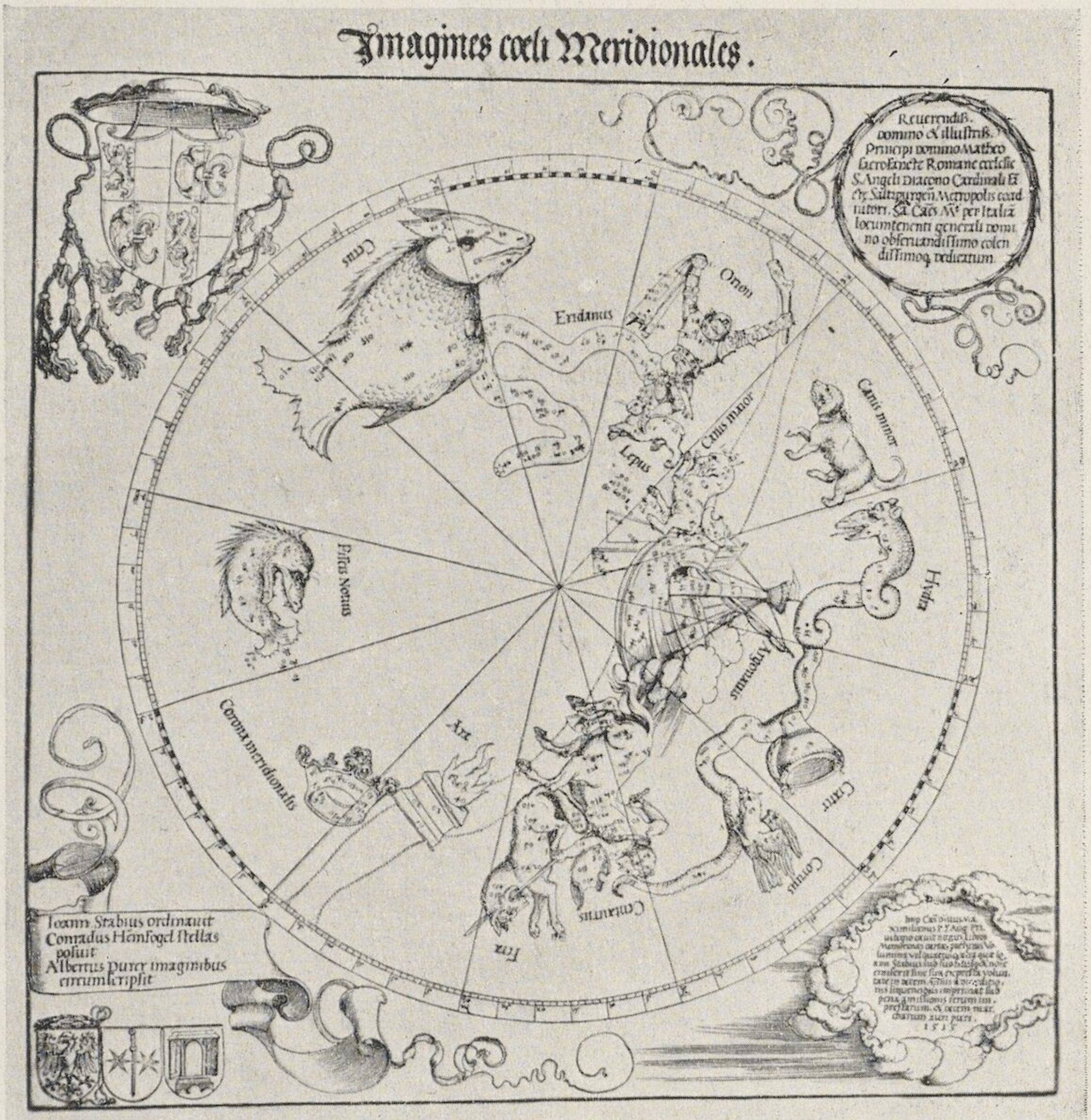


Fig. 43. Dürer's map of the southern heaven (1515)

