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CONCLUDING LECTURE by

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1. CONTINUUM OBSERVATIONS OF THE GALAXY AND THE EXTRAGALACTIC BACKGROUND

Results have been presented from continuum observations in the range from 19.7 to 1390 Mc/s ($\lambda = 15$ to 0.22 m).

The low-frequency information (19.7 and 38 Mc/s) refers to the high-temperature background and halo radiation; this was investigated by observers at Cambridge and Sydney. The large-scale features of the Galaxy discussed most were the effects of absorption along the galactic equator caused by ionized hydrogen. This effect was found to be small at 8 m (Blythe, reported by Baldwin, paper 82) but readily noticeable at 15 m (Shain, paper 81). The detection of nearby H II regions showing in absorption (Baldwin) should provide a valuable tool in locating optically obscured emission nebulae.

At the intermediate frequencies (86, 160 and 400 Mc/s) several items were dealt with. Mills's (paper 79) model of the corona would seem to lead to a rather satisfactory estimate of the emission of the inner parts of the corona (0.2 °K/parsec), since his estimate is largely independent of the extragalactic component. It was brought out in the discussions that Mills's model agrees with the one recently obtained by Baldwin both in shape and size and in the total emission found (1.1×10^{22} watts $(c/s)^{-1}$). For the outer parts of the model, however, the extragalactic corrections still form a source of considerable uncertainty. According to Mills, the axial ratio and the diameter to half-emissivity points in the Galaxy are smaller than those found by Seeger for M 31. The total emissivity seems to be the same.

The correlation between the extragalactic component and the optical data on extragalactic systems remains a difficult problem. The earlier correlation announced by the Australian observers was not substantiated by their additional observations (Hill, referred to by Mills, paper 79). A similar conclusion was reported by Baldwin and Shakeshaft (paper 66): the bright band of emission roughly perpendicular to the galactic plane about right ascension 12^h cannot with certainty be identified with the concentration of bright galaxies observed optically in these directions. Doubt is thrown on this correlation by the lack of detailed agreement and by the fact that if the identification were correct stronger radiation might also be expected from other similar galactic clusters.

A related problem is that of the comparison of the spectra of the halo and the extragalactic component. Here, again, the identification of certain small features in the continuum radiation with optical galaxies would be of con-

siderable help (Baldwin), but this identification is still lacking. In fact, the opinion was expressed that these small features probably are sources in the galactic corona (Oort, paper 76).

Mills's definition of the disk (the broad band of radiation minus the strong sources) and his interpretation of its "peaks" in terms of spiral structure (paper 79) aroused considerable interest and debate. The definition of the disk remains somewhat arbitrary in view of the presence of the uneliminated large number of weaker sources. As to the evidence for spiral structure, it is my feeling that the 21-cm information on this structure is still superior. The association of the sources of emission with the spiral structure is, however, a matter of great interest.

From observations at the highest frequency, 1390 Mc/s, reported by Westerhout (paper 80), a different picture of the distribution of ionized hydrogen has emerged from the one obtained by Mills. In both analyses a separation of thermal and nonthermal sources was obtained by comparing the 3.5-m and the 22-cm surveys. In interpreting the distribution of the thermal sources Westerhout was led to the picture of high H II density in a ring at about 3.5 kiloparsecs from the galactic center, contrary to the regularly winding spiral arms according to Mills. The discrepancy obviously needs further investigation. Westerhout's result might somewhat better fit with the 21-cm expanding region around the galactic center.

2. 21-CM OBSERVATIONS IN THE GALAXY

The present state of studies of the neutral-hydrogen distribution in the Galaxy has been assessed in Oort's paper 76. As to the large-scale spiral structure, the most gratifying result is the completion of the Australian work, which, together with the Dutch results, should form the basis for future refined studies.

The earlier suggestion of turbulent velocities in the inner parts of the Galaxy ($R < 3$ kiloparsecs) has been replaced by the picture of expanding neutral hydrogen and the existence of spiral structure in this region (Rougoor and Oort, paper 77). It is tempting to consider these results as pointing toward the process of spiral-structure formation. An important problem raised in this connection during the discussions concerns the variation of the expanding velocity with the distance from the galactic center. An increase of velocity with the distance would seem plausible (Oort, paper 76) and we might think of the expanding hydrogen as being the result of condensations from the halo over the entire area within 3 kiloparsecs. The degree of ionization in this region is very low according to Westerhout's 22-cm results (paper 80). No satisfactory explanation of the driving force behind the expansion has been presented, although suggestions are made by Gold and Hoyle.

3. EXTRA-GALACTIC OBJECTS

Miss Volders and van de Hulst (paper 78) reported 21-cm observations. Results are accumulating for late-type spirals and irregular objects and are

summarized in these authors' tables. They refer especially to the density distribution and rotation law in M 33 and M 101, and lead to data on the ratio between the total mass of the spirals and the mass of neutral hydrogen contained in them.

This ratio was an item of the discussion following the paper. It may be correlated with type or with mass of the system, and would then indicate that in the more massive systems a larger fraction of the original H mass has been used up in the formation of stars (Mrs. Burbidge). This result would agree with independently obtained information on the dependence of star formation on gas density (Schmidt).

Another item of discussion was the contribution of the ionized and molecular H to the total mass. The amount of molecular H is still an unknown quantity.

The use of comparison fields in the neighborhood of the extragalactic systems has been criticized, on the basis of information derived from continuum observations of the extension of certain systems (Hanbury Brown). Such observations were reported by Shain for three extragalactic sources associated with three distant galaxies plus the Magellanic Clouds. The three first mentioned radio sources have elongated shapes, and dimensions of the order of 100 kiloparsecs, much larger than the associated optical objects.