SHORT COMMUNICATIONS

A SEARCH FOR RADIO EMISSION AT 3·5 M FROM THE LOCAL SUPERGALAXY*

By E. R. Hill†

As described by de Vaucouleurs (1953, 1956) the local supergalaxy is a large flattened system of galaxies and clusters of galaxies centred near the Virgo cluster. It is seen most clearly in the northern galactic hemisphere as a band of bright galaxies about 10° wide extending along a great circle. Our Galaxy appears to be near the rim of this system.

Radio emission apparently originating from the supergalaxity has been reported by Kraus and Ko (1953) and Kraus (1954) at 1·2 m and by Brown and Hazard (1953) at 1·9 m. In both instances the band of radio emission followed the band of galaxies quite closely; the combined observations extend about 90° along the supergalactic equator.

Particular interest has been added to radio observations of the local supergalaxy since the suggestion of Shklovsky (1954) that the emission arises from the synchrotron process which may be active in the intergalactic space within the supergalaxy. If this be so, radio observations might be expected to yield data relating to conditions in space between the galaxies—a region very difficult to study by any other means.

Observations to be described presently cast doubt upon the existence of radio emission from the supergalaxy. It should be added that other arguments leading to this negative conclusion have recently been reported by J. E. Baldwin and J. R. Shakeshaft at the I.A.U.-U.R.S.I. symposium on radio astronomy held at Paris in August this year.

Records taken with the Sydney 3·5 m cross-type aerial (Mills *et al.* 1958) have now been examined for traces of emission from the supergalaxy. The region studied in detail was from R.A. $10^{h}\,30^{m}$ to $14^{h}\,30^{m}$ between Dec. $-15°$ and $+10°$. Although this area has been investigated by Kraus and Ko, the high-resolution pencil beam of the "cross" (beamwidth 50′ east-west by 70′ north-south at these declinations) can provide a more detailed picture of the distribution of radiation. The results obtained, after a uniform gradient in temperature corresponding to the general fall-off in temperature away from the galactic plane has been removed, are shown in Figure 1. Effects of discrete sources have also been removed.

Also shown in Figure 1 are Shapley-Ames galaxies (dots) and the band, illustrated by the shading, observed by Kraus and Ko. The principal feature

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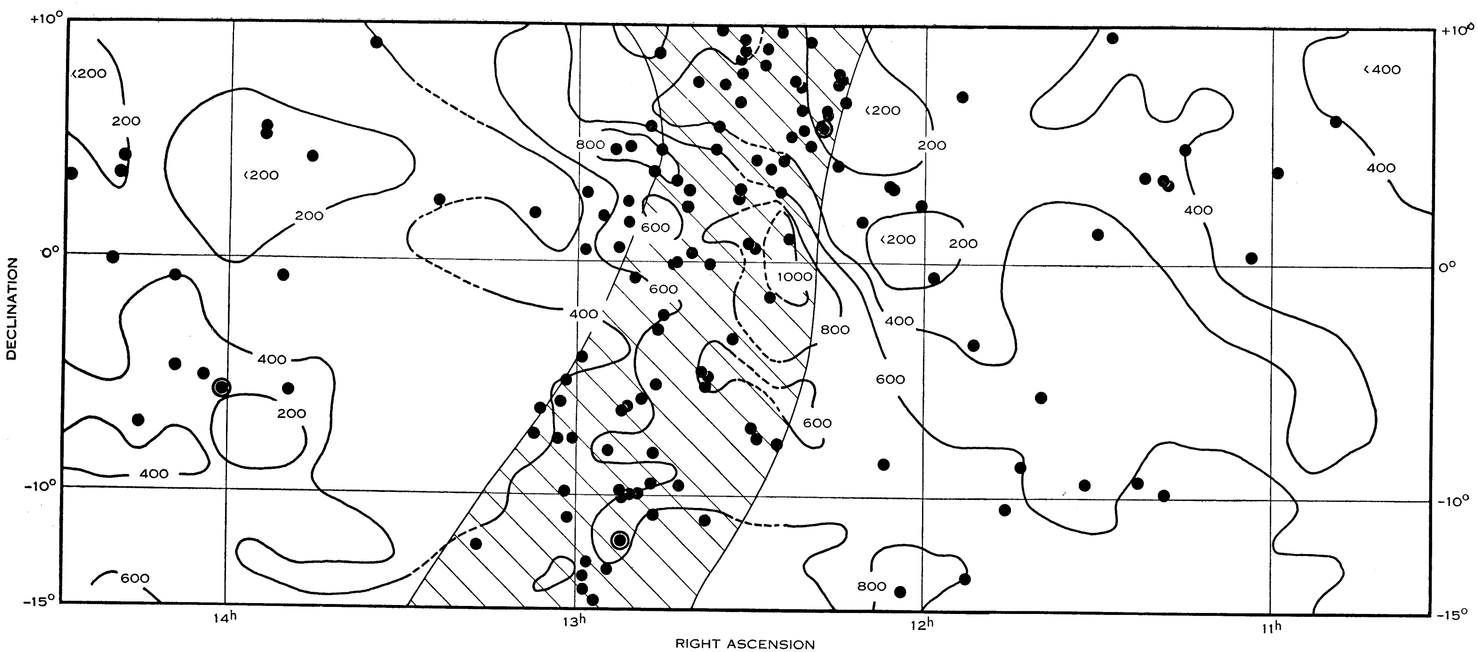

Fig. 1.—The contours shown are of brightness temperature at 3·5 m after a uniform gradient stretching from R.A. 10^h 30^m, Dec. +10° to R.A. 14^h 30^m, Dec. —15° was removed. Contours are broken in areas subject to side-lobe effects of radio sources Virgo-A and Centaurus-A. Dots represent Shapley-Ames galaxies, and when circled represent two galaxies. The shaded region illustrates the band of emission observed by Kraus and Ko.

