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A Meteor Star Atlas

BY

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A METEOR STAR ATLAS

BY REYNOLD K. YOUNG, Ph. D.

The following set of twenty maps is intended to facilitate the observation of meteors and the plotting of their paths. As is well known, the observed track of a meteor is nearly an arc of a great circle and is therefore conveniently plotted on a map where great circles are represented by straight lines. The accompanying charts are constructed on the gnomonic or central projection which gives this desired property.

It is not easy to calculate what amount of error will be introduced by using a map constructed by other projections, because it will depend on several factors; the fraction of the sky covered by one chart, the distance of the meteor track from the radiant and also the particular projection used. It is safe to say, however, that in many cases the error will be more than five degrees, that is to say that a path which has been correctly observed, if produced backward on a map with unsuitable projection, may not pass within five degrees of the radiant. Of course the difficulty arising from projection may be eliminated by using a celestial globe but in general a globe is awkward to handle. Also a record of observations would be hard to preserve if plotted on such a globe.

The epoch is taken at 1900. All stars given in the Revised Harvard Photometry, volume fifty, as brighter than 5.0 have been plotted. Variables whose maxima are brighter than 5.0 have been entered. The size of the circles indicates the brightness of the stars. The smallest marked five indicates magnitudes as faint or fainter than 4.6. Those marked four indicate magnitudes lying between 4.5 4.1 and 4.0 3.6 and so on. Those marked zero indicate magnitudes brighter than 0.6. In choosing a scale for the representation of magnitudes, one has to bear in mind that the relative apparent brightness of the stars varies from night to night. The bright stars stand out relatively strong on a clear moonlight night, while on a moonless night the immense number of faint stars

visible, renders the bright stars less conspicuous. The clearness of the atmosphere also affects the appearance of the stars. The best one can do is to strike an average. A normal appearance of the maps is more nearly approached, if all constellation boundaries and star names are omitted. It has become so general however to think of the stars by name and constellation, that it would seriously detract from the usefulness of the maps to omit these features. Nevertheless nothing has been plotted which was deemed unnecessary and which might confuse the maps. The right ascension circles for every hour and the declination circles for every ten degrees have been drawn. In order to make the readings of positions from the maps easier, the intermediate positions of the right ascension circles for every twenty minutes and the declination circles for every five degrees have been indicated. This procedure avoids the confusion which results if all the circles are drawn in full.

It is hoped that the positions will in general be found correct to within one-tenth of one degree. In reading of positions more accuracy can be obtained by measuring rectangular co-ordinates and then computing the right ascension and declination than by estimating the distances from the neighbouring hour and declination circles. For those who may desire to compute the positions, the method of construction of the maps and the constants used in the projection are outlined.

For the circumpolar map, the celestial sphere is imagined cut by a plane which includes a segment of the sphere sixty degrees in diameter. Any point in this segment is projected on the plane by joining it to the centre of the sphere. The north celestial pole may be called the axis of projection. The right ascension circles are straight lines uniformly distributed around the pole and the declination circles remain circles, the distances from the pole being given by the formula

$$r = 5.33 \cot \delta,$$

where r is the radius of the circle in inches and δ is the declination of the circle under consideration.

For the next six maps, the axis of projection lies at plus forty-five degrees declination and right ascension successively zero hours, four hourstwenty hours. If we call the axis of projection of any map the

point (0, 0,) in cartesian co-ordinates, x being the abscissa and y the ordinate, δ the declination of a star and (a) the angle between the hour circle passing through the axis of projection and that one passing through the star, the following relations hold:—

$$x = 5.33\sqrt{2} \frac{\tan (a) \cot \delta}{\sec (a) + \cot \delta} \quad (1)$$

$$y = 5.33 \frac{\sec (a) - \cot \delta}{\sec (a) + \cot \delta} \quad (2)$$

The equation to the right ascension circles is

$$x = \frac{\tan (a)}{\sqrt{2}} [5.33 - y] \quad (3)$$

and to the declination circles

$$[5.33 - y]^2 - [5.33 + y]^2 \cot^2 \delta + 2x^2 = 0 \quad (4)$$

The axis of projection for the next set of six maps lies on the equator and at right ascensions, zero hours, four hours,.....as before. With the same notation,

$$x = 5.33 \tan (a) \quad (5)$$

$$y = 5.33 \sec (a) \tan \delta. \quad (6)$$

The equation to the right ascension circles is

$$x = 5.33 \tan (a) \quad (7)$$

and to the declination circles

$$y^2 \cot^2 \delta - x^2 = (5.33)^2 \quad (8)$$

In the next set of six maps the axis of projection lies at minus forty-five degrees of declination and the relations are the same as for plus forty-five. The southern circumpolar map is similar to the northern circumpolar one. The co-ordinates are measured in inches. The method of computing the position of a point on the chart by means of the foregoing relations will now be illustrated by an example.

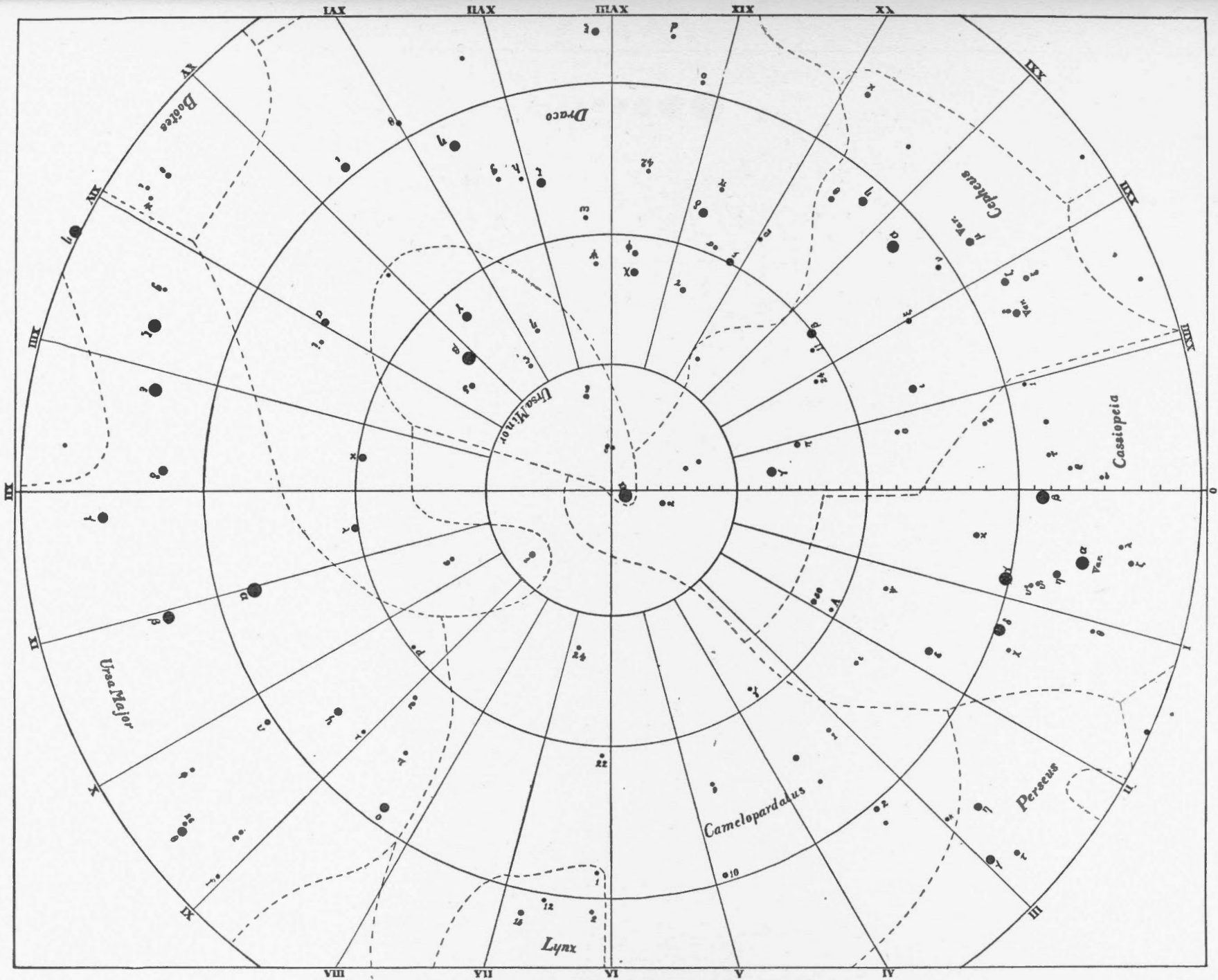
Let it be required to find the position of α Arietis from the first chart of the set whose axis of projection lies at plus forty-five degrees declination. By measurement $x = 2.94$ inches. $y = -1.81$ inches. Substituting these values in equation (3)

$$(a) = 30^{\circ} 30'$$

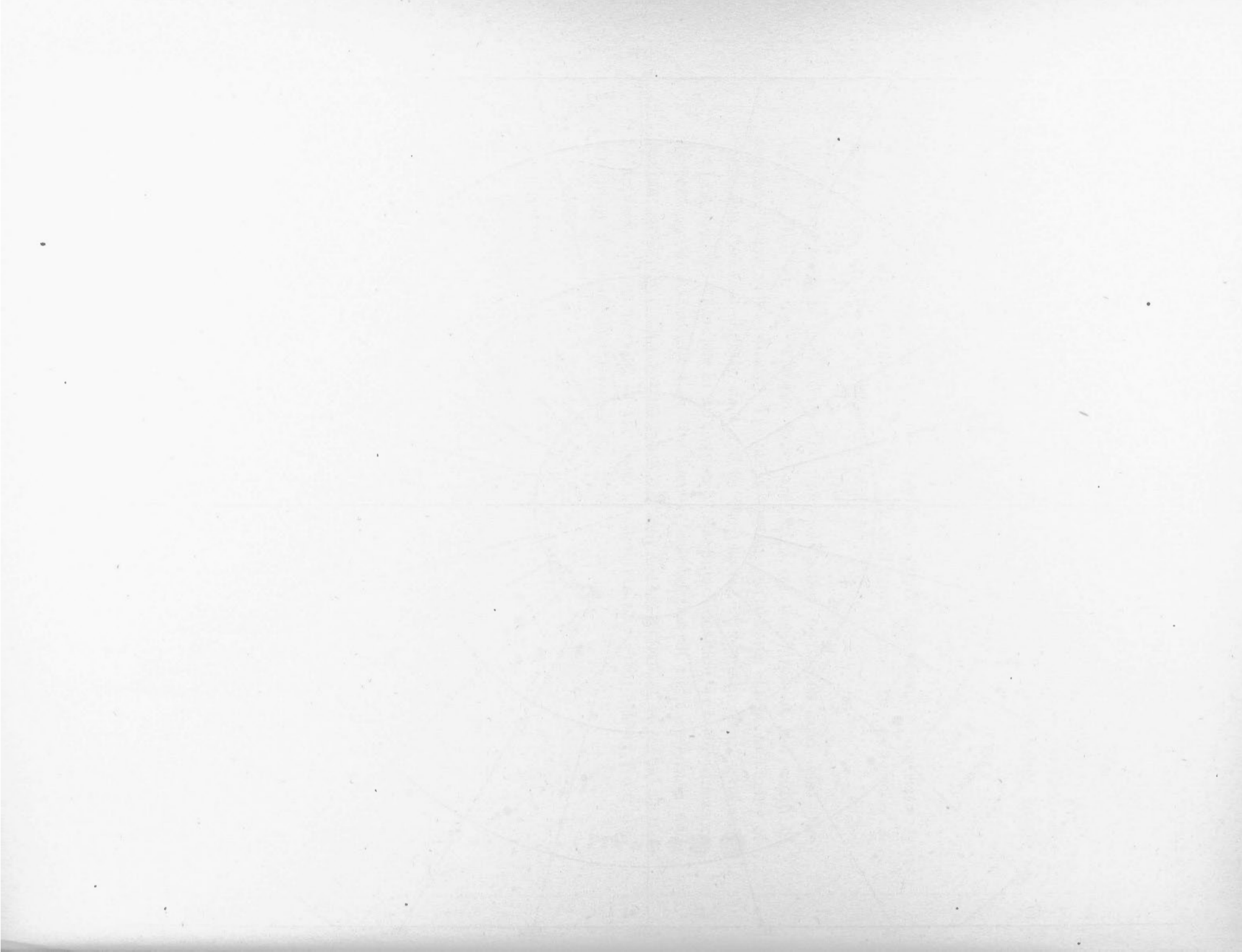
α of center of map equals zero, therefore right ascension of α Arietis is $2^{\text{h}} 1^{\text{m}} 2$. Either equation (1) or (2) will now serve to determine δ . Substituting in (1) we obtain $\delta = +22^{\circ} 59'$.

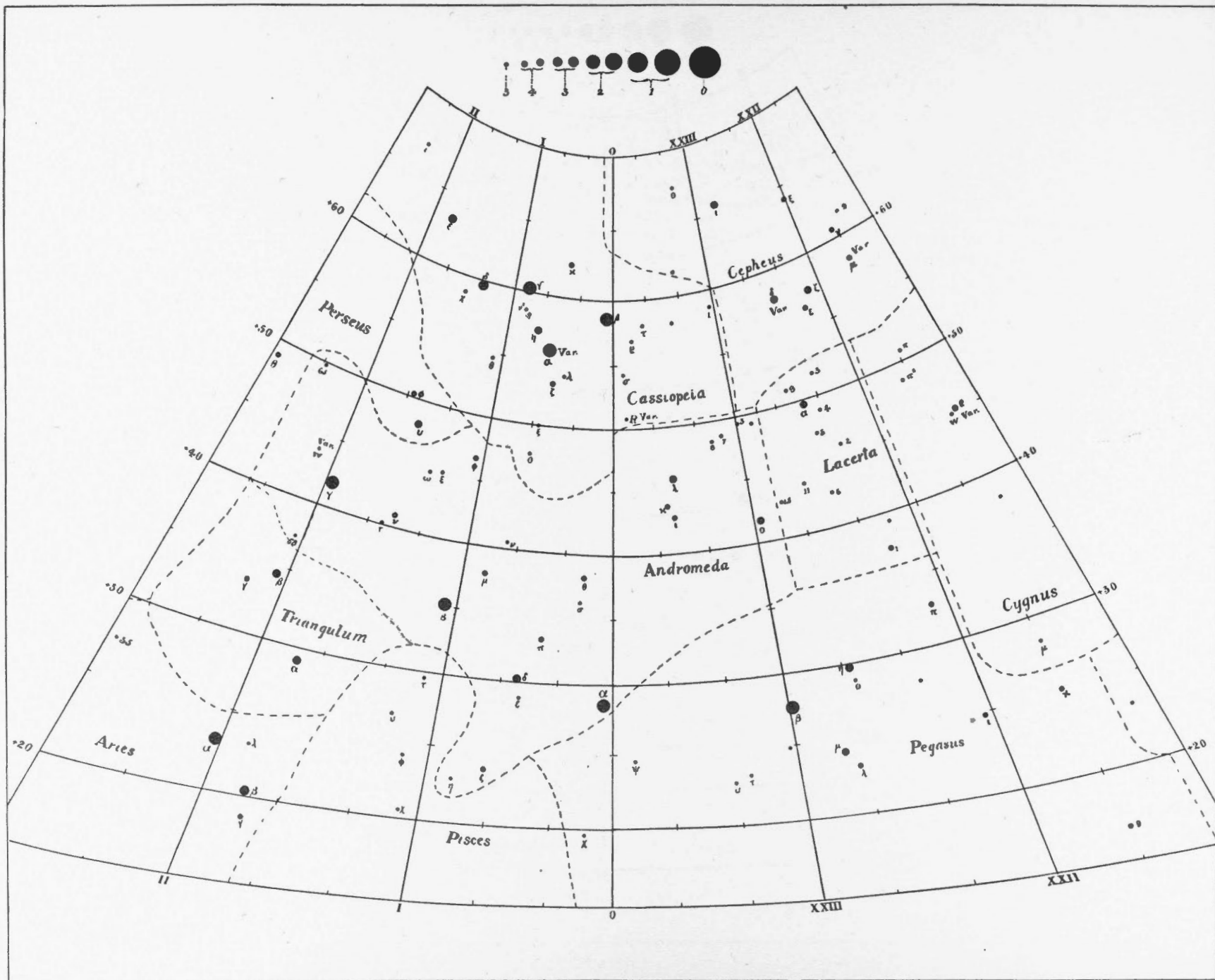
The numerical coefficients in the preceding equations and also the measurements in the example were computed on the basis of the width of the maps being nine inches. The maps vary in size to some extent, and many of them have become slightly distorted in the process of reproduction. Probably the best method to pursue in attempting to compute a position, is to first measure the rectangular co-ordinates of the nearest intersection of right ascension and declination circles. This computation will give the correction, if any, that should be applied to that portion of the map to eliminate any error arising from distortion or shrinkage of the paper.

