PAPER 30

RADIO AND OPTICAL INTENSITY DISTRIBUTIONS IN THE CENTAURUS SOURCE (NGC5128)

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(1) A preliminary determination of the apparent intensity distribution in the Centaurus source has been made with the 1500-ft. Mills' Cross at 3·5 metres wave-length. At the declination of the source the beam is nearly circular and has a half-power width of 0°.8. Fig. 1 shows contours of apparent equal intensity above a smooth interpolated reference level. The inner 'point' source [1] which is not resolved by the present equipment appears to be embedded in an extended source strongly elongated in position angle 12°. The secondary, isolated maxima and minima of intensity on the major axis of the extended source at distances greater than 1° from the central maximum are probably unreal and may represent side lobes in the diffraction image of the point source.

(2) The optical intensity distribution in NGC5128 was determined from a combination of photographic and photo-electric measurements with the 30-inch Reynolds reflector at Mount Stromlo. Fig. 2 shows the isophotes of the inner globular condensation determined directly on short- and long-exposure photographs in blue light. The unit of B is approximately 21 mag./sq. sec. corresponding to an integrated (total) magnitude of 6·1 (*pg*) for NGC5128.* The intensity distribution in the outer elliptical 'corona' was derived from photo-electric scans along the east–west direction through the nucleus. The photo-electric results agree well with those obtained from tracings of the long-exposure plate along the same direction. In the outer corona the isophotes are very nearly elliptical, with a major axis in position angle 30° and a nearly constant ratio of axes $b/a = 0{\cdot}70$. Beyond $\bar{r} = 10'$, where $\log B = -0{\cdot}85$, the slope of the curve of $\log B$ plotted against $\bar{r} = \sqrt{a \times b}$ is about $-4{\cdot}3$ per degree. Along the east–west

* The results in Fig. 2 are in fair agreement with those of Evans[2].

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direction the nebula has been traced out to about 0°.5 from the nucleus in both directions.

For comparison with the radio data the optical absorption in the dark lane was neglected and the isophotes treated as concentric circles, the hidden central maximum being taken as $\log B = 1 \cdot 0$.

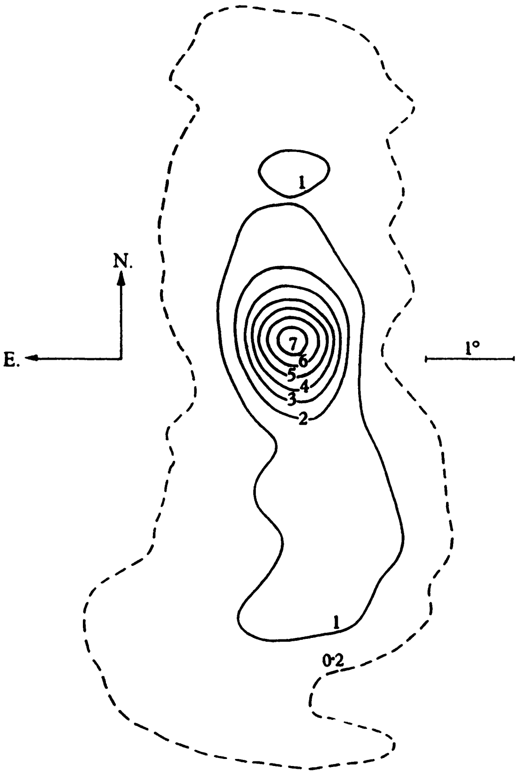

Fig. 1. Apparent radio isophotes of the Centaurus source at 3·5 metres determined with the 1500-ft. Mills Cross aerial at Sydney.

(3) The optical distributions along both the minor and the major axes were smoothed with the aerial beam pattern which can be approximated by a gaussian distribution for $r < 1°$ as drawn in Fig. 3 (small circles). The mean luminosity distribution in the nebula is reproduced on the same scale in the lower left corner of the figure, with the minor (m) and major (M) axes shown separately on a scale enlarged ten times in ordinates beyond $r = 5'$.

The apparent radio and optical distributions as 'seen' by the radio telescope are shown, reduced to a common maximum, for the nebula and the radio source.

(*a*) *The minor axes* of both the nebula and the source are barely resolved by the aerial and they appear to agree with one another within the uncertainty of the data. The hypothesis that the laws of radio and optical emission along the minor axes of the source and the nebula are similar is supported by earlier interferometer observations of the east–west distribu-

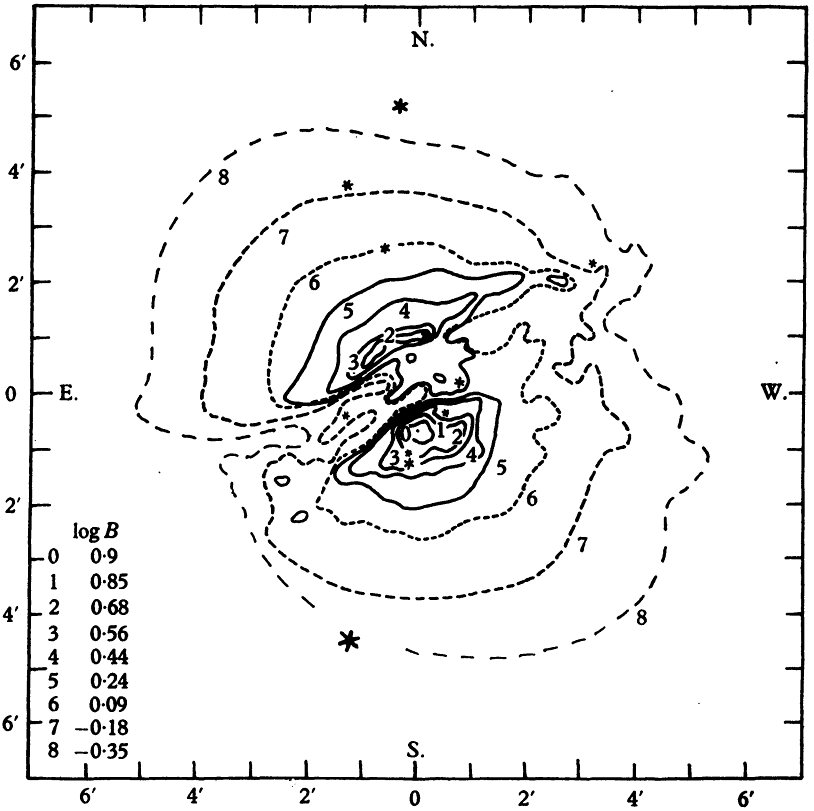

Fig. 2. Optical isophotes of the core of the nebula NGC 5128 in blue light determined on short- and long-exposure photographs taken with the 30-inch Reynolds reflector on Mount Stromlo.

tion across the source by Mills [1]. This is shown by a comparison of the Fourier transform of the amplitude spectrum of the east–west radio interferometer data with the east–west intensity distribution through the nucleus obtained by direct photo-electric scanning at the Cassegrain focus of the Reynolds reflector [3]. The two sets of data are, however, not directly comparable and there is some uncertainty in the interpretation of the radio observations.

(*b*) *The major axes* of the nebula and of the source are both well resolved by the aerial, but the major axis of the source appears much more extended than that of the nebula. The divergence is particularly marked in the outer parts where the radiation comes mainly from the 'corona'; in the inner parts the apparent distribution is dominated by the diffraction

