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75-CM AND 22-CM CONTINUUM SURVEYS

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Continuum surveys were made at 75 cm (400 Mc/s) and 22 cm (1390 Mc/s) with the Dwingeloo 25-m telescope.

At 75 cm the halfwidth of the main lobe of the antenna pattern was 2 degrees. Effects of ground radiation in far side- and back-lobes (spillover) amounted to differences in zero level at different antenna positions of up to 15 °K. Since the receiver noise figure and stability permitted the measurement of differences of 1 °K this was very disturbing. In such a case the advantages of an altazimuth mount, with which sweeps at constant altitude and constant polarization can be made, are obvious. The receiver, a nonswitching type, was built by Seeger, and the observations were made by Seeger, Conway, and the author. Some results, including the intensities of a number of discrete sources and a contour map of the Andromeda nebula, have been published [1]. The final results will appear in the *B.A.N.* The survey covered the whole sky visible from Dwingeloo, i.e. declination > -35 degrees. The reductions, which are being made mainly by Hoekema, have reached the stage where a map of the North polar cap, declination $> +35$ degrees, can be presented (Fig. 1). Some detail is visible in the complex source Cygnus X, which may be identified with emission nebulae. The nebula IC 1759, several other emission objects, and some nonthermal sources are also visible. Measurements of the radiation from three clusters of galaxies gave the following results:

Coma cluster	flux density	$S = 11 \times 10^{-26} \pm 2$
Virgo cluster		$S < 300 \times 10^{-26}$ (excluding Virgo A)
Ursa Major cluster?		$S = 200 \times 10^{-26} \pm 100$?

Muller built the 22-cm receiver, which was also a nonswitching type. The beamwidth was 0°.57, and the side lobes were below $\frac{1}{2}$ per cent. Full results of the observations are published by the author in the *B.A.N.* [3]. A detailed survey was made over a region 40 degrees wide in latitude along the galactic equator, from $l = 320$ to $l = 56$ degrees (Fig. 2), and a region of 30 × 50 degrees around the Orion nebula.

The results further include a list of 74 discrete sources, 11 of which have a nonthermal spectrum. The number of well-established thermal sources is 56, of which 35 are identified with optical emission nebulae. The regions in which the proportion of unidentified sources is largest are around $l = 20$ degrees, where the line of sight runs between two spiral arms and we are probably seeing sources beyond $r = 6$ kiloparsecs, and Cygnus, in which many sources may be situated behind dark foreground clouds. The complex source Cygnus X is resolved into about 10 discrete sources. A determination was

