

study of minute details may be useful in such researches as Easton's, about the connexion of the distribution of the smallest stars with the appearance of the Milky Way; and, in the future, to discuss the question whether changes in the appearance of the Milky Way take place. But as it will be a great satisfaction for an observer to have a picture as exact as possible I will explain the manner in which to construct it from these observations; moreover, it may make the foregoing explanations somewhat clearer. When on a star chart we draw the lines of equal brightness obtained by the second of the described ways of research, and shade the regions between them with increasing deepness, then, blending these shades into another at their boundary lines, we have a picture with good distribution of brightness, but showing only the more general details, though it gives back the general appearance very well. Upon this background we can draw the minutest peculiarities taken from the results of the first way of research. We then have a picture that contains all that the observer has been able to see, and still it shows the brightness of the different parts in a very exact proportion.

New Charts for inserting the Milky Way.

By ANT. PANNEKOEK.

Among the existing star charts few are adapted for Milky Way studies. Most of them have a scale far too small, and leave no space for drawing the minutest differences of brightness. Without getting too great dimensions we can use a much larger scale, because we need only the parts of the sky that contain the Milky Way. It is especially necessary that the charts contain all the stars visible to the naked eye; with only the 5th magnitude there are great blank spaces, where we have no stars to delineate the streamers and spots, and the greater number of the existing maps, especially those which contain the whole sky in one sheet, do not go further than the 5th magnitude. It is also a matter of great importance that on the map we have a name to each star. In order to comprehend the meaning of the picture better we often need verbal descriptions, and it is readily conceived that it is not sufficient to use only the names of the brighter stars. And none of the charts I am acquainted with possess this needful quality. Those who are engaged in studying the Milky Way will all have experienced this want. At present it has been redressed by the efforts of Mr. Easton, already known among the astronomers by his excellent drawings of the Milky Way.

In Vol. LIII. of the Monthly Notices Mr. A. Marth has published an extensive catalogue of galactic longitudes and latitudes of stars in the neighbourhood of the Milky Way. These offer an excellent opportunity for drawing a star chart in cylindrical projection, by representing the axis of the Milky Way by a straight line through the middle, the galactic parallels by lines parallel to it, and the galactic latitude-circles by perpendiculars on it. Such charts I had constructed for my private use, directly after the publication of the catalogue. Afterwards Mr. Easton has lithographed them, and now they can be had by anyone studying this subject at very slight expense. I will now proceed to describe these charts, and the methods how to use them.

The northern Milky Way is contained in two charts, each extending 90° in galactic longitude and 50° in galactic latitude (25° on each side of the axis). The first extends from 0° long. (the intersection with the equator in Aquila) to 90° (the point nearest to the N. pole, in Cassiopeia), and the other from 90° to 180° long. (intersection with the equator in Monoceros). The degrees of longitude are everywhere $1^\circ = 5$ mm., the degrees of latitude are growing smaller with increasing latitude, in the ratio of $\cos. \text{lat.}$ This is done with the purpose that equal parts of the sky in different latitudes should be represented by equal parts on the chart.

In order to prevent confusion, only the black points of different size, representing the stars, are drawn on the charts; but the means are given to add, when desired, the lines of equal longitude and latitude, which are straight lines in this projection, and the names of the stars. The four edges are divided into degrees by short strokes, so that it is easy to draw the straight lines through the chart. On both sides of the chart a margin is added, measuring the fourth part of the breadth of the chart itself; this margin contains the names exactly on the spot where the stars would be placed if the scale of longitude was the same and the scale of latitude was reduced to the half; in this manner the name of each star on the chart is very easy to find in the margin. As each observer uses more than one chart, I should advise to fill up one of the charts with the names and latitude circles and parallels, and to use this chart always as object of reference.

For the names of the stars I have at first used the Greek letters of Bayer and the numbers of Flamsteed. But these are not sufficient. For stars not contained in Flamsteed's "Catalogus Britannicus," I have made use of the numbers in Baily's "British Association Catalogue," which are usually designated by the prefix B.A.C., but which in this case, in order to gain space, are placed in parentheses. Some stars of the 6th magnitude remain that do not occur in the B.A.C. For these I have used the number in the catalogue of Heis ("Atlas Coelestis Novus") with H. prefixed. The magnitudes of the stars are taken by Marth from the "General Catalogue" of Pickering. It should be observed, however, that the magnitude of the black circles is not always exactly concordant with the visual magnitude, because they are drawn at eye-estimate.

A few little stars remain that have no names at all. As this can give confusion and uncertainty in filling up the charts with names, I have added a list of these anonymous stars, indicated by their galactic longitude and latitude.

