21-CM. MERIDIAN PLANE SURVEYS

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The meridianal surveys [1] at 21-cm. of interstellar hydrogen gas have been continued. Surveys at galactic longitudes of 50° [1], 60° [2], 80° [2], 90° [1], 110° and 200° have been completed while partial surveys have been made at longitudes of 20°, 205°, and 210°.

These surveys of apparent antenna temperature as a function of frequency are carried out at one longitude for a series of latitudes. The

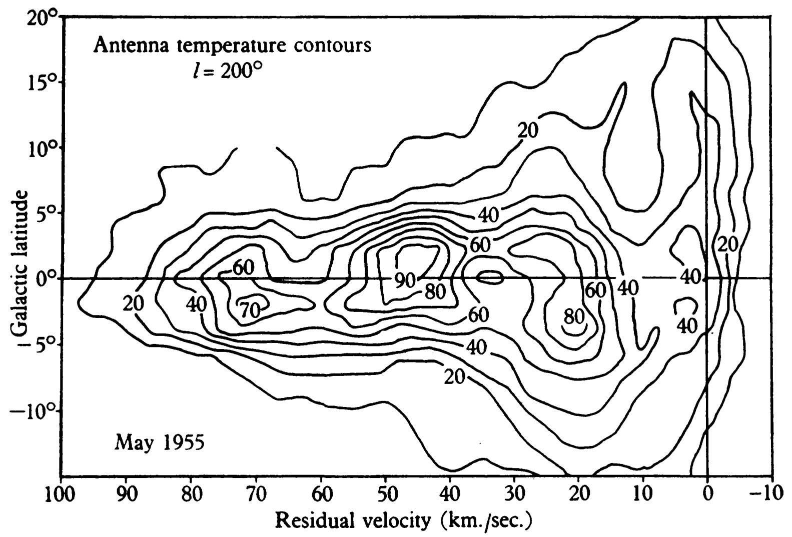

Fig. 1. Isotherms at wave-length of 21 cm. for galactic longitude of 200°. Temperature scale is approximate.

latitude interval is from two to five degrees depending upon the structural detail. The 'slit' width used is 12 kc./s. It is instructive to plot the data on a cartesian system in which the abscissa is the Doppler shift and the ordinate is the galactic latitude. Contours of constant apparent antenna temperature are drawn. These plots show distinct maxima associated with the spiral arm structure as first pointed out by the Australian [3] and Dutch [4] workers. These particular plots are useful in that the original data are entered with no adjustments. On the other hand, they give distorted pictures of the spatial configuration of the gas. In order to improve the presentation certain assumptions have to be made such as random cloud velocities and the variation of galactic rotation with distance. These will not be considered here.

By making plots of this nature certain simple properties of the galactic gas distribution appear. One interesting aspect is that these plots give an excellent presentation of the solid angle of a given gas concentration which is related, to a first approximation, to any particular contour grouping.

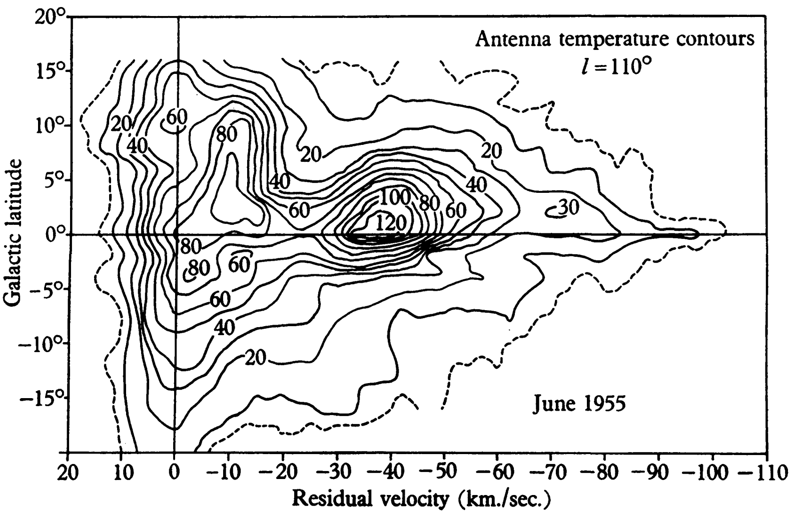

Fig. 2. Isotherms at wave-length of 21 cm. for galactic longitude of 110°. Temperature scale is approximate.