Dominion Observatory,
Ottawa,
March, 1915.

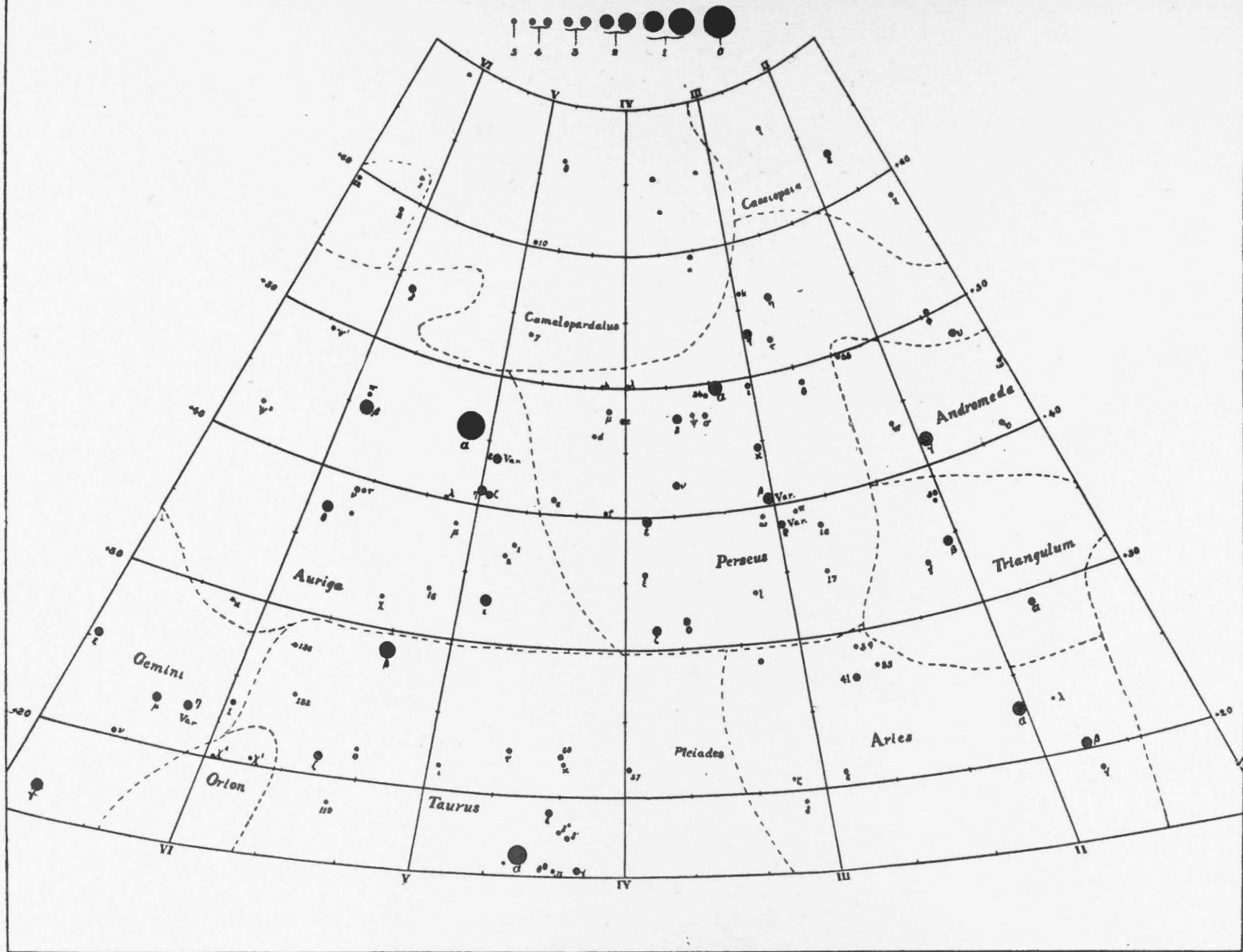


MAP I.

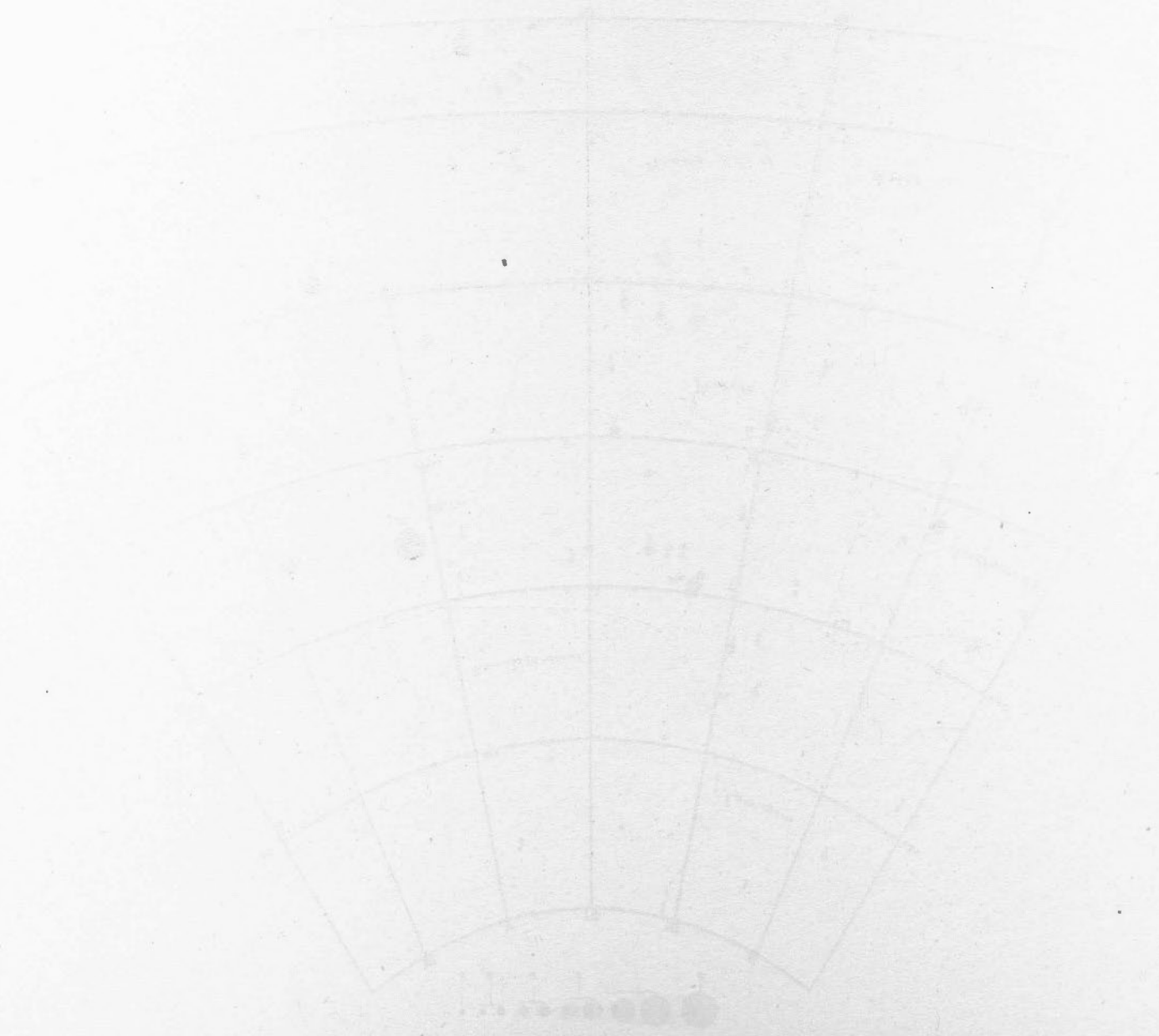


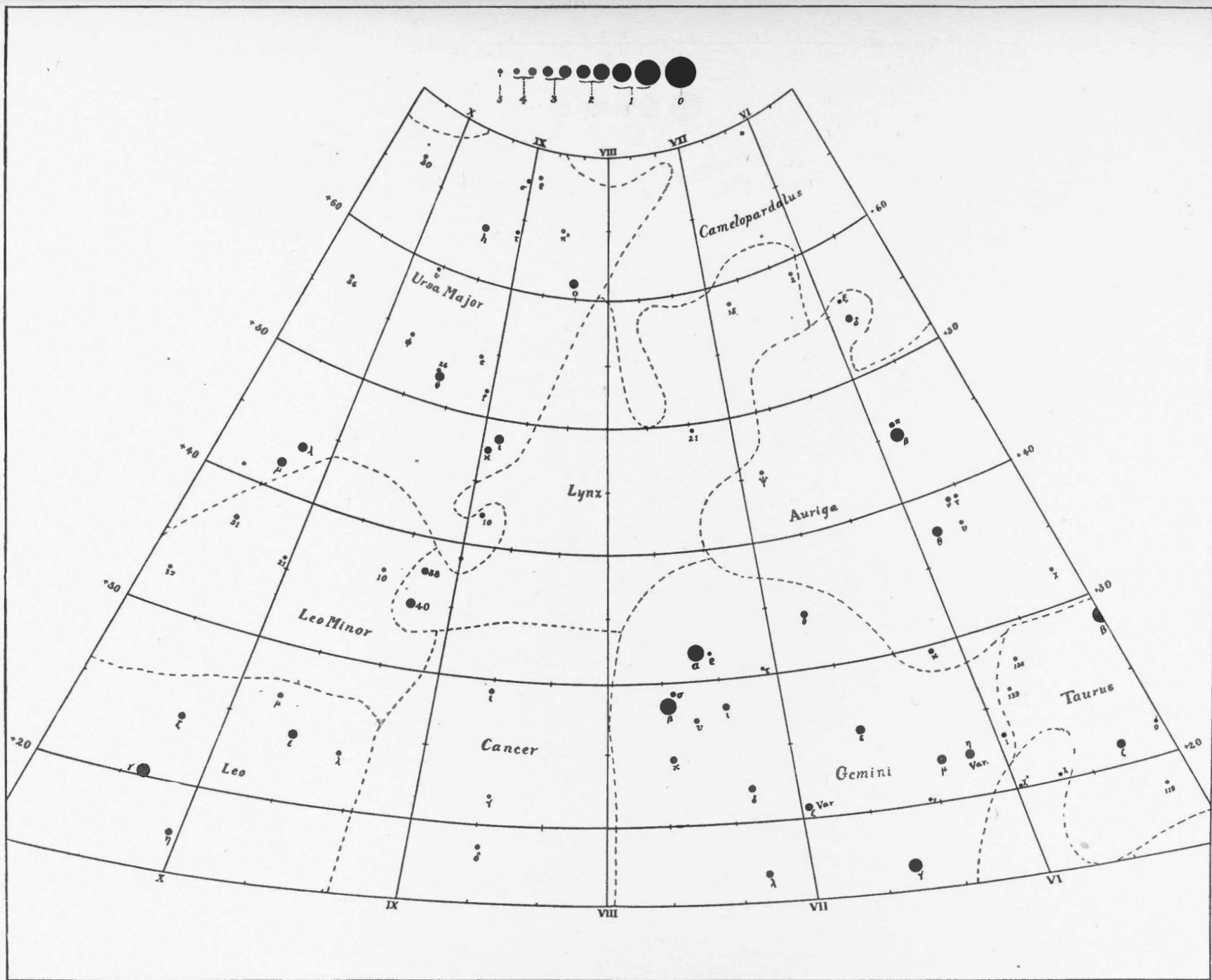


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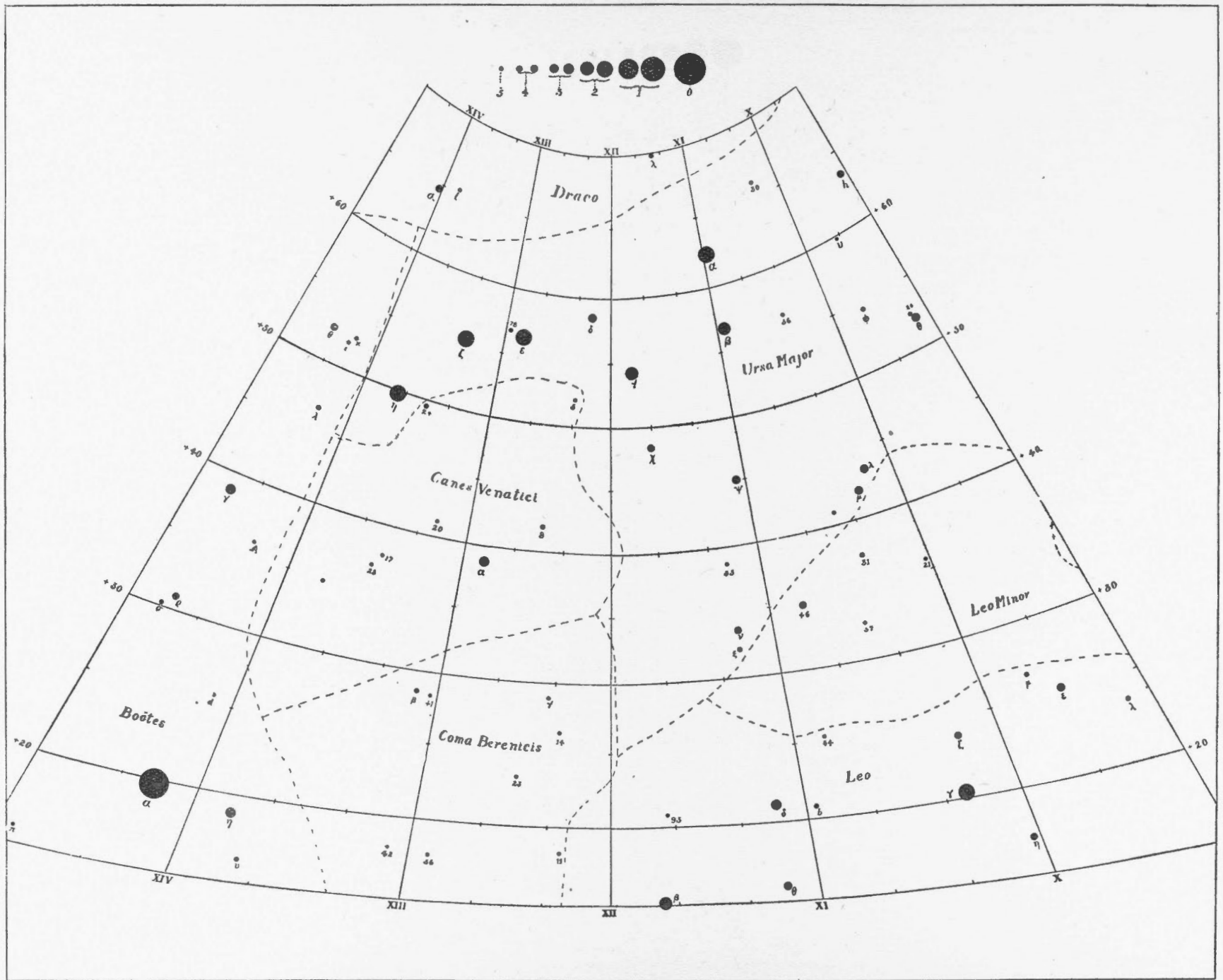