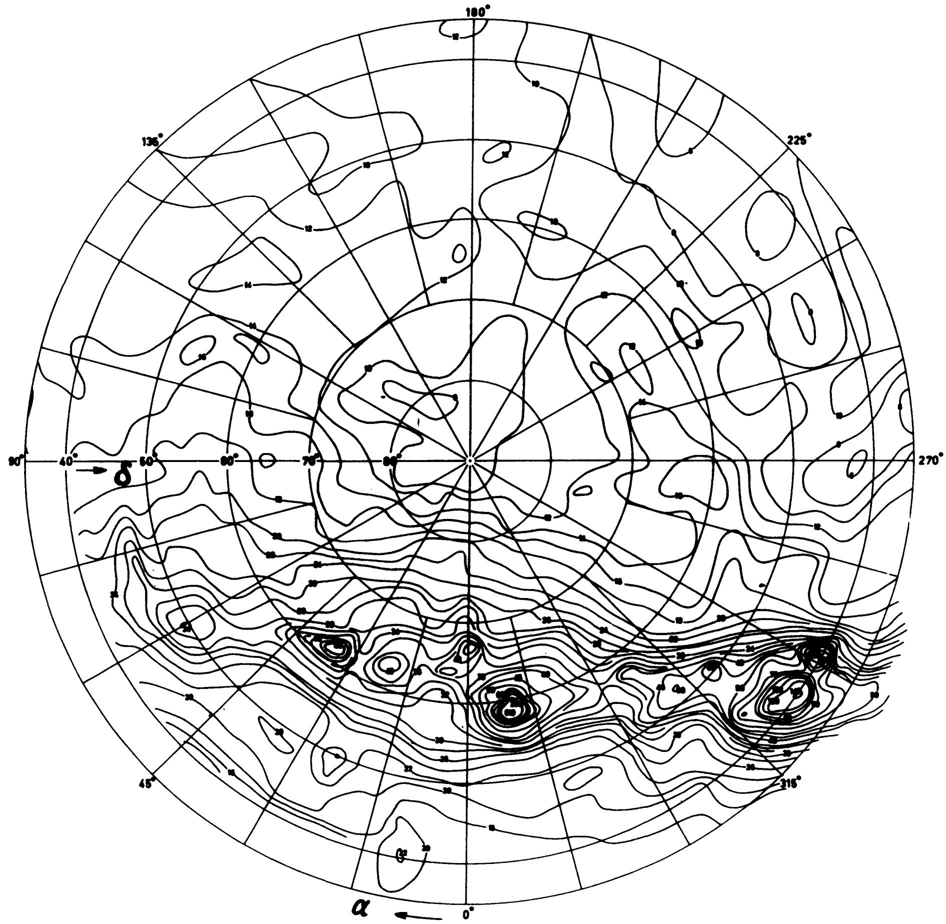

FIG. 1. Contour map of the North Polar cap at 75 cm. Units are approximately 1 °K in T_b, contour intervals for intensities <40 are approximately 2 °K.

made of the emission measures, the average densities and the masses of those sources of which the distances are known. It appears that only the more massive nebulae are detected. Two-thirds of the sources have $M > 1000 M_\odot$.

A comparison of the 22-cm survey with Mills's high-resolution survey at 3.5 m enabled us to separate the background radiation of the galactic ridge into a thermal and a nonthermal component. The brightness temperature of the nonthermal radiation was assumed to be proportional to $\nu^{-2.70}$. The space distribution of ionized hydrogen in the Galaxy was derived from the distribution of the thermal component. The radio and optical data for the region around the sun agree if we assume that the majority of emission regions have emission measures between 400 and 800, densities between 5 and 10 cm^{-3}, and diameters between 5 and 30 parsecs. We find that between 0.6 and 0.15 per cent of space near the sun is filled with ionized hydrogen. The