Fig. 44. Map of the northern heaven in the treatise by Rusconi

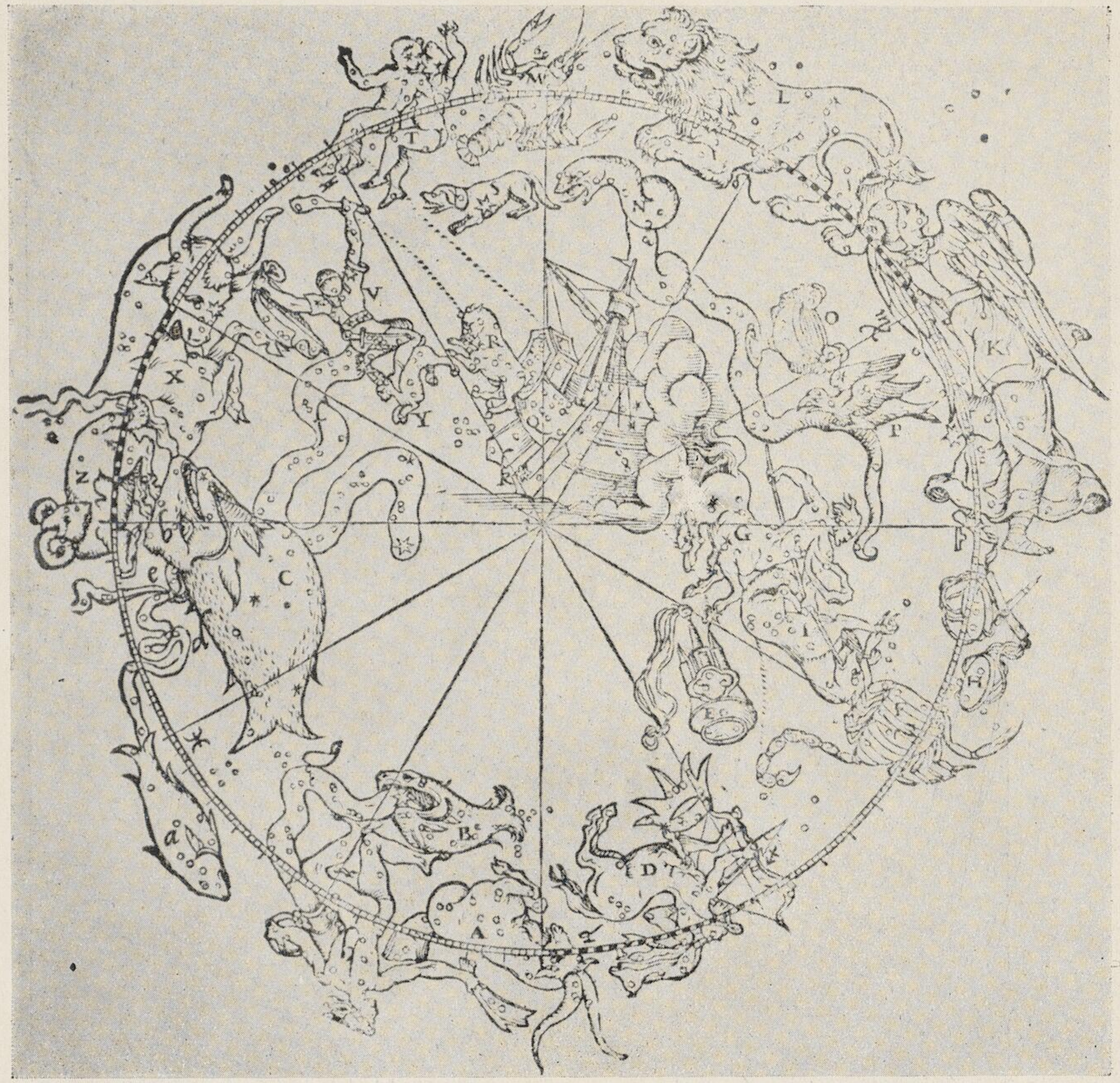


Fig. 45. Map of the southern heaven in the treatise by Rusconi

Fig. 46. Sperantius praying to the Muse Urania

Cena zł 20.—

Maior