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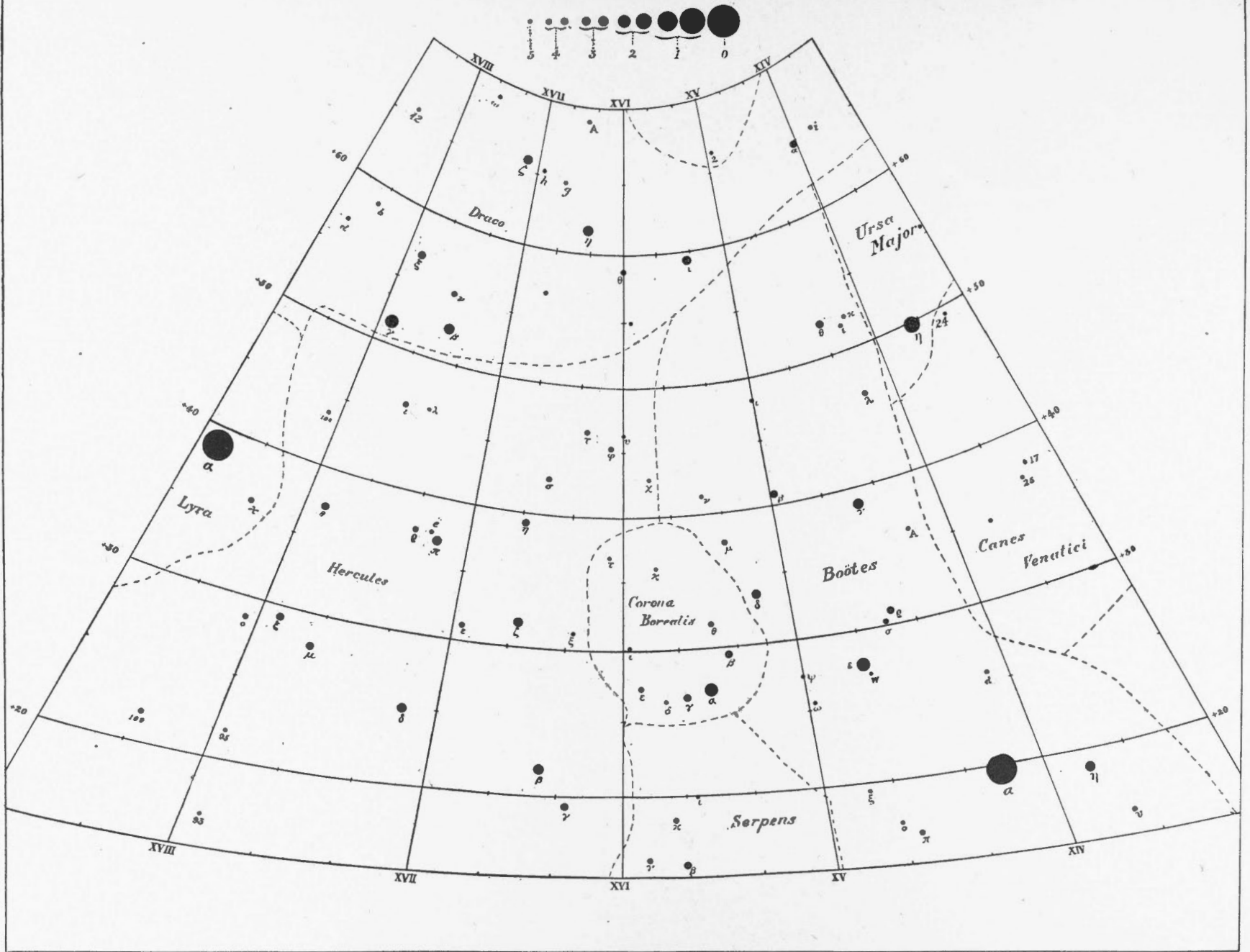




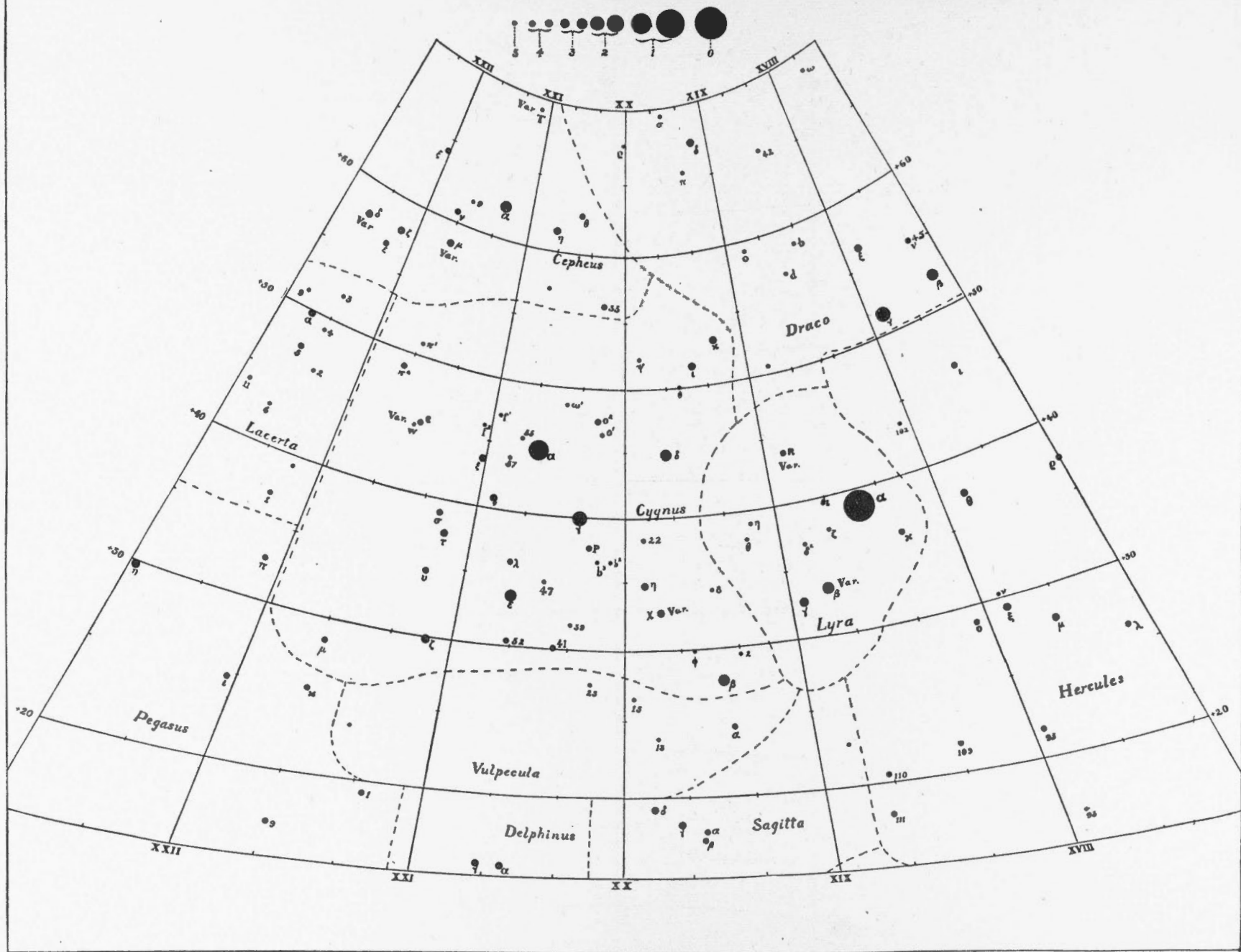
MAP IV.



MAP V.

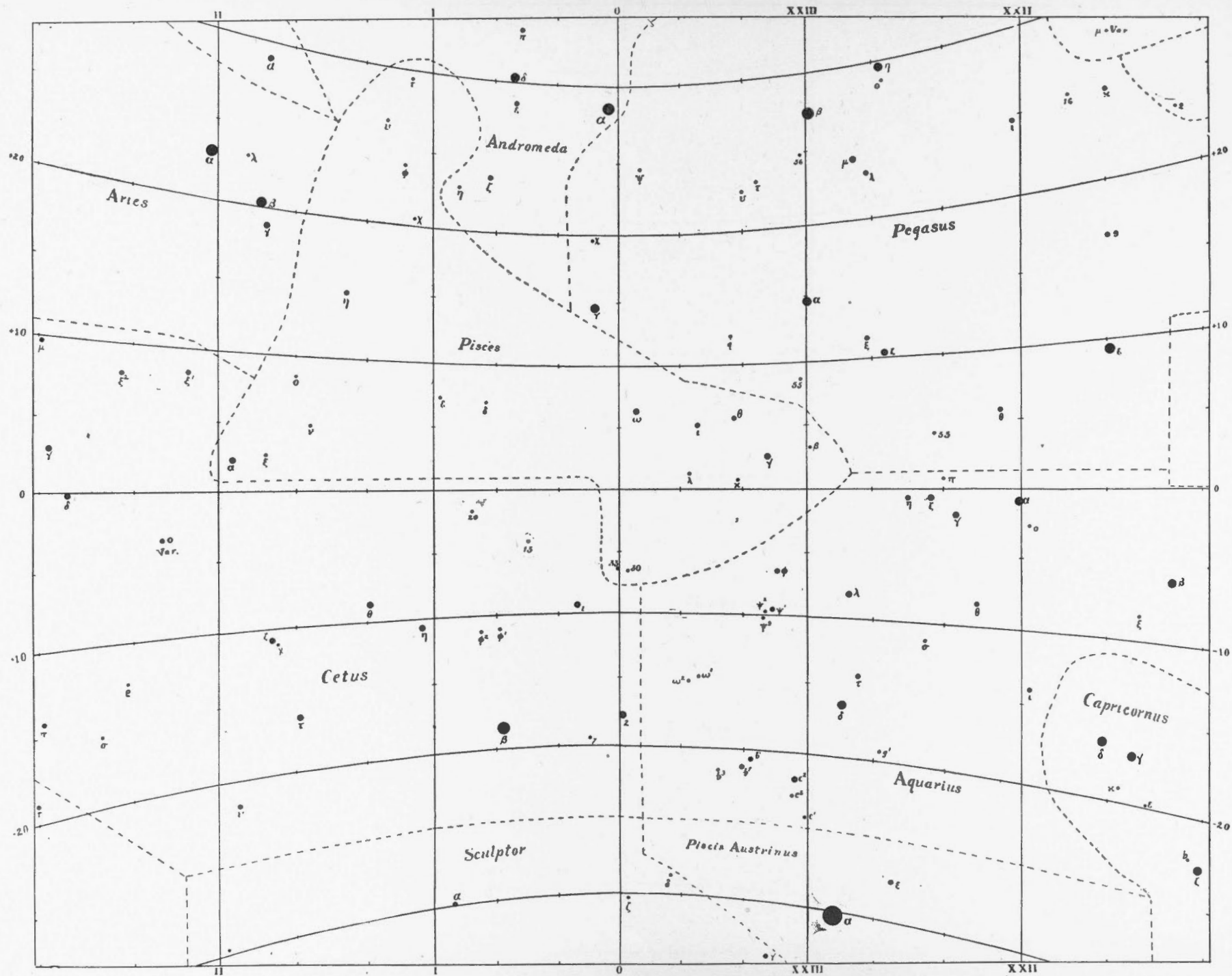


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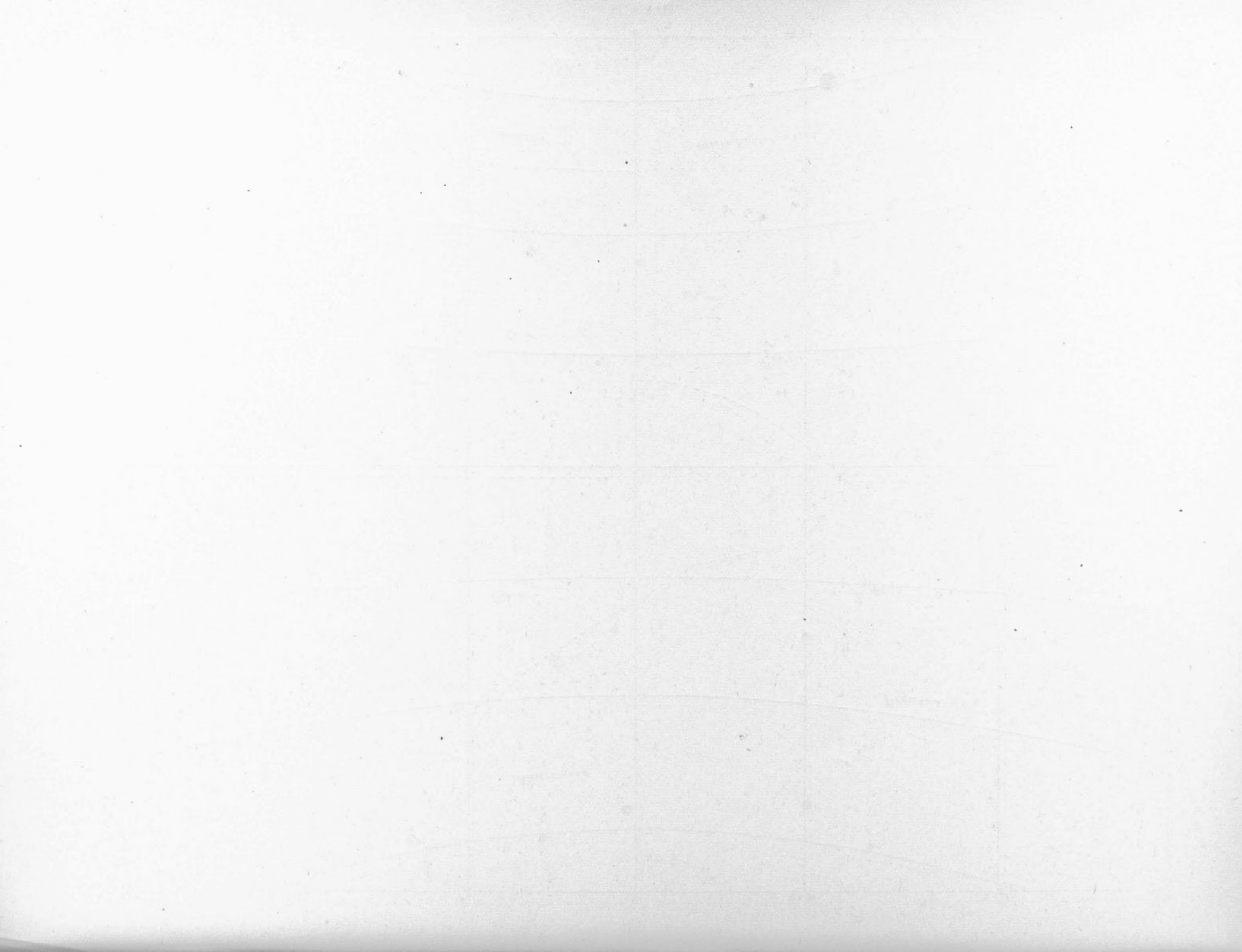


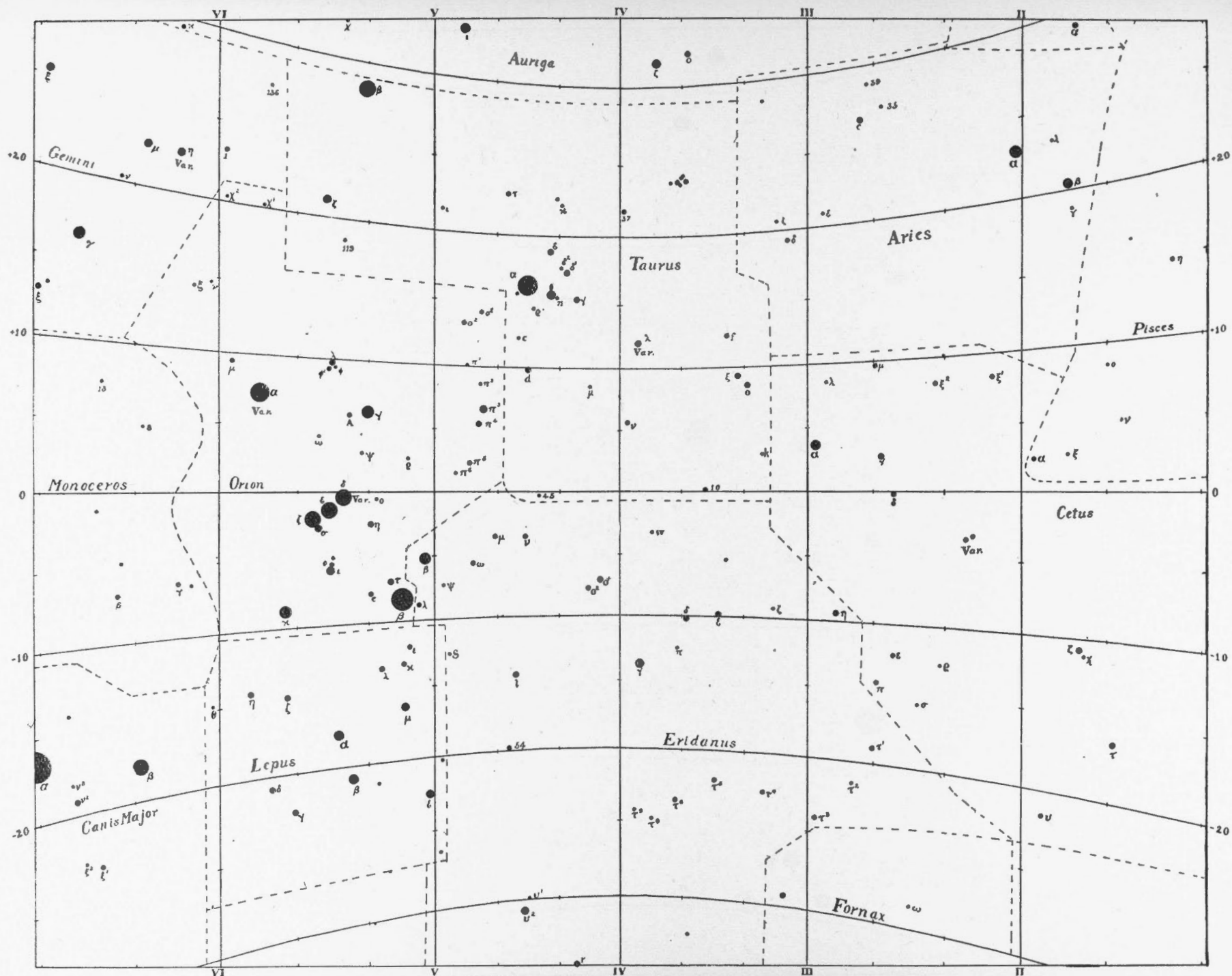
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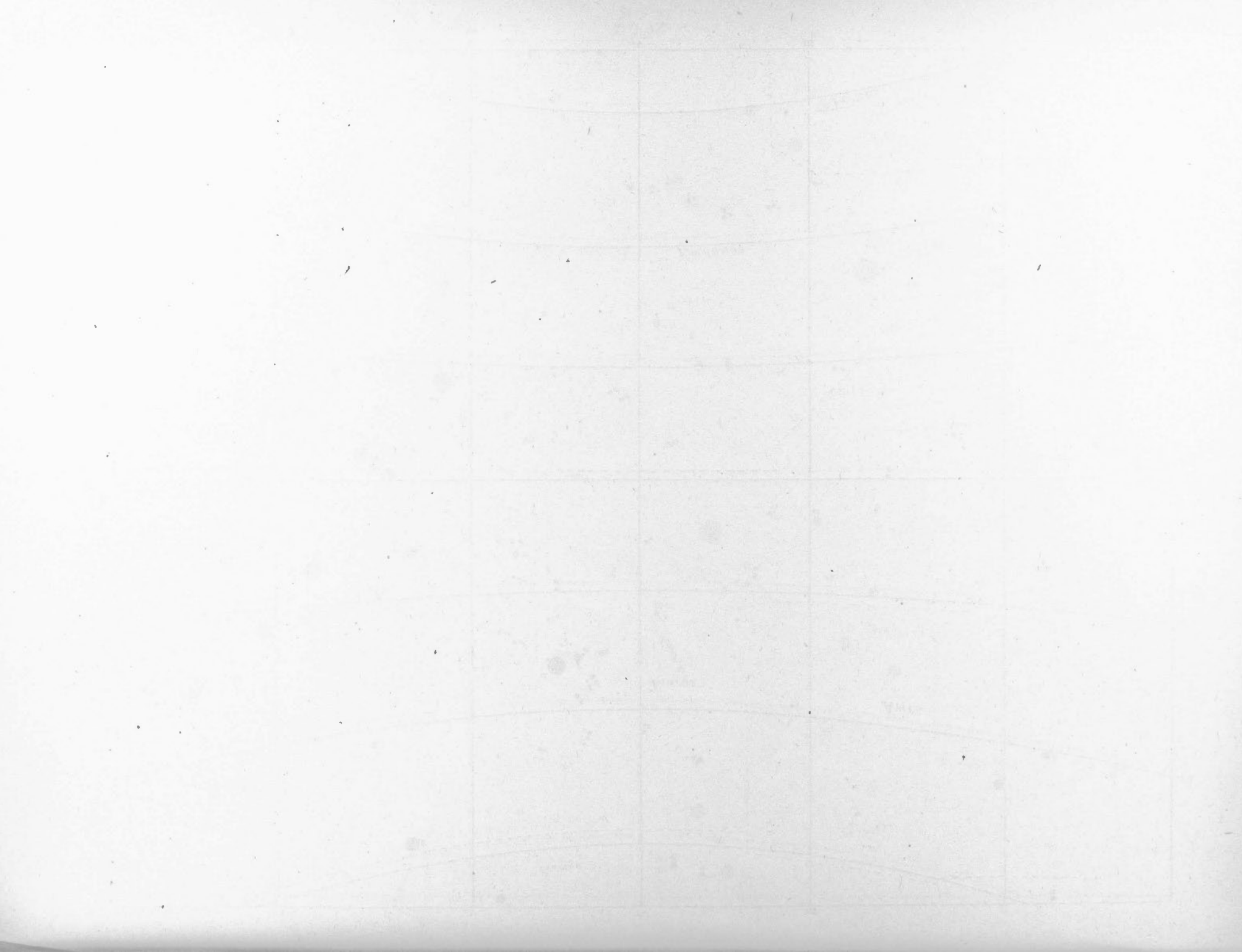


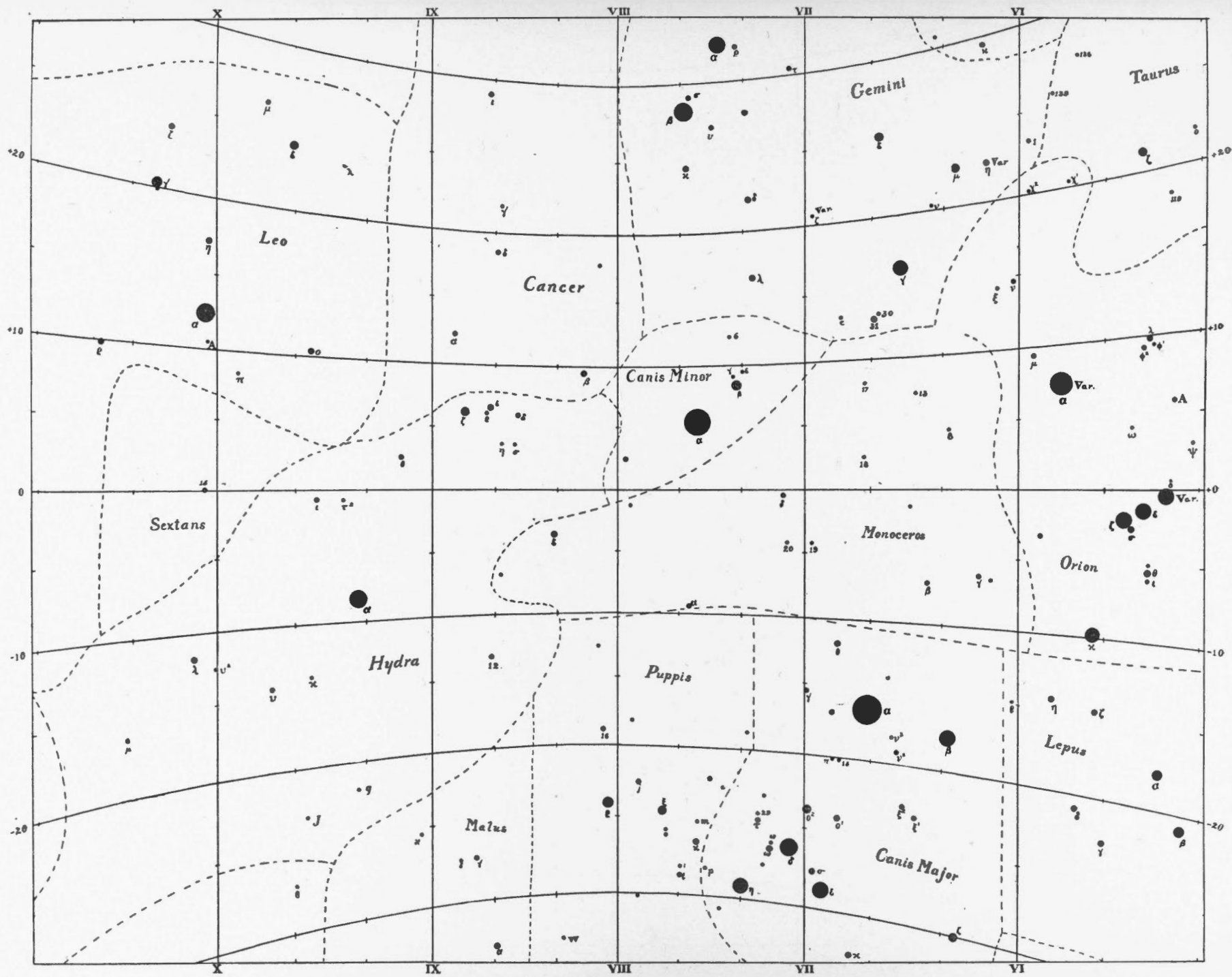
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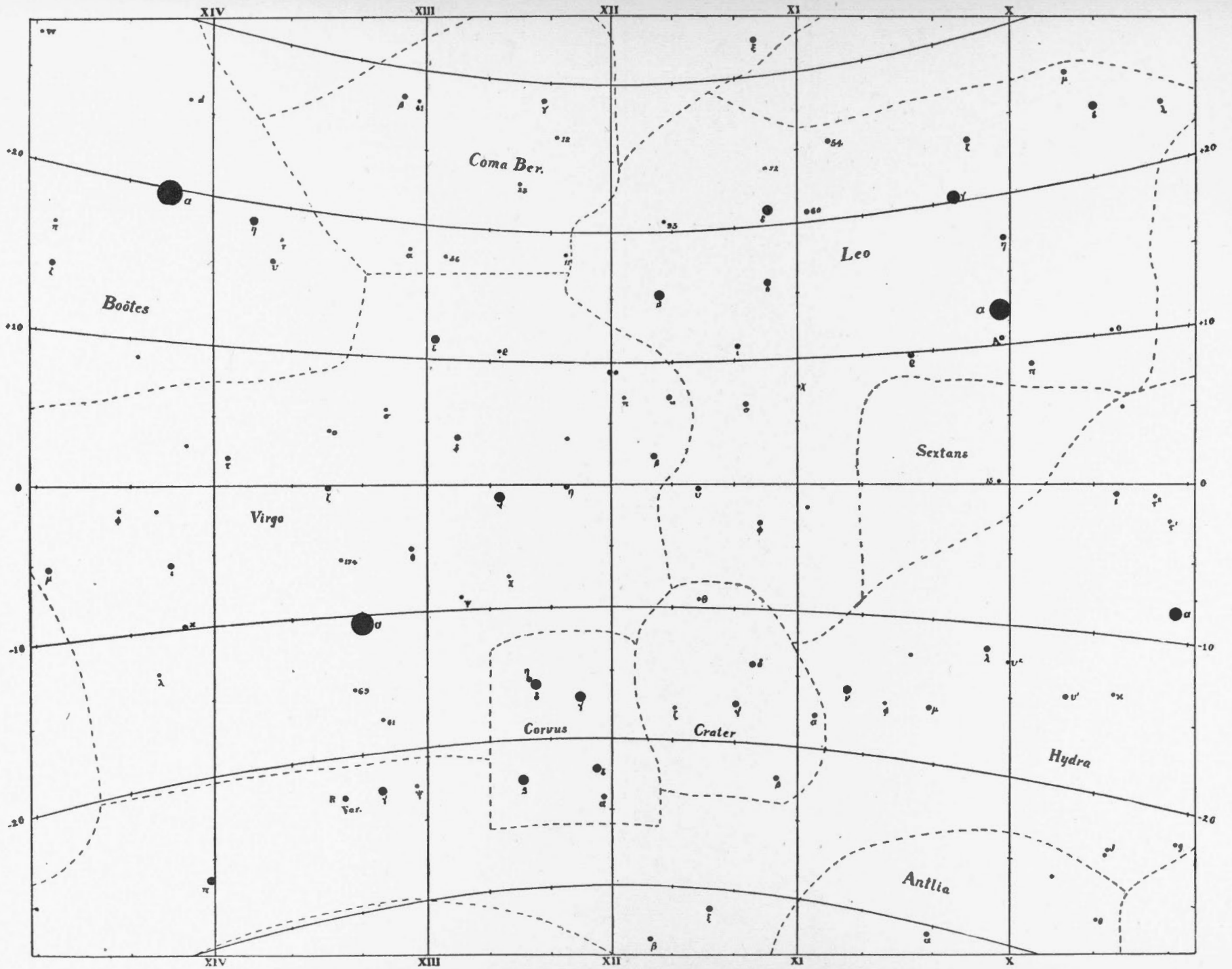


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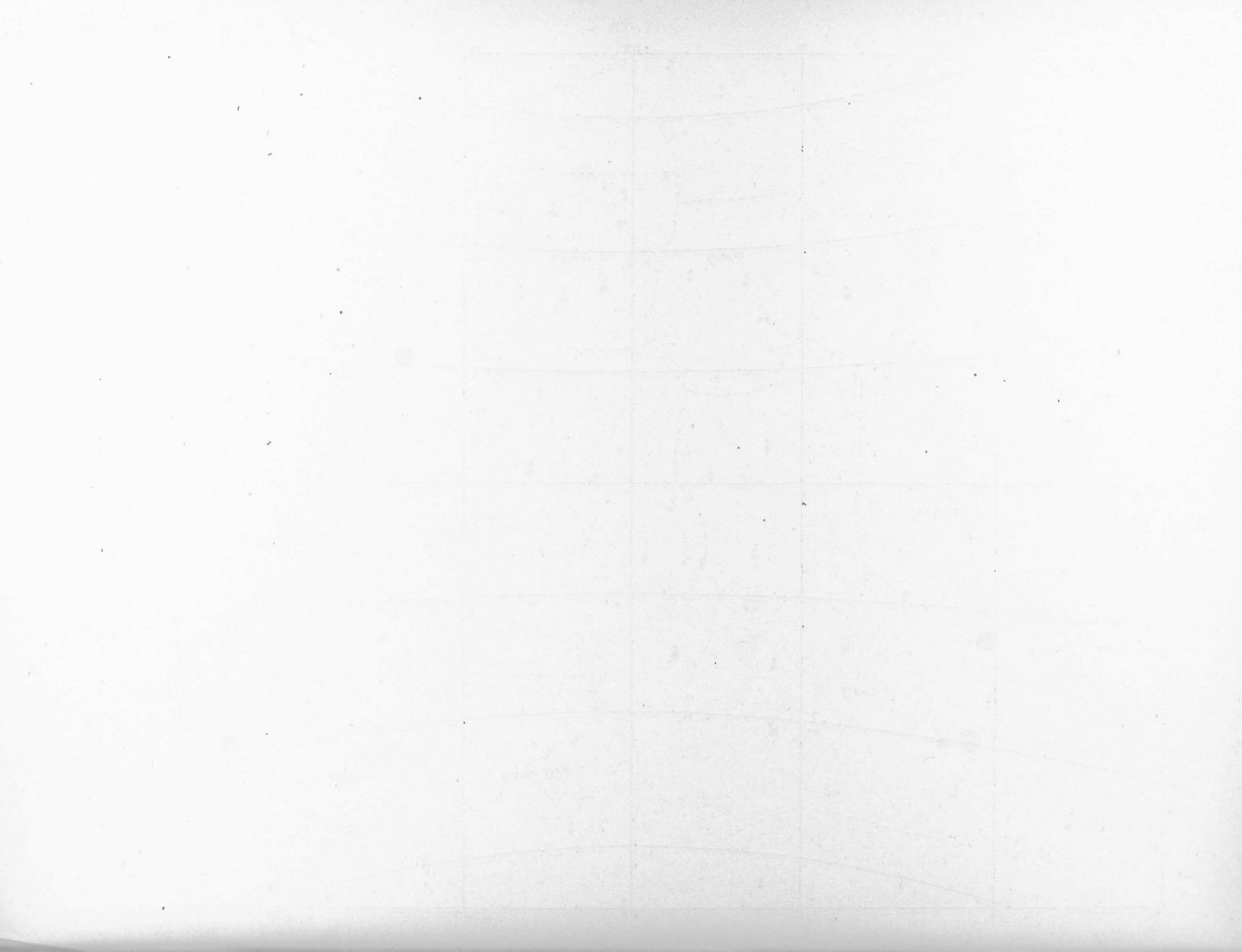