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of the 3·5 m contours is the band of emission stretching from R.A. 13h 06m at Dec. +10° to about R.A. 11h 32m at Dec. −15°, with a peak near R.A. 12h 24m, Dec. 0°. It is clear that this feature does not conform to the band observed by Kraus and Ko nor does it appear to be related to the bright galaxies. Moreover, at the northern edge of the diagram at R.A. 12h 28m the aerial beam passes within 3° of the supergalactic centre and even here no excess emission is observed.

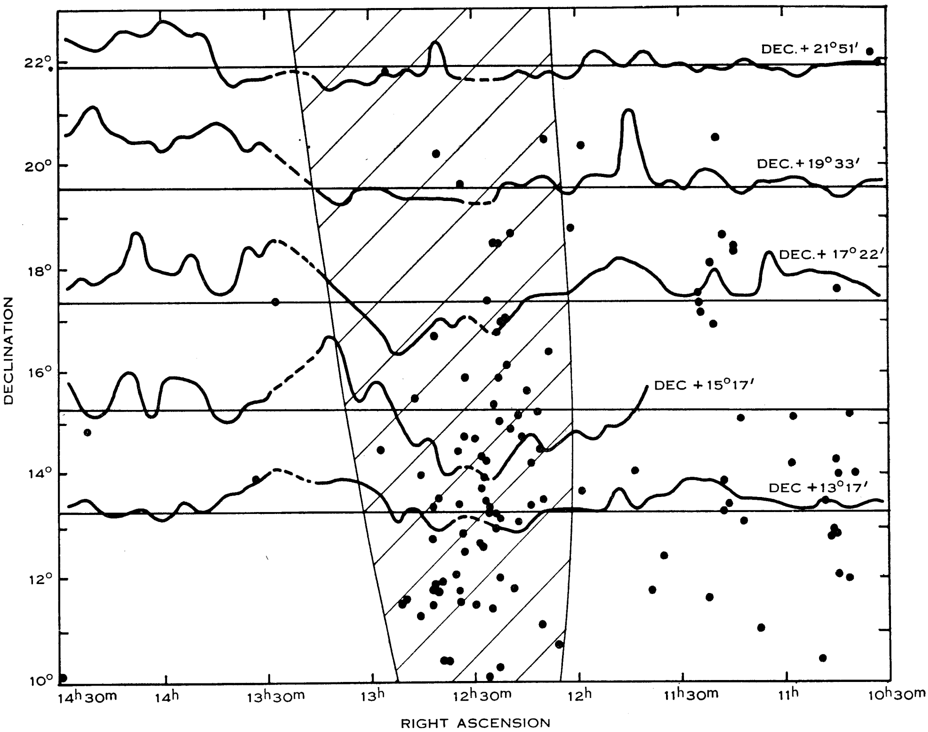

Fig. 2.—The radio band observed by Kraus and the distribution of bright galaxies between Dec. +10° and +23° are shown here in the same manner as in Figure 1. Superimposed are the additional records obtained with the Mills Cross at 3·5 m. The horizontal lines associated with each scan indicate the declination of the scan.

Additional observations at intervals of approximately 2° in declination have been made at 3·5 m from R.A. 10h 30m to 14h 30m between Dec. +10° and +22°. Records so obtained are shown in Figure 2 superimposed on the band of emission observed by Kraus and the bright galaxies in the region. These 3·5 m observations carry less weight than those described above because of the larger zenith distances involved. They do, however, indicate that the feature noted at lower declinations retains its predominance and continues northward towards Dec. +22° at R.A. 14h, and up to this declination continues to show no relation with the bright galaxies. Observations by Blythe (1957) at 8 m also show this feature, and comparison with the present results indicates that the radiation is non-thermal. From the extensive map given by Blythe, it seems possible that the feature is an extremity of the well-known flare emanating from the galactic plane near $l=0°$.

It is clear that between Dec. $-15°$ and $+22°$ emission from the supergalaxy is not apparent at 3·5 m in regions where earlier observations might have led one to expect it. Thus, if radio emission from the supergalaxy does exist in the region discussed, it is overshadowed by the feature described above.

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THE CLOCK PARADOX IN SPECIAL RELATIVITY*

By H. Jeffreys†

Dr. G. Builder (1957) has produced a new analysis of this problem, which is criticized by Professor Dingle (1957). I think that both introduce concealed hypotheses, and that the methods of the special theory cannot produce a unique answer.

Standard works on relativity still start from the postulated invariance of the velocity of light, which can be stated in the form

$$\mathrm{d}s=0 \text{ is equivalent to } \mathrm{d}s'=0 \quad \ldots\ldots\ldots\ldots\ (1)$$

for the observers, and infer that there is a linear relation between the coordinate systems, leading to the Lorentz-Einstein transformation. It was, I think, first shown by E. Cunningham that the conclusion does not follow; there are infinitely many relations that satisfy the equivalence, which do not even need to be linear. I have given additional conditions that are sufficient to lead to the transformation (Jeffreys 1957). The first is that for two observers of the same body

$$\frac{\mathrm{d}^2x}{\mathrm{d}t^2}=\frac{\mathrm{d}^2y}{\mathrm{d}t^2}=\frac{\mathrm{d}^2z}{\mathrm{d}t^2}=0 \text{ is equivalent to } \frac{\mathrm{d}^2x'}{\mathrm{d}t'^2}=\frac{\mathrm{d}^2y'}{\mathrm{d}t'^2}=\frac{\mathrm{d}^2z'}{\mathrm{d}t'^2}=0.\ \ldots\ (2)$$

This amounts to saying that two observers will agree on what particles move with uniform velocity in straight lines. It does not say that there are no other

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