A more sophisticated analysis in which self-absorption is taken into account will shift the true gas centres with respect to the apparent temperature system here under consideration. Near the sun these shifts should not vary enough with direction to affect the gross conclusions, as the apparent temperature gradients do not vary rapidly with longitude. The gas concentrations near the sun have a small Doppler shift and subtend large angles compared to the more distant concentrations. As these near gas structures are examined in different longitudes, from 50° to 210° (Figs. 1, 2), it is seen that the structure changes.

First there is the gas which at longitude 60° extends to latitudes of ±20° and greater, with appreciable concentrations. At $l = 200°$ (Fig. 1) the peak temperature of the distribution has dropped to almost half and at 210°, which is difficult to observe because it is so close to our horizon, there are only the most vestigial traces of this concentration, particularly at negative latitudes. A preliminary survey at 20° longitude indicates that this local gas has a high concentration in this direction. Thus, it appears that the sun is in a gas concentration which is denser in the region from $l = 50°$ to $110°$ and far less dense in the direction $l = 210°$. This local gas concentration is distinct and apart from what we have been calling the local arm.

Inspecting once again the gas concentration of the local arm, there is a suggestion that the main body of this gas is inclined out of the galactic

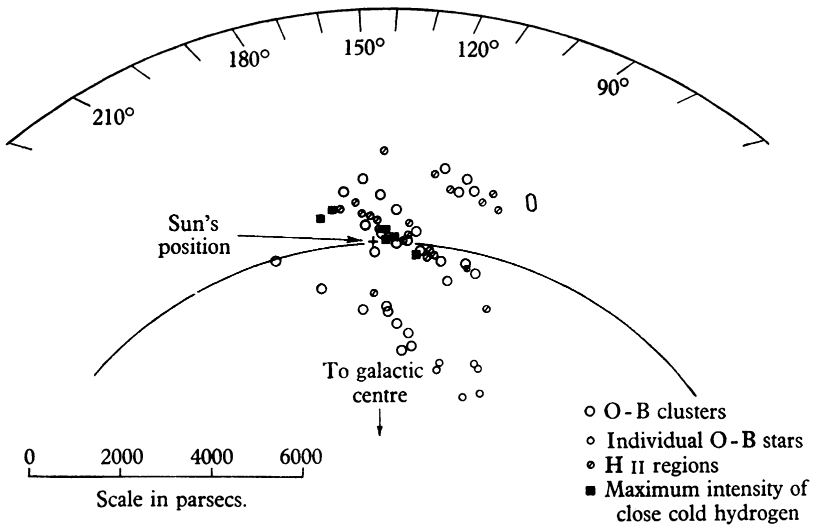

Fig. 3. Galactic map showing star associations and the approximate position of apparent antenna temperature maxima of the cold hydrogen in the near arm.

plane. At $l = 110°$ (Fig. 2) it is 4° out of the plane and fairly well separated from the local cloud. At 200° (Fig. 1) there is no doubt, for there are four major concentrations instead of the three found between $l = 60°$ to $110°$. While we have not traced these four concentrations in intermediate longitudes, for example between $l = 170°$ to $190°$, there is good evidence for their existence in the equatorial traces made at these longitudes for this region. The traces show four well-defined peaks instead of the three as found at $l = 60°$ to $110°$. As this near arm gas concentration becomes more separated from the local cloud, its Doppler shift is also increasing. If the position of greatest temperature is mapped (Fig. 3) assuming that its distance from the sun is a function of the galactic rotation constants and the sine of twice the galactic longitude, then the distance from the sun of this arm is seen to increase as l both increases and decreases from $l=70°$. We have one point at $l=50°$ and the data for $l=20°$ are at least consistent with this hypothesis. Thus, the near arm, which apparently coincides in position with the star associations of Morgan, Whitford, and Code, has an inclination with respect to the circle through the sun about the galactic centre.

The values of the Doppler Shift presented by Helfer and Tatel in *Ap. J.* **121**, 585, 1955, should be increased by a non-linear factor equal to 7 % at 100 km./sec. I am indebted to Messrs Raimond and Westerhout of Leiden, who called this to my attention.

REFERENCES

[1] Helfer, H. L. and Tatel, H. E. *Ap. J.* **121**, 585, 1955.
[2] *Carnegie Inst. of Wash. Year Book*, no. 55, 80, 1955–1956.
[3] Christiansen, W. N. and Hindman, J. V. *Aust. J. Sci. Res.* A, **5**, 437, 1952.
[4] Hulst, H. C. van de, Muller, C. A. and Oort, J. H. *B.A.N.* **12**, 117, no. 452, 1954.