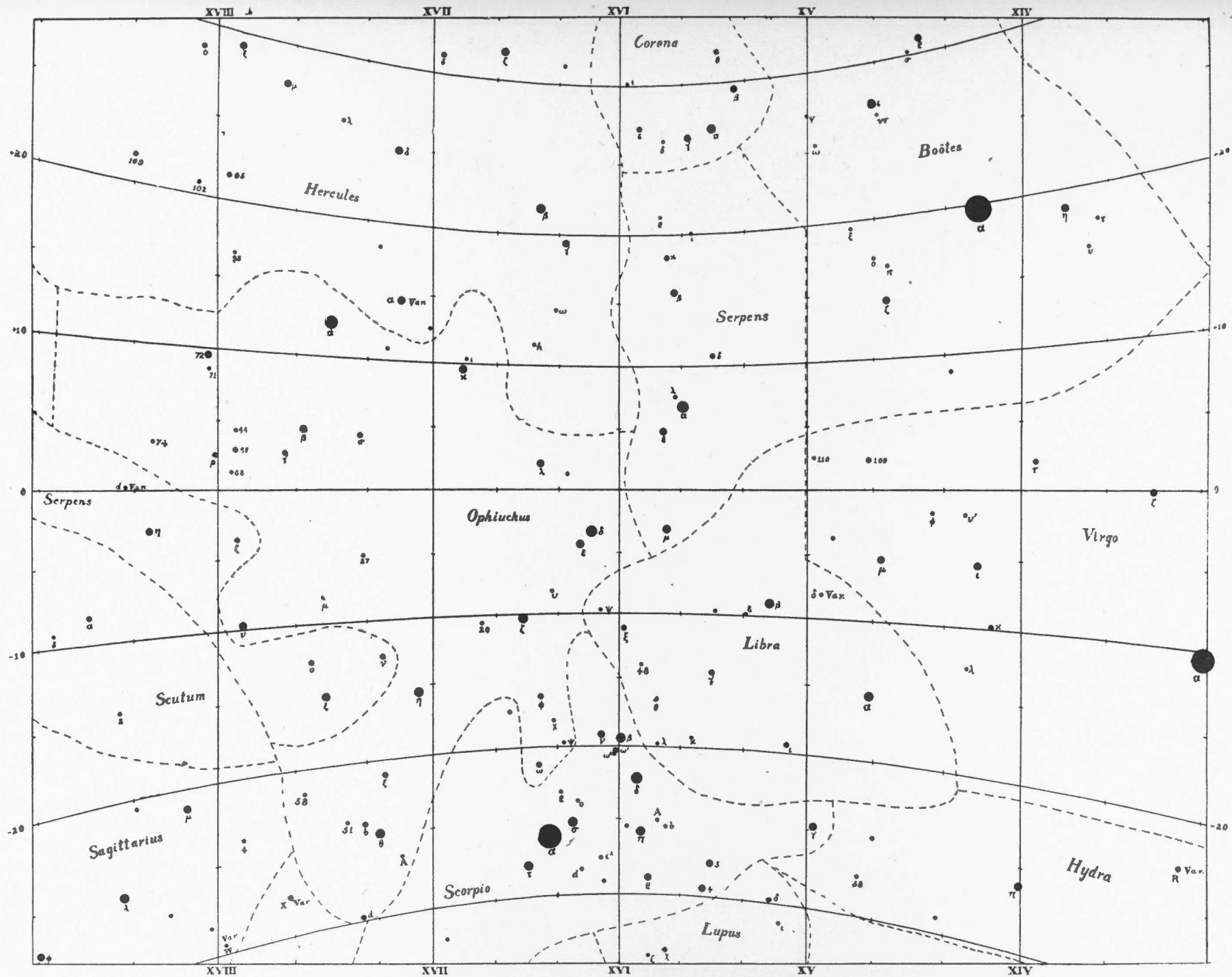


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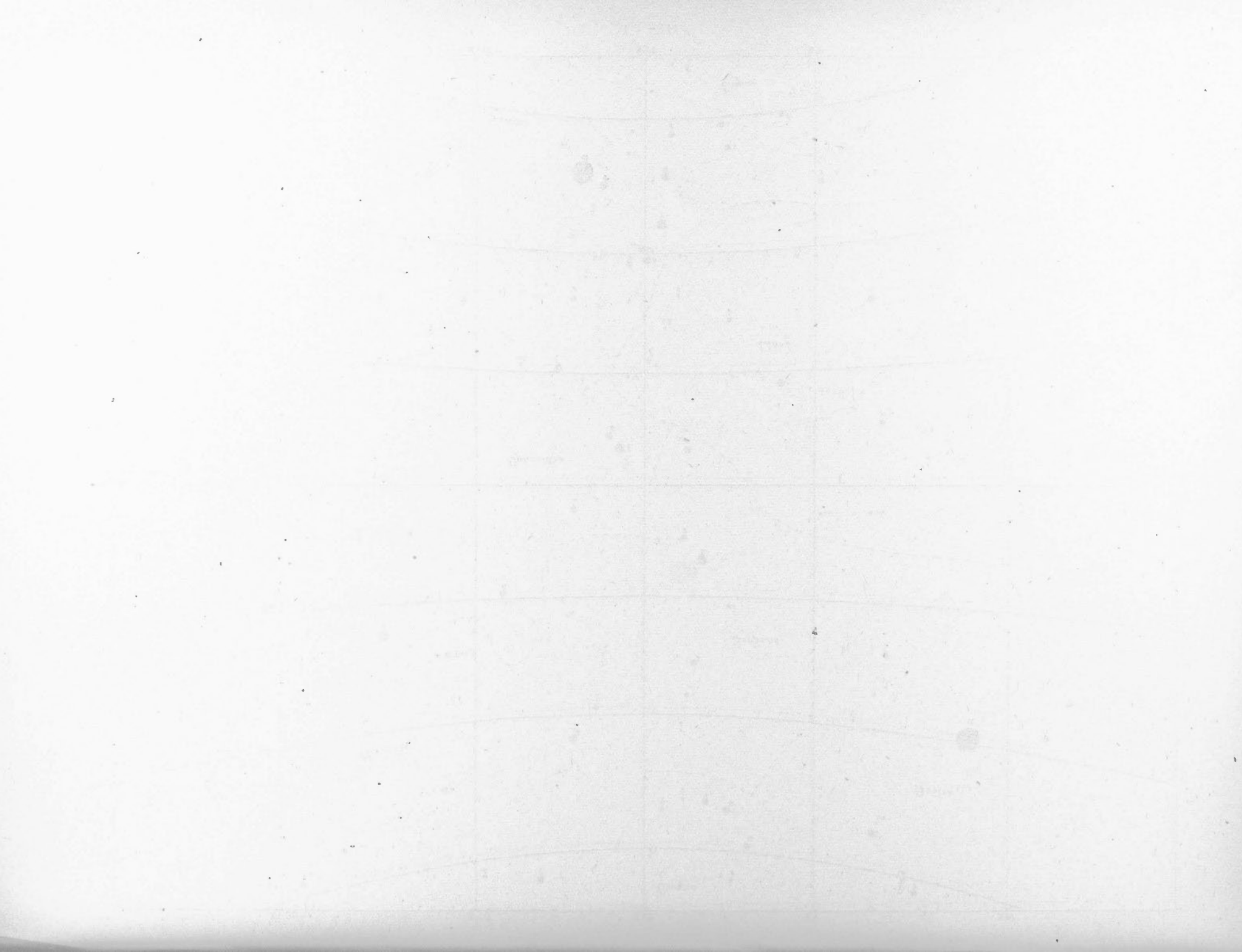


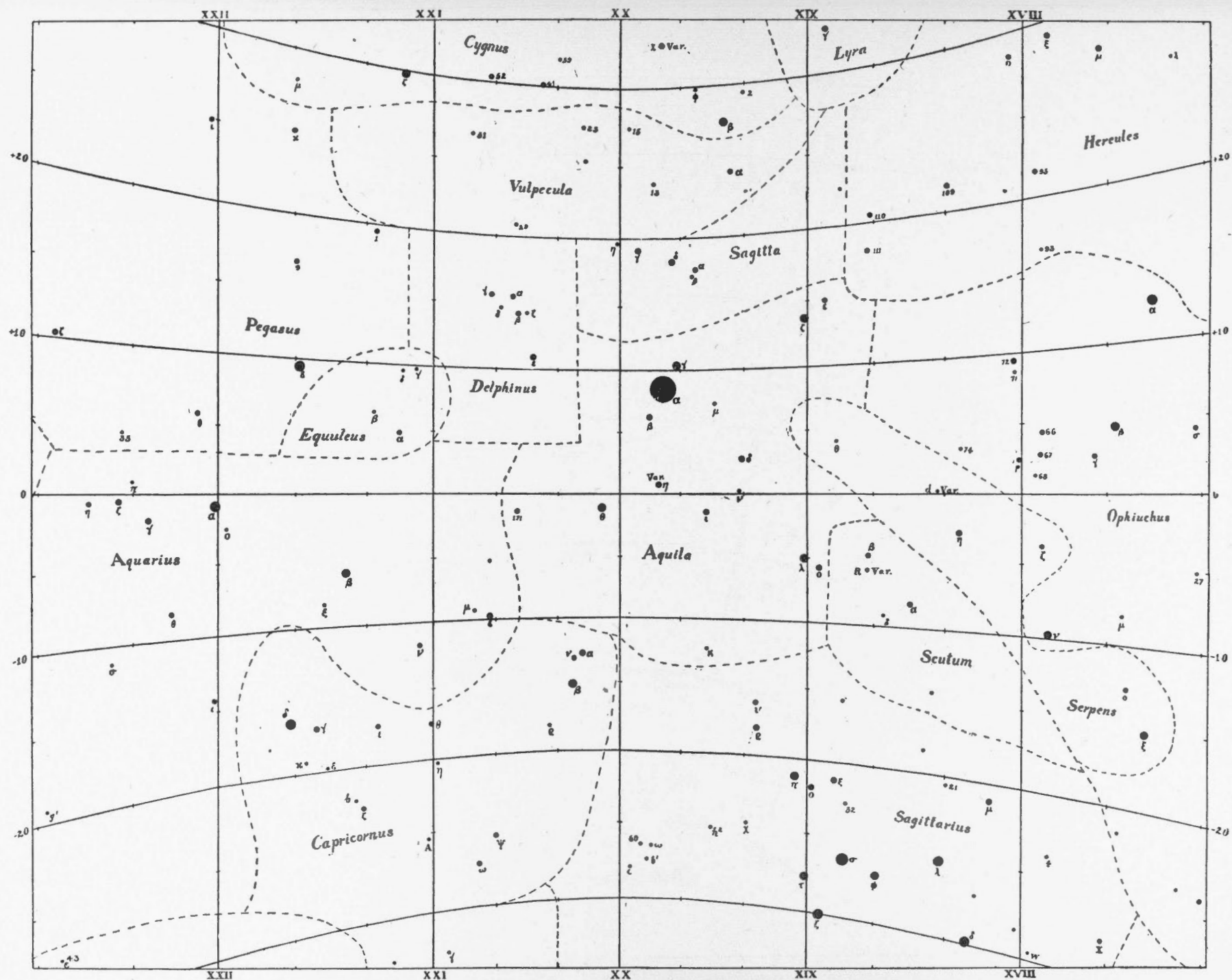
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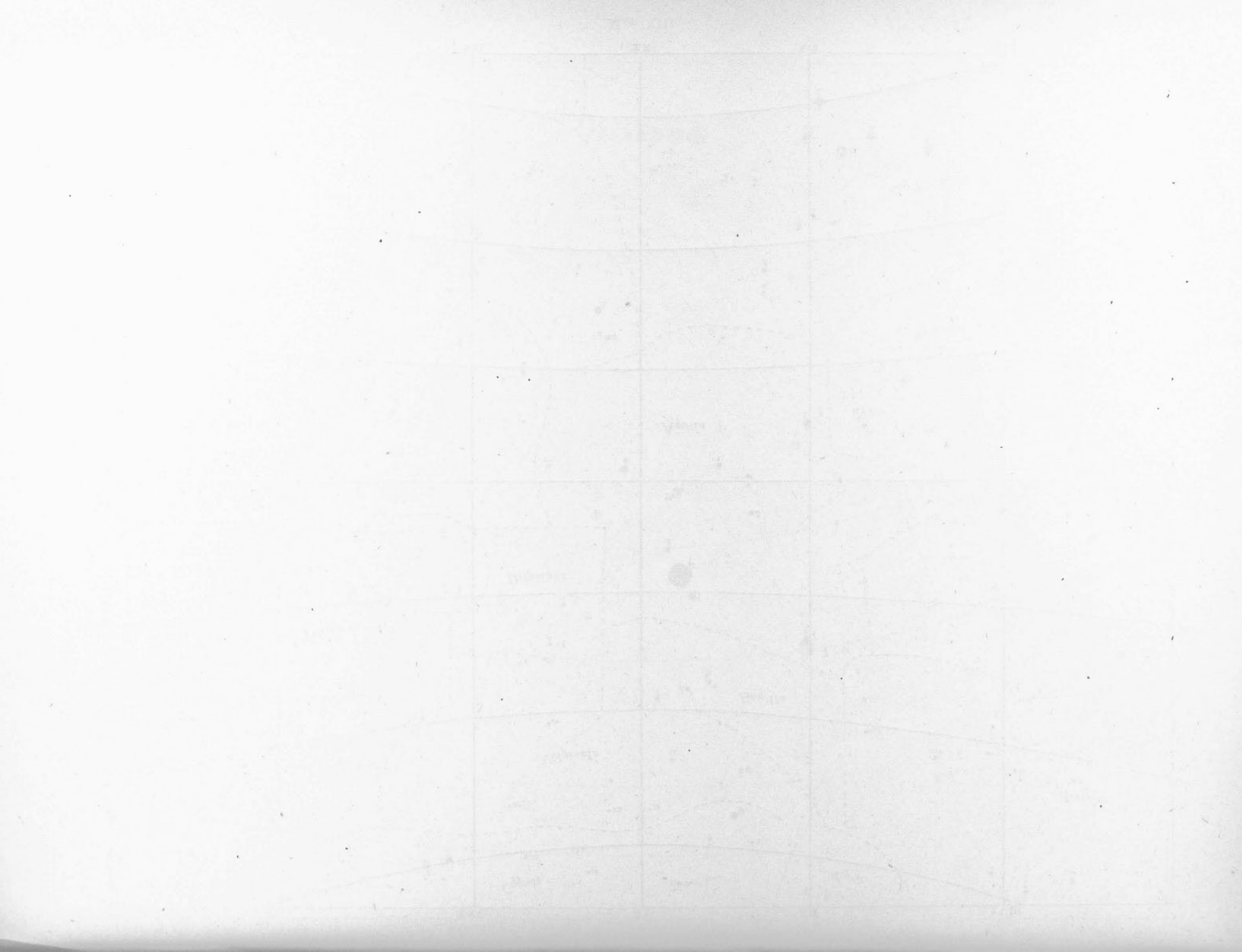


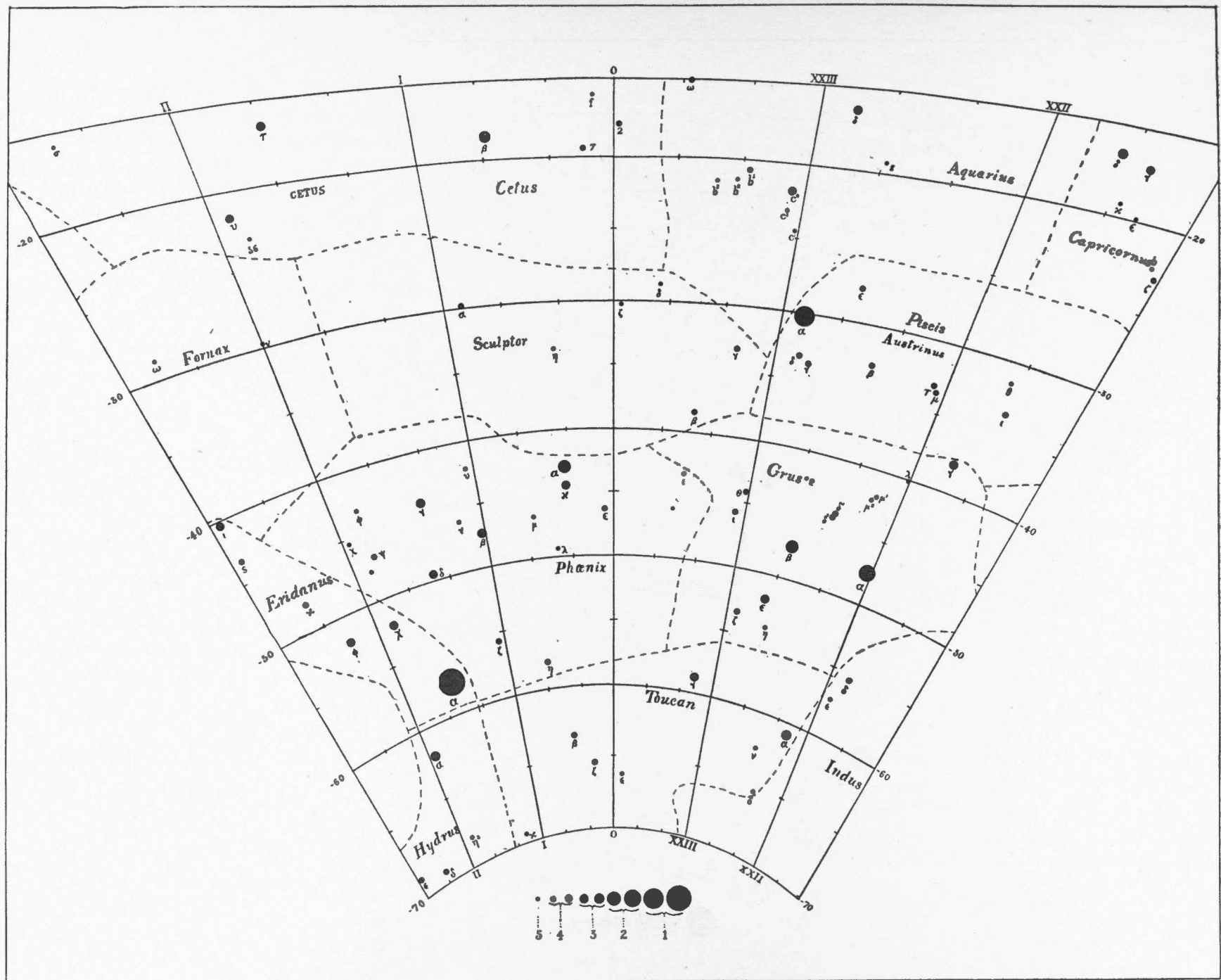
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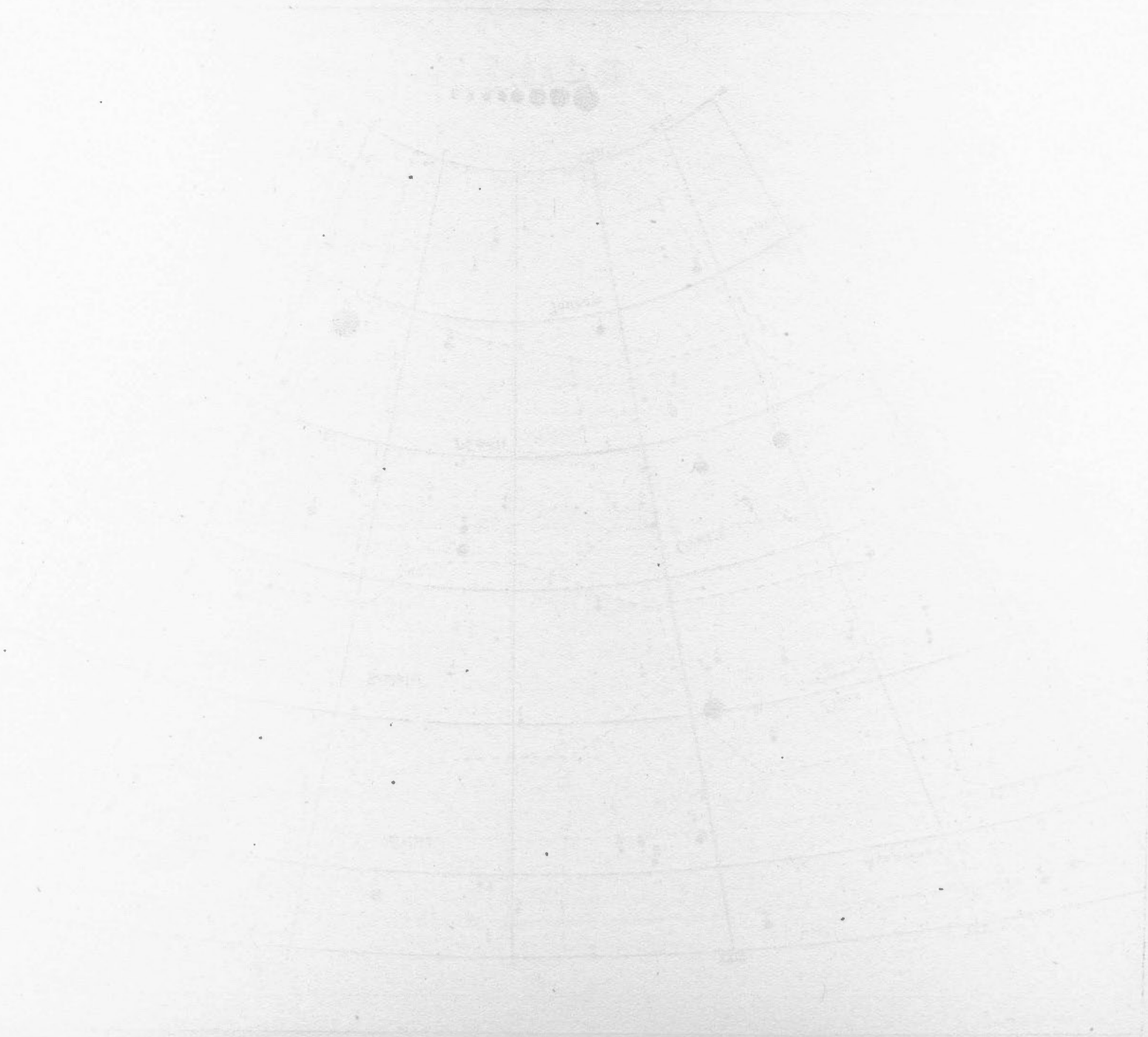


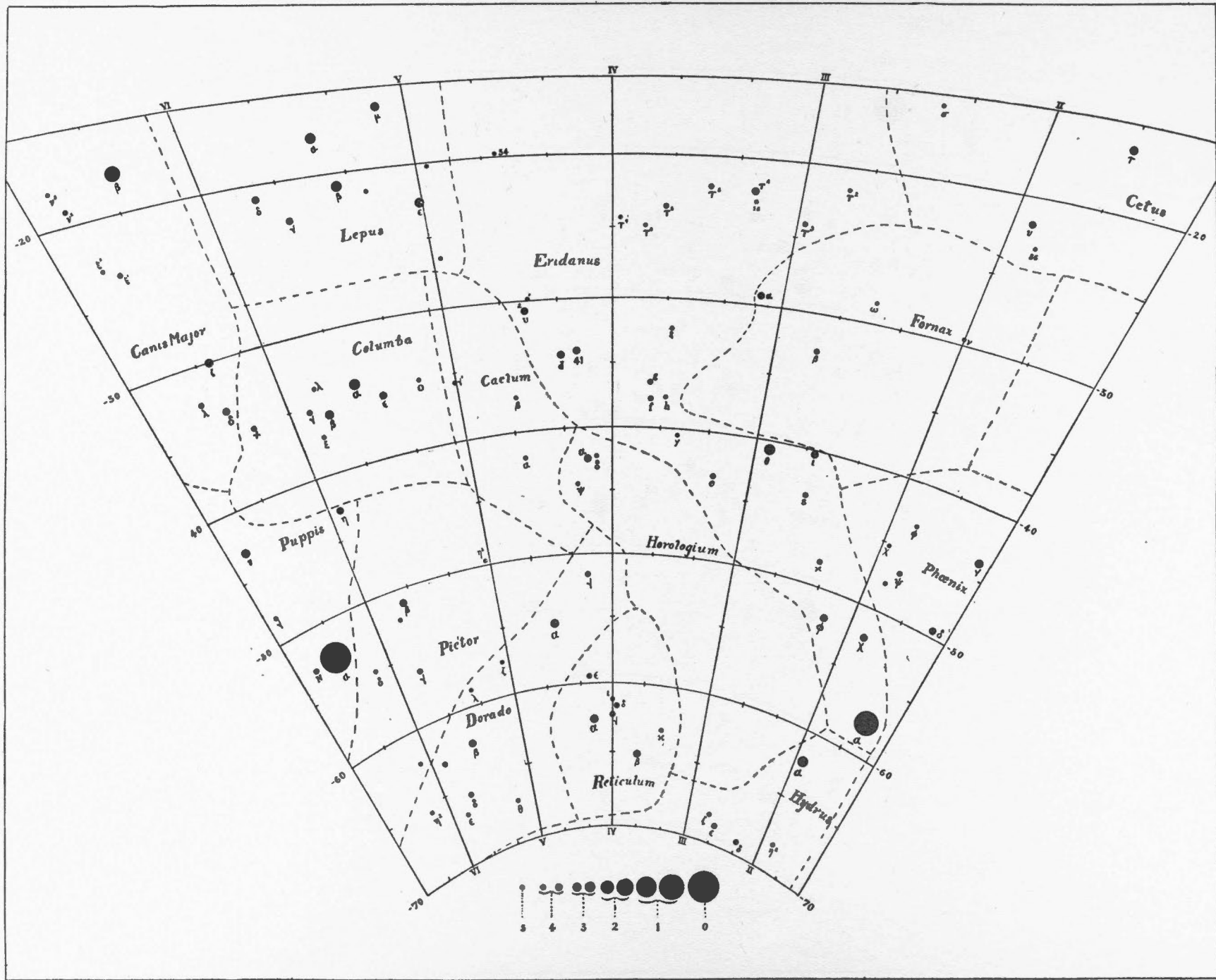
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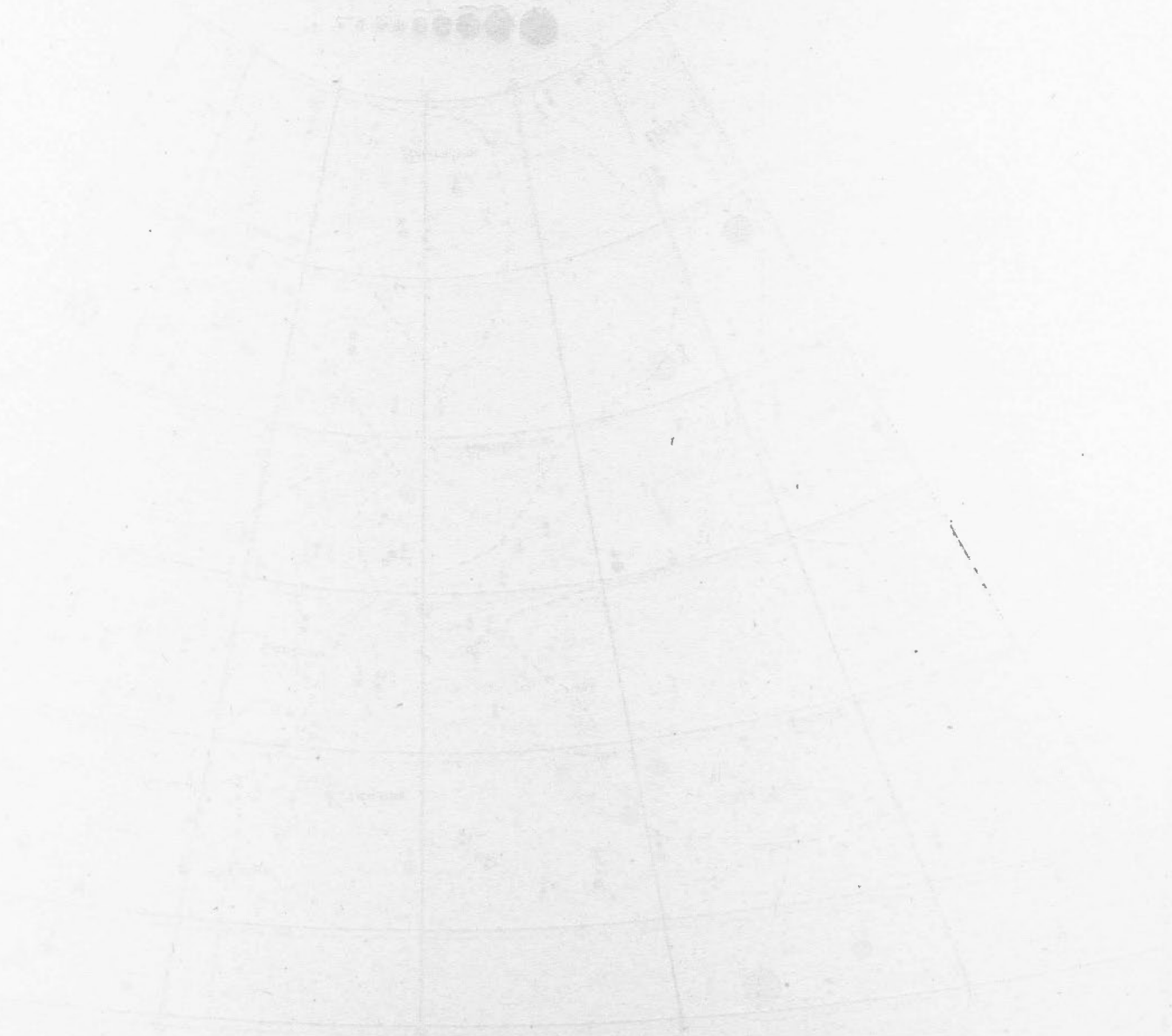


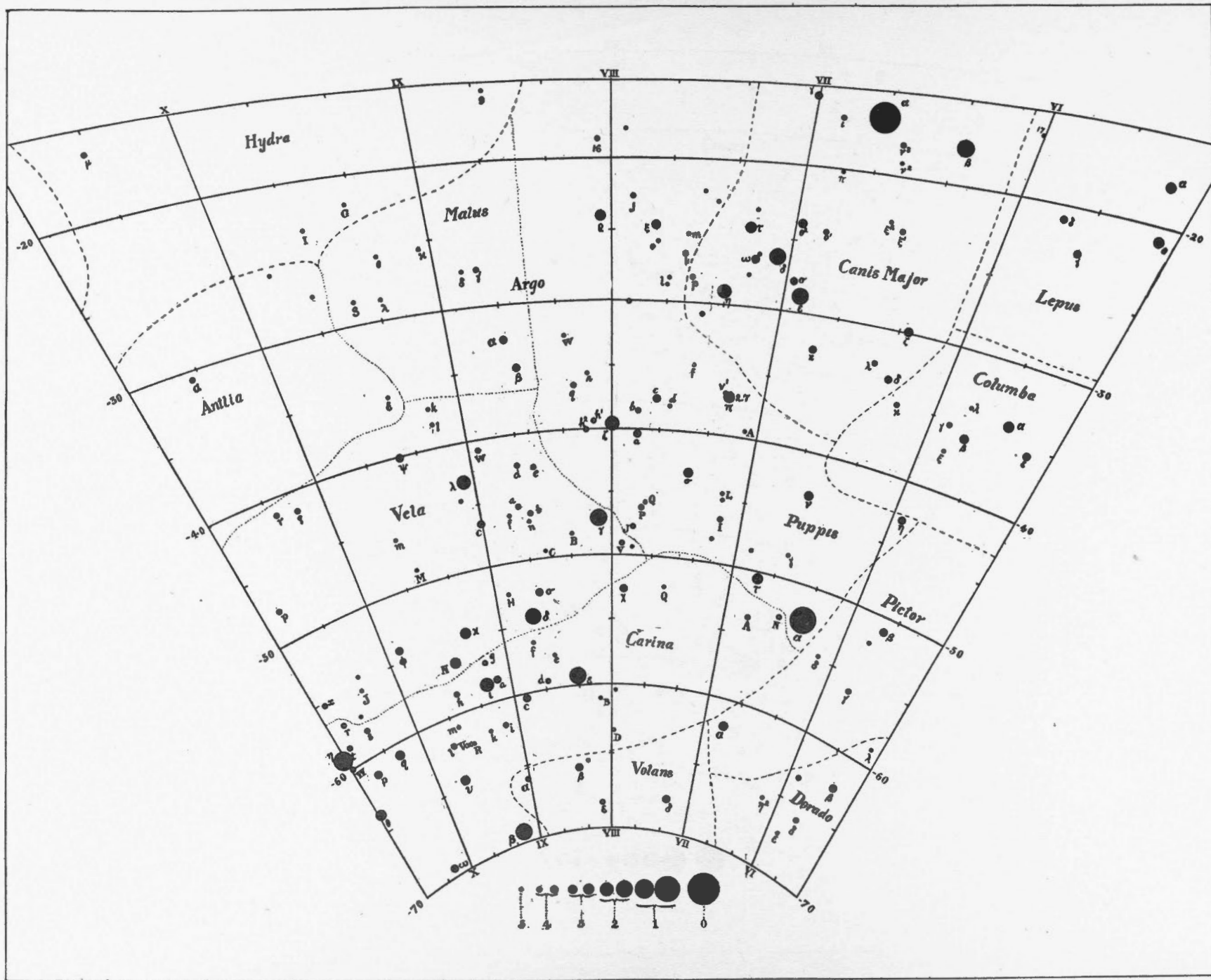
MAP XIV.



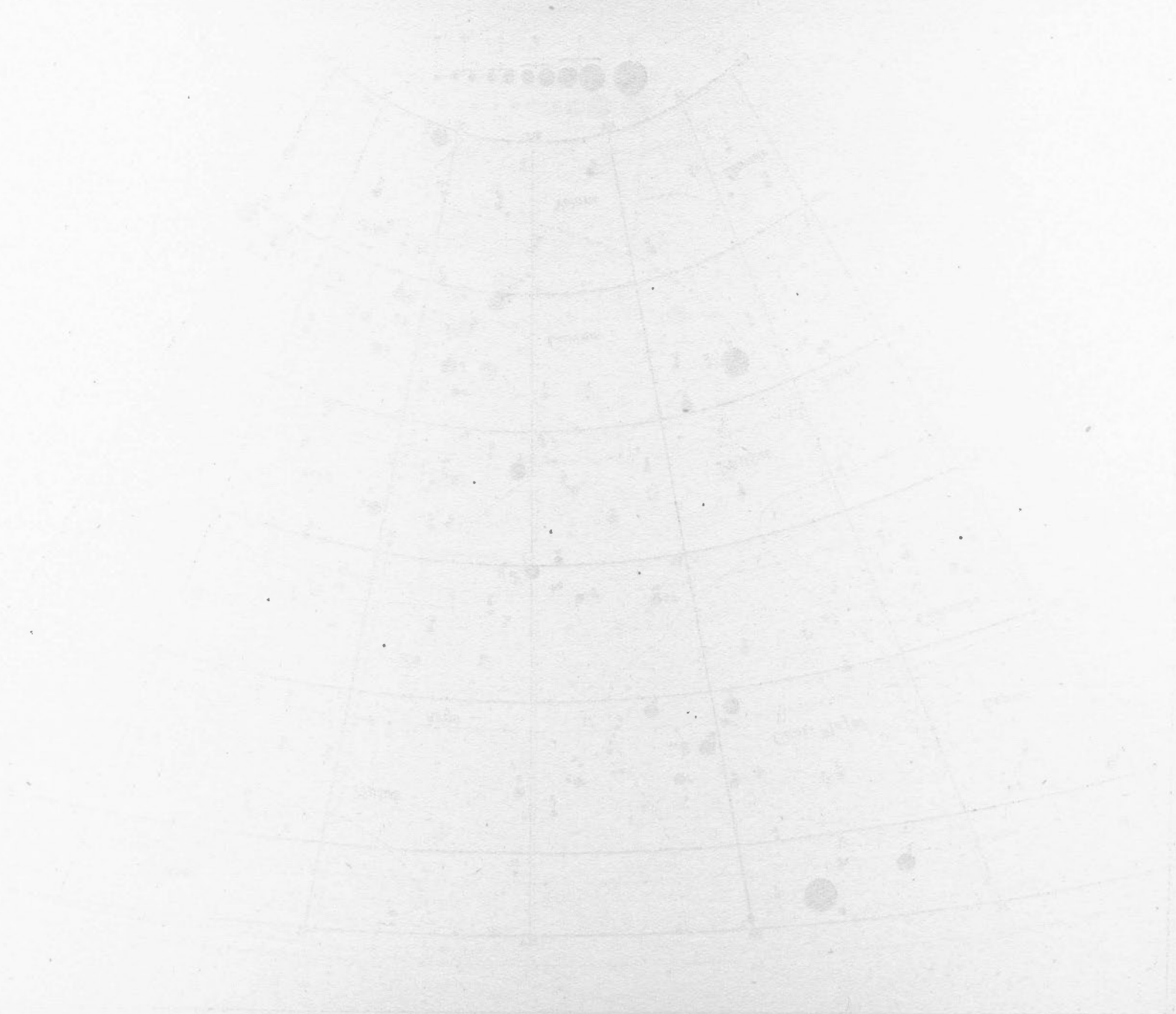


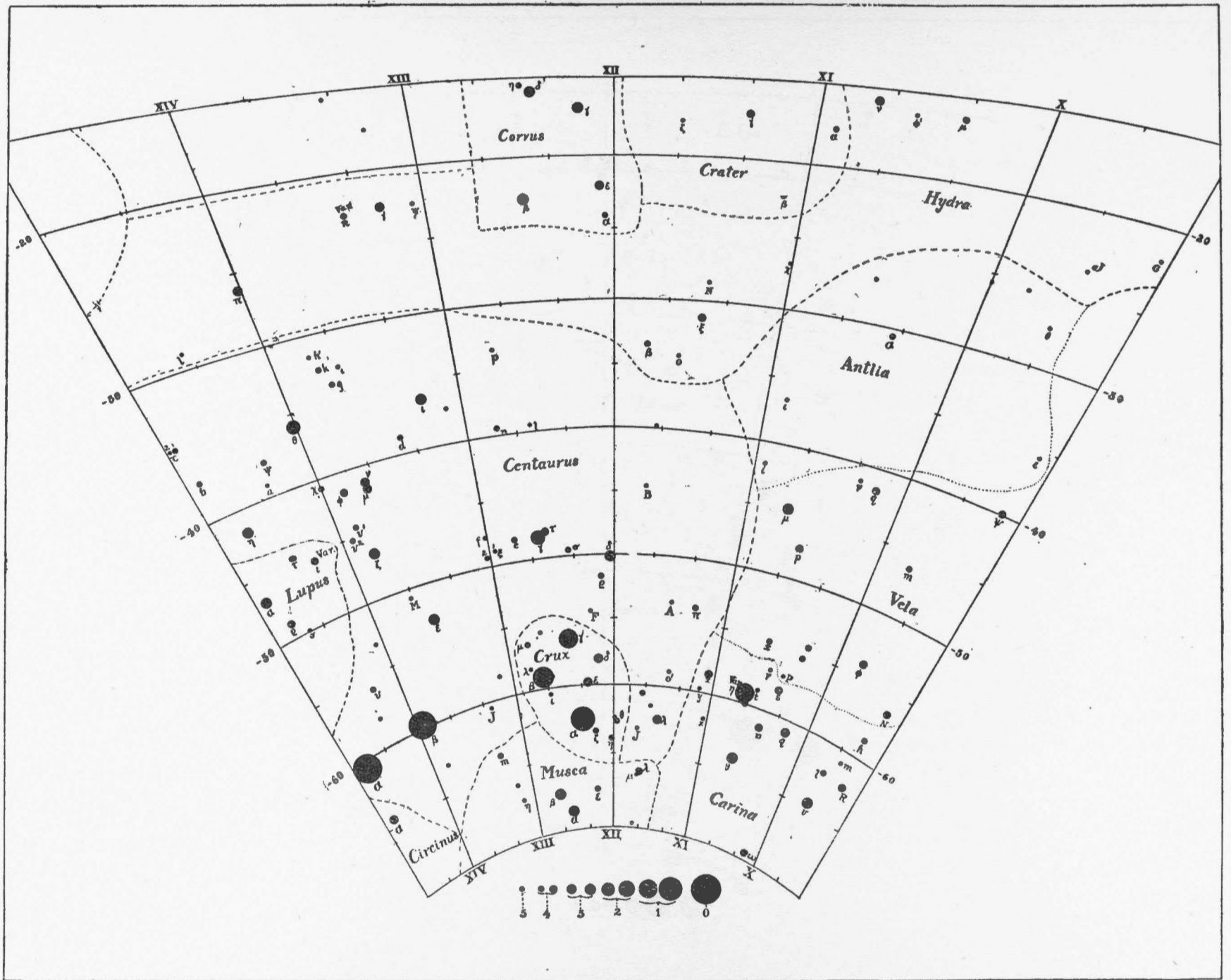
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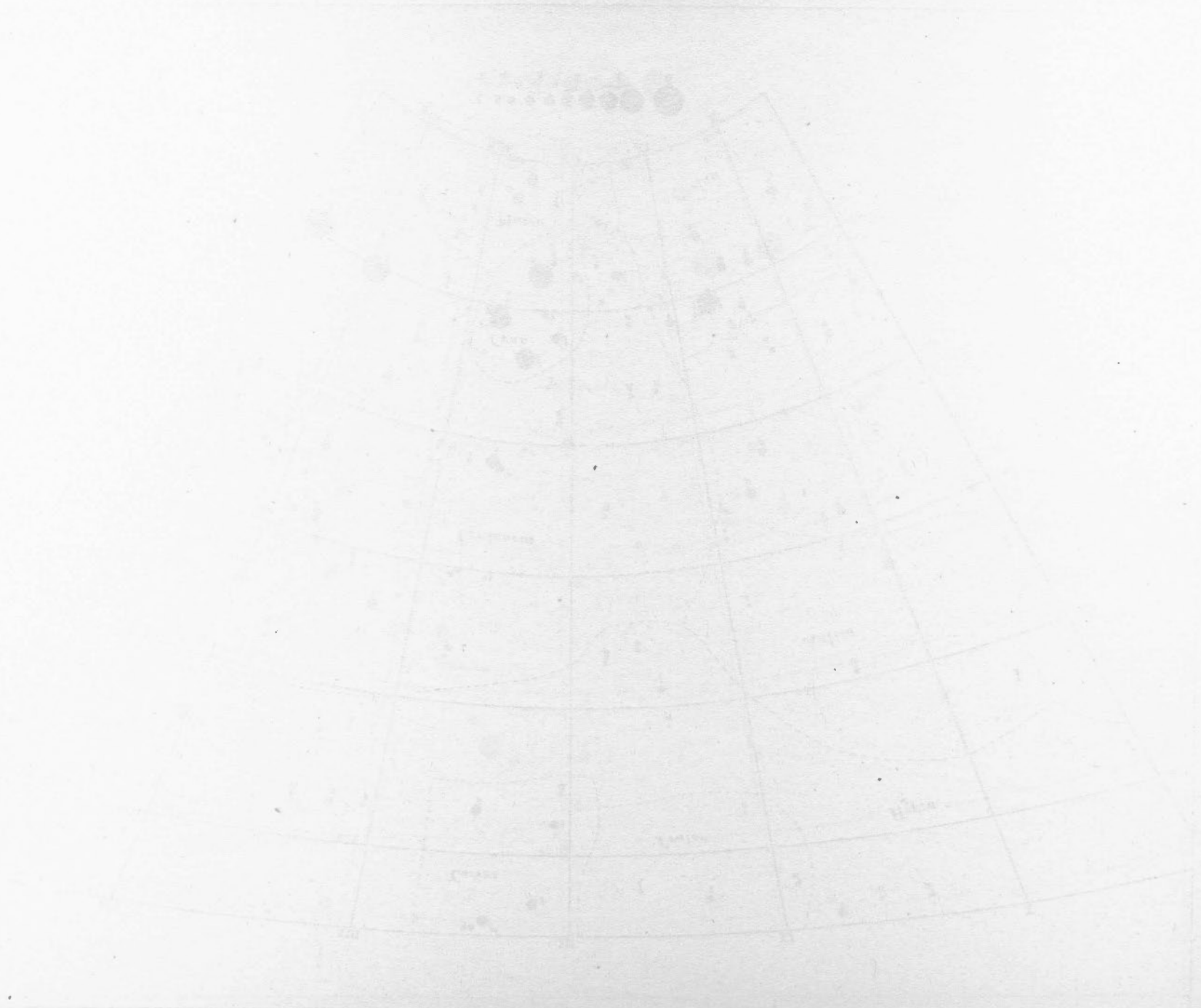


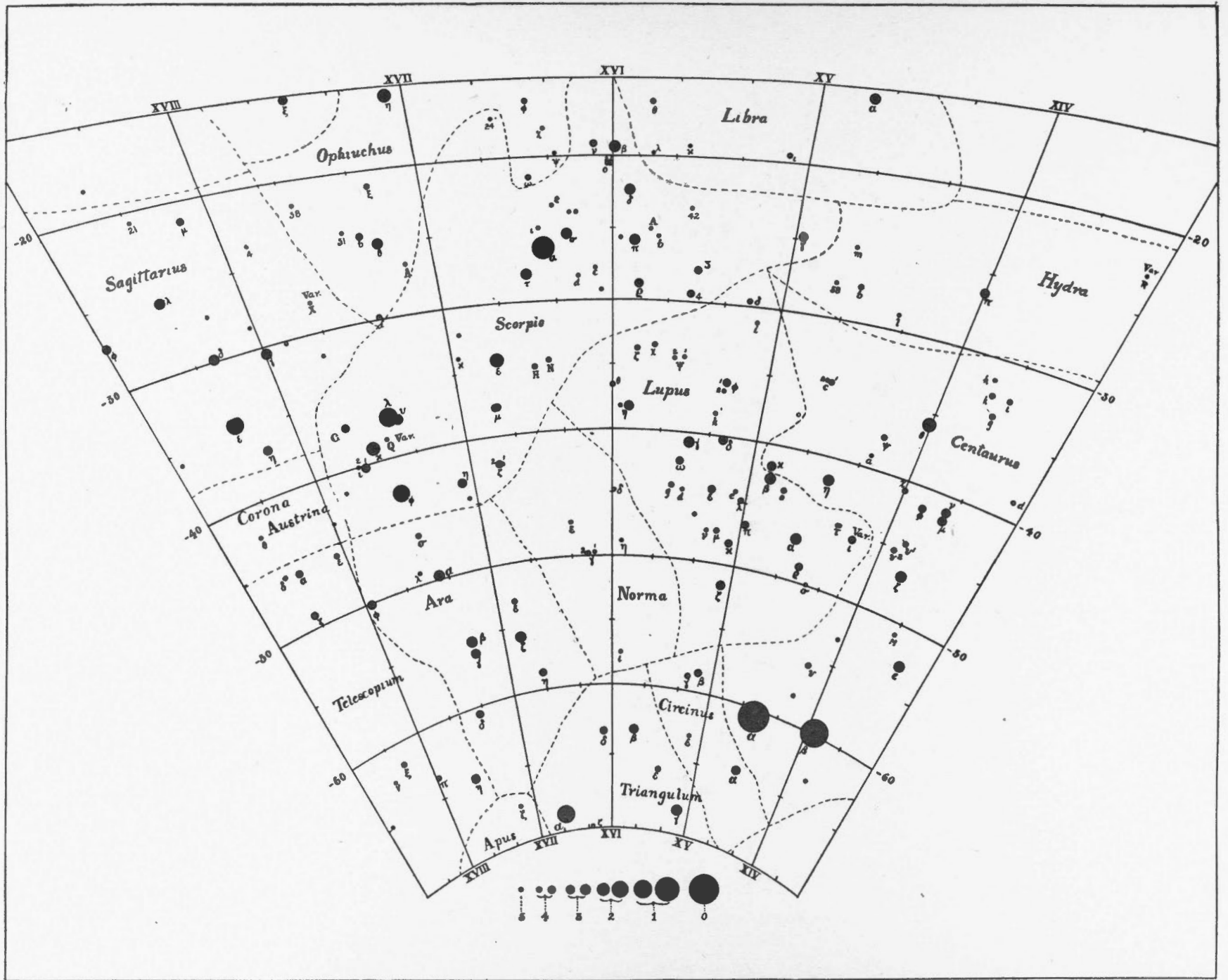
MAP XVI.





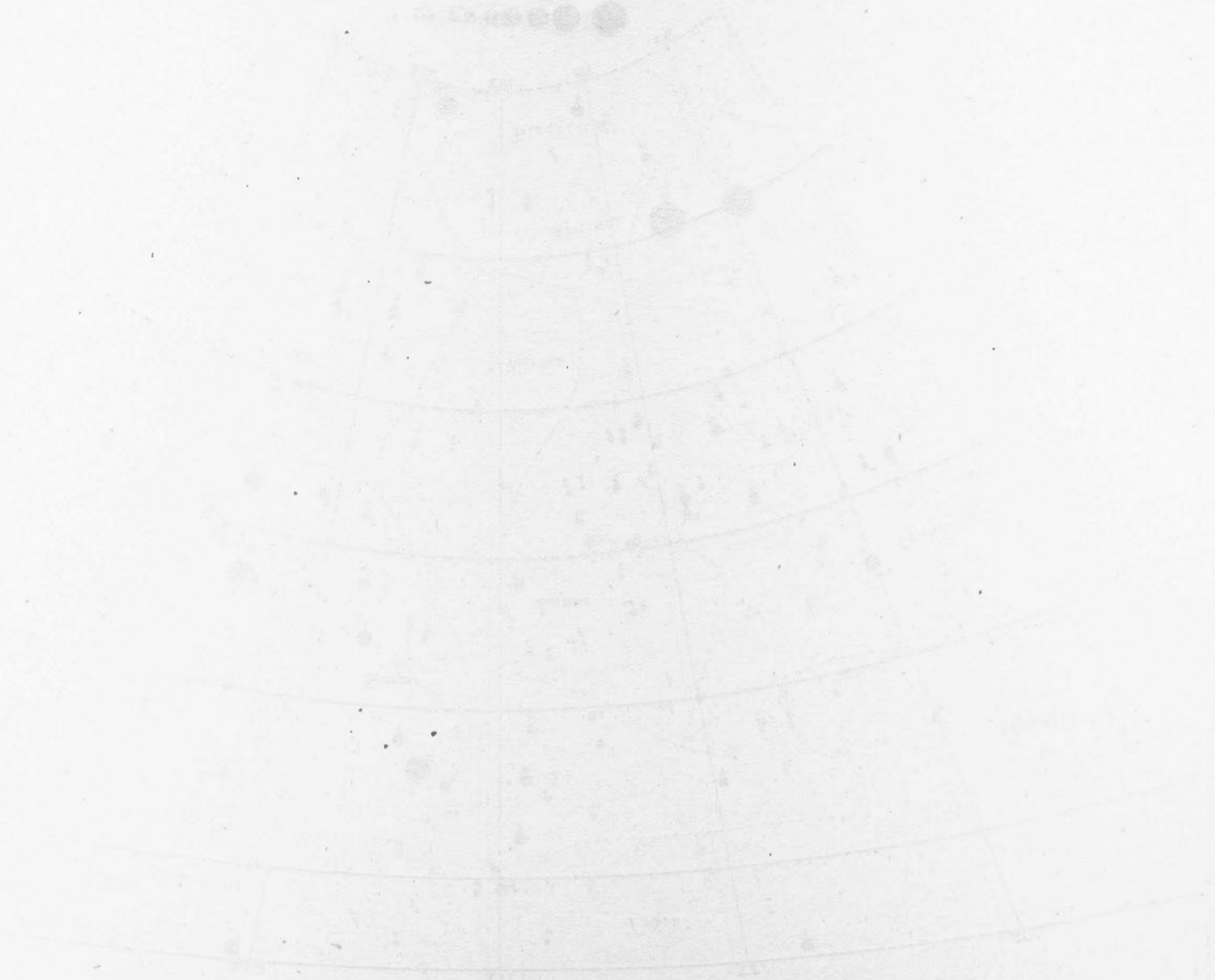
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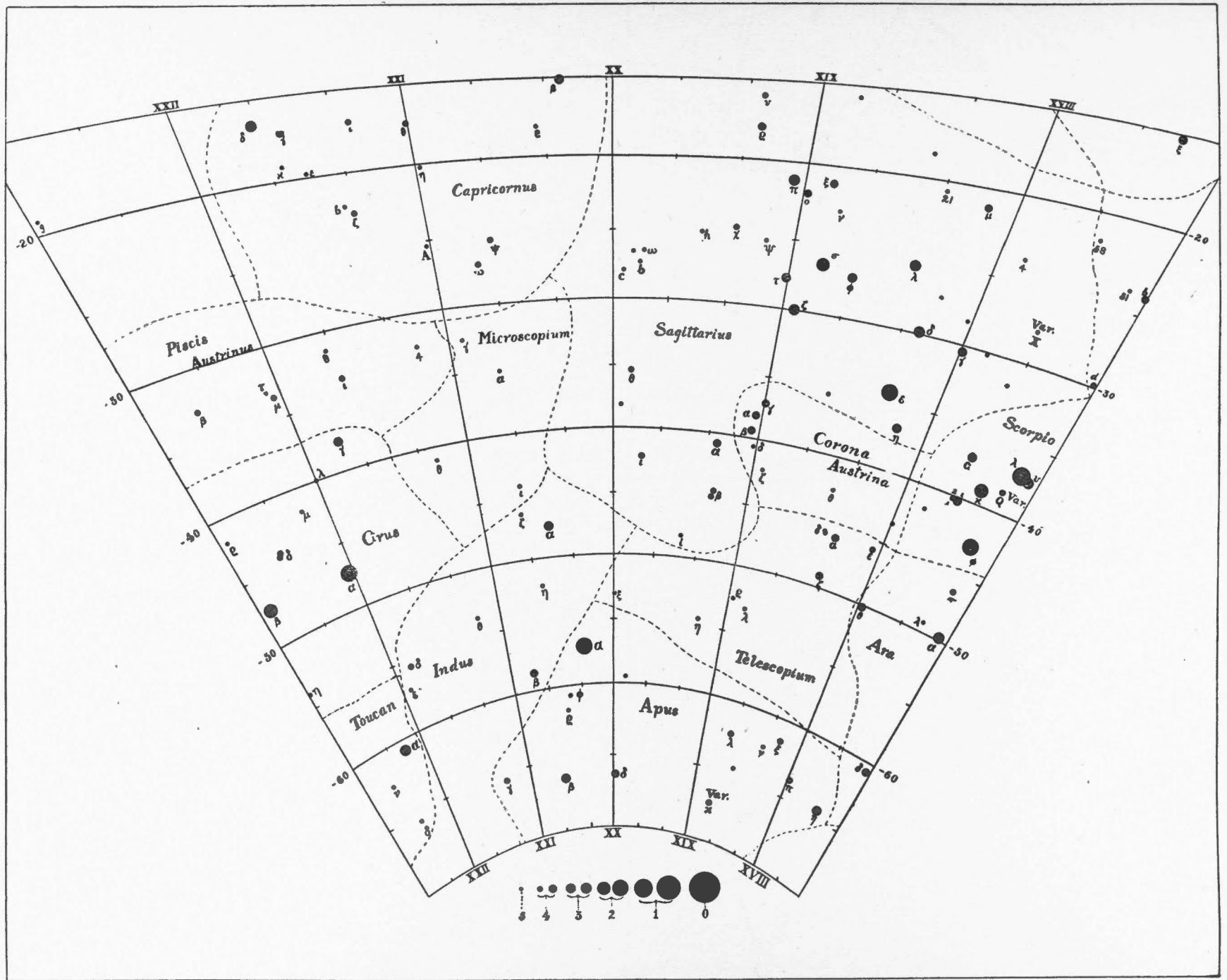




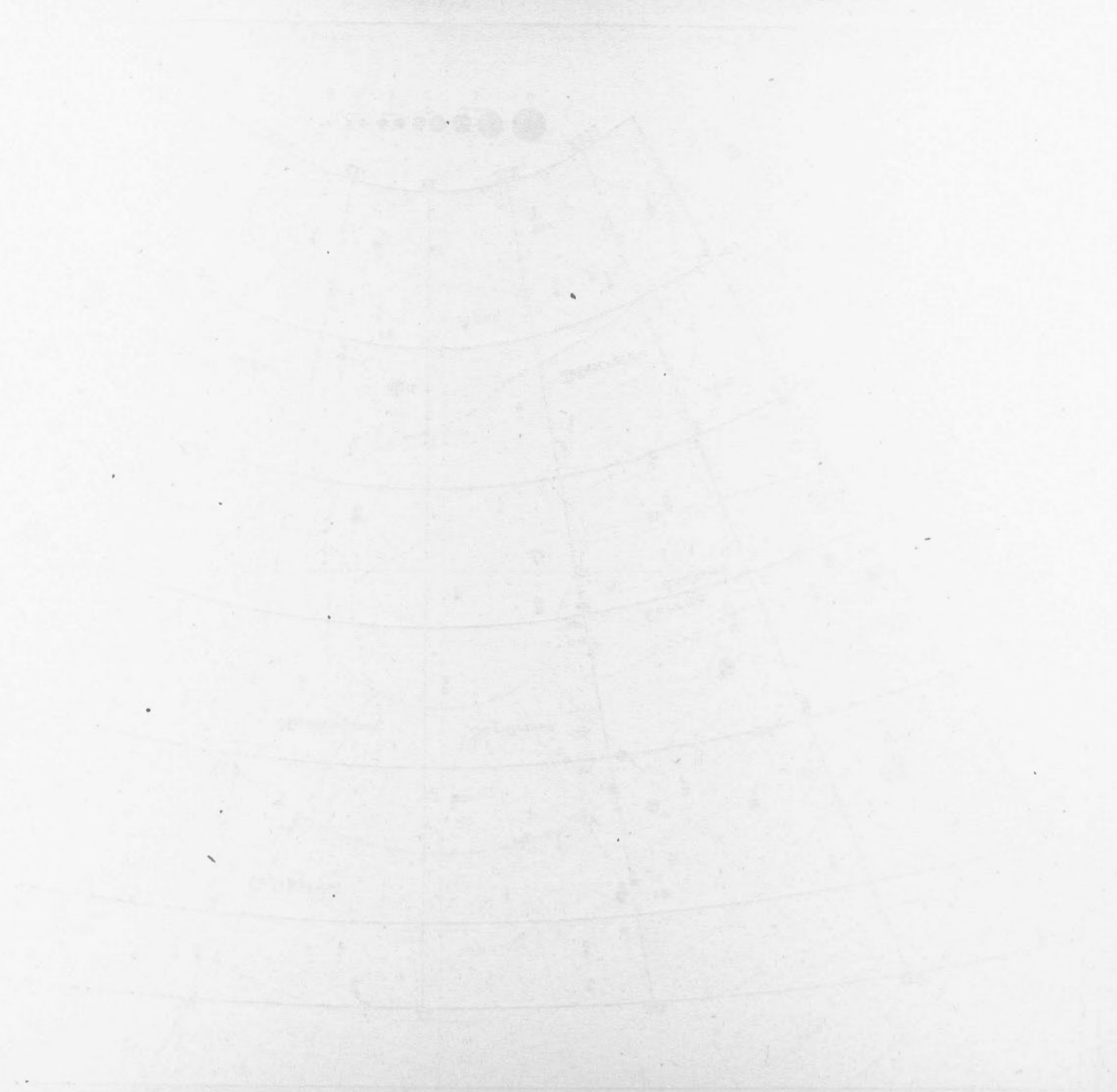
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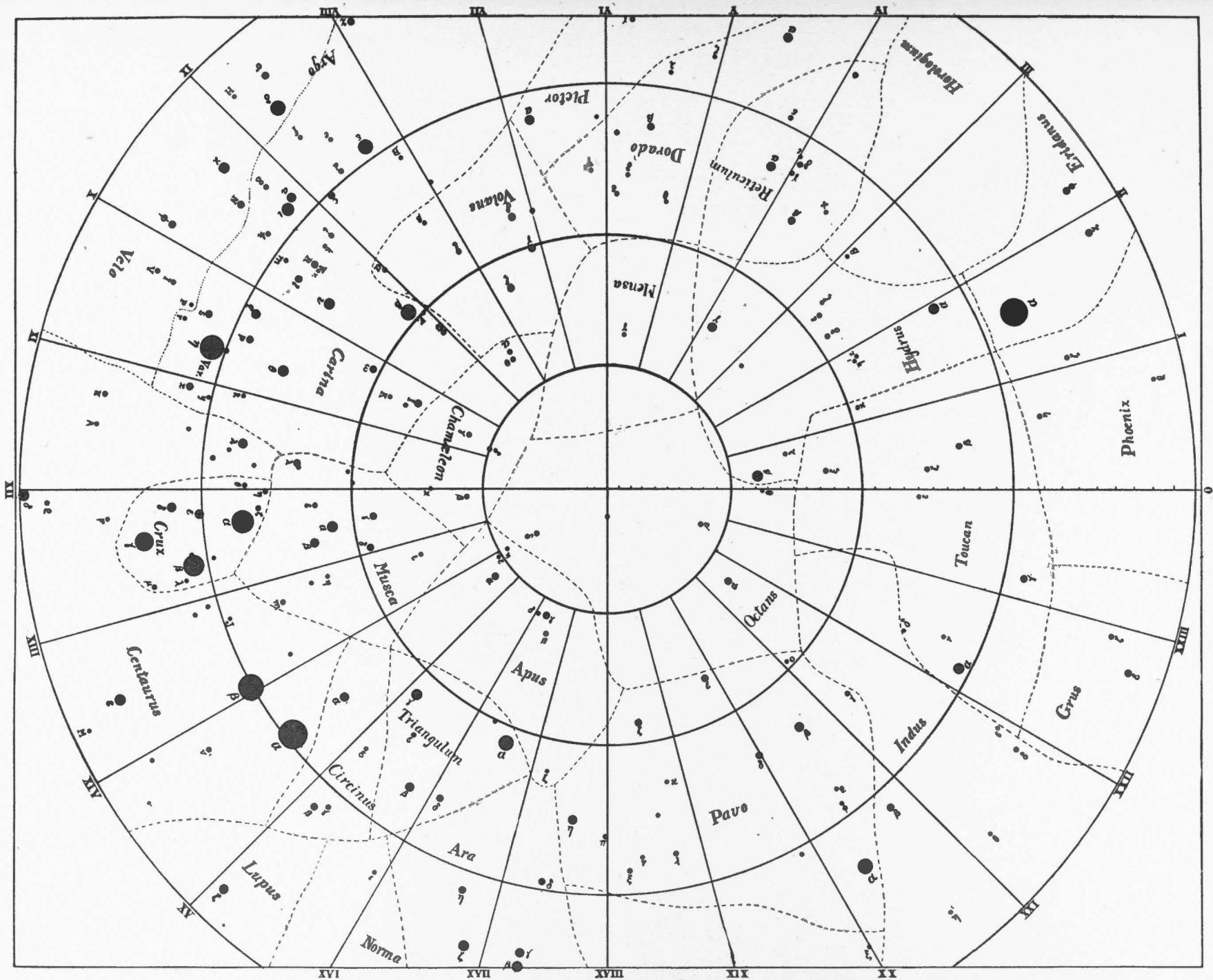
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MAP XIX.





MAP XX.