$9^\circ.5 - 18^\circ.1^*$	$62^\circ.2 + 8^\circ.8$	$114^\circ.8 - 3^\circ.8^\ddagger$	$156^\circ.2 - 1^\circ.3^\S$
$34^\circ.7 + 10^\circ.1$	$91^\circ.3 - 0^\circ.3$	$118^\circ.3 - 6^\circ.5$	$156^\circ.7 + 24^\circ.3$
$37^\circ.0 + 0^\circ.7$	$92^\circ.1 + 1^\circ.0$	$124^\circ.8 + 14^\circ.3$	$166^\circ.0 - 4^\circ.3$
$42^\circ.9 + 9^\circ.3$	$104^\circ.0 + 15^\circ.2^\ddagger$	$126^\circ.3 + 21^\circ.5$	$169^\circ.6 - 17^\circ.8\ \ $
$53^\circ.1 + 0^\circ.2$	$104^\circ.8 + 4^\circ.6$	$133^\circ.6 - 19^\circ.5$	$174^\circ.0 - 8^\circ.3$
$55^\circ.6 + 20^\circ.2$	$106^\circ.0 + 8^\circ.9$	$141^\circ.7 - 7^\circ.7$	$176^\circ.0 - 8^\circ.3$
$61^\circ.2 + 0^\circ.2$	$108^\circ.3 + 8^\circ.9$	$144^\circ.2 - 1^\circ.9$	$176^\circ.6 - 18^\circ.6^\P$
$62^\circ.2 + 4^\circ.7$	$111^\circ.7 - 8^\circ.1$	$145^\circ.2 - 14^\circ.9$	

* Between θ and 62 Aquilæ.

† Fainter of the pair.

‡ Between (1035) and (1059).

§ On the right side of χ_1 Orionis.

|| On the left side of 22 Orionis.

¶ Touches ι Orionis.

Some errors are found in the charts, for which reason I have appended the following list of corrections.

I.—Wrong names of the stars :—

(In the first column the galactic longitude has been written, and the sign of the latitude.)

9°—Aquila	7	should be	η	93°+Cepheus (608)	should be (605)
19+Hercules	40	"	100	122—Perseus	H 26 " H 86
24+ "	103	"	108	123+Camelop	H 57 " two
27+Lyra	7616	"	H 26	names, viz. 7 (for left; brighter	
30—Vulpecula	7640	"	H 40	star) and H 55 (for right; fainter	
33— "	7650	"	H 50	star).	
41+Cygnus	(6847)	"	(6817)	141—Taurus	57 should be 51
44+ "	H 23	"	H 123	142— "	92 " 72
58+ "	(7405)	"	(7105)	147— "	γ " h
59+ "	(6853)	"	(6852)	148— "	155 " 105
63—Lacerta	(7618)	"	H 18	149— "	g " C
63— "	p	"	(7705)	163—Orion	H 16 " H 18
64— "	i	"	H 6	163— "	H 112 " H 102
66—Cygnus	(7476)	"	(7676)	164— "	(1857) " (1851)
72—Lacerta	(H 30)	"	7630	167— "	32 " 52
72+Cygnus	(9658)	"	(7658)	168— "	H 63 " H 53
74+ "	(1766)	"	(7766)	172—Monoceros	H 1 " H 7
76+ "	(7943)	"	(7973)	154—Orion	76 " omitted.
77+Cassiopeia	e	"	i		

II.—Names that are not clear, and therefore may be misunderstood :—

11—Aquila	σ	(resembles 5)	106—Andromeda	C (resembles k)
30—Vulpecula	H 23	(" H 28)	112—Perseus	Mess 34 (" 54)
31+Cygnus	9	(" ρ)	114— "	κ (" 10)
51—Pegasus	ι	(" i)	114+Camelop	(1751)
64—Lacerta	H 28	(" H 23)	139+Auriga	H 29
97—Andromeda	(425)		154+Gemini	28
105+Camelop	(1510)		159+ "	σ (resembles 6 or 5)

III.—Stars whose names are forgotten :—

16°2—4°5 Aquila	is named	ψ	91°2+5°8 Cassiopeia	is named (261)
62°0—7°2 Lacerta	"	(7681)	126°5—14°2 Perseus	" 40
62°8—9°8 "	"	(7770)	162°9—22°9 Orion	" 5

IV.—Stars are missing, but their names are not :—

14°3+2°6 Aquila	ζ	magnit. 3	75°0—15°6 Andromeda	13 magnit. 5½
28°3+14°6 Lyra	H 26	" 6	100°3—22°4 "	(465) " 6
44°6+12°0 Cygnus	(6731)	" 5	178°9—12°5 Canis Min.	η " 5
44°9+21°3 Draco	(6428)	" 6		

The smallest stars on the chart have the 6th magnitude, γ Aquilæ, e.g., the 3rd.

V.—False stars, to be effaced from the charts :—

1°8+7°9 Ophiuchus		126°5—13°0 Perseus
90°8—14°7 Andromeda		

VI.—Errors of the constellations :—

140° long., boundary line around H 132 and (2261) should be effaced. Both stars belong to Auriga. Long. 170°—175°. Constellation with star β is not Lepus but Eridanus.