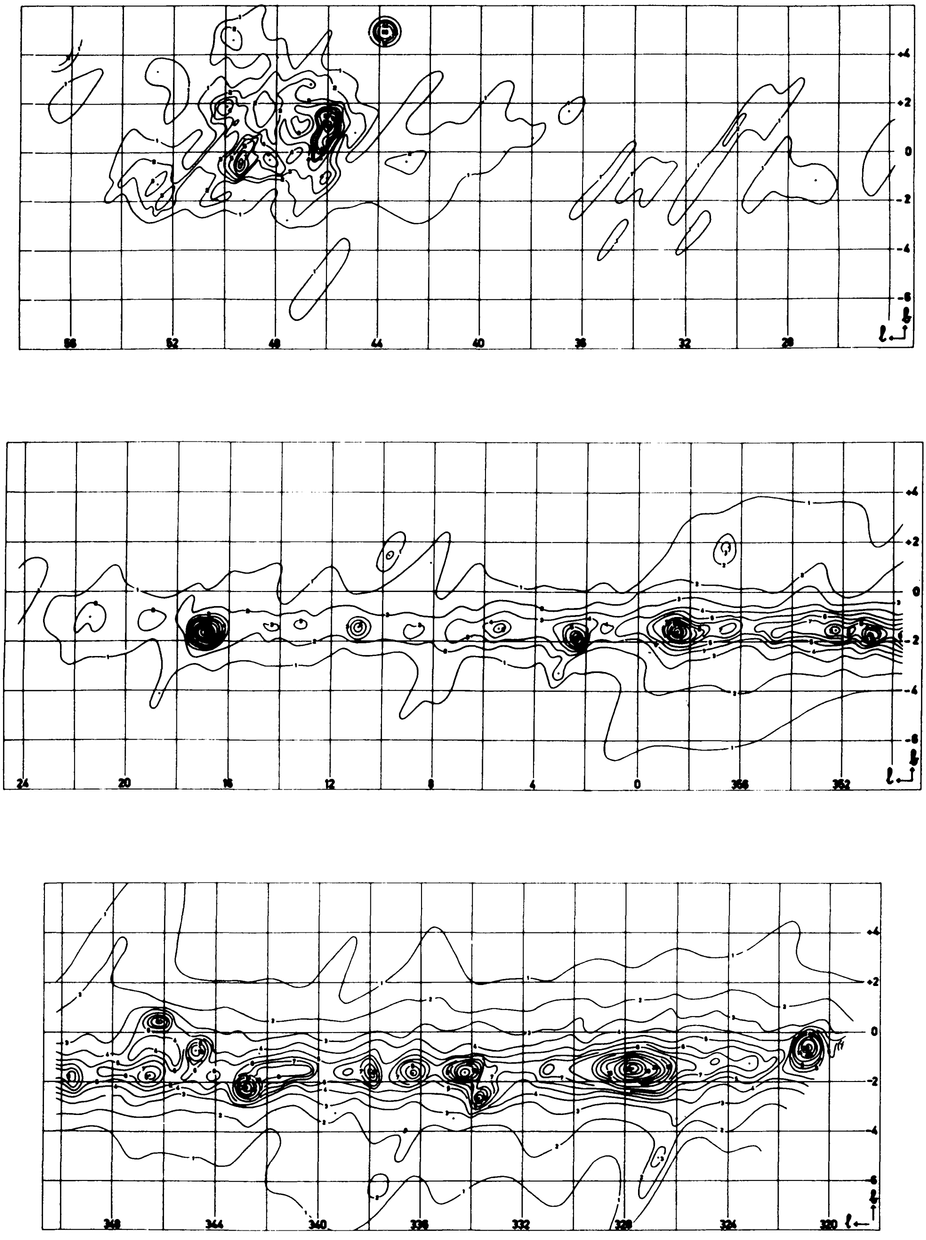

FIG. 2. Contour map of the Milky Way at 22 cm. Contour intervals are 3.25 °K in T_b.

density ratio of ionized and neutral hydrogen near the sun is between 0.06 and 0.03. The average space density of ionized hydrogen increases to a value of 7 times that near the sun at $R = 3.5$ kiloparsecs, and is very much smaller for $R < 2$ kiloparsecs. The total mass of the ionized hydrogen in the Galaxy is $6 \times 10^7 M_\odot \pm 50$ per cent. There is a striking coincidence in position between the border of the region where the neutral hydrogen is in expansion (at $R = 3$ kiloparsecs or somewhat farther out) and the density maximum of ionized hydrogen at $R = 3.5$ kiloparsecs. There may well be a physical relation between these two phenomena.

A comparison of the observations of the galactic center at 3.5 m and at 22 cm is very interesting. A model for the source in the galactic center which fits the observations at both wavelengths, consists of a thermal source with halfwidths of $0^\circ.55 \times 02^\circ.5$ and a 22-cm top temperature of 500 °K, and a nonthermal source with halfwidths of approximately 2×1 degrees and a 22-cm temperature of 25 °K. The thermal source is embedded in the nonthermal source and causes absorption at 3.5 m. Observations with narrower beamwidths will be of considerable interest.

REFERENCES

[1] Seeger, Ch. L., Conway, R. G., and Westerhout, G. *Ap. J.* **126**, 585, 1957.
[2] Westerhout, G. *B.A.N.* **14**, 215 and 261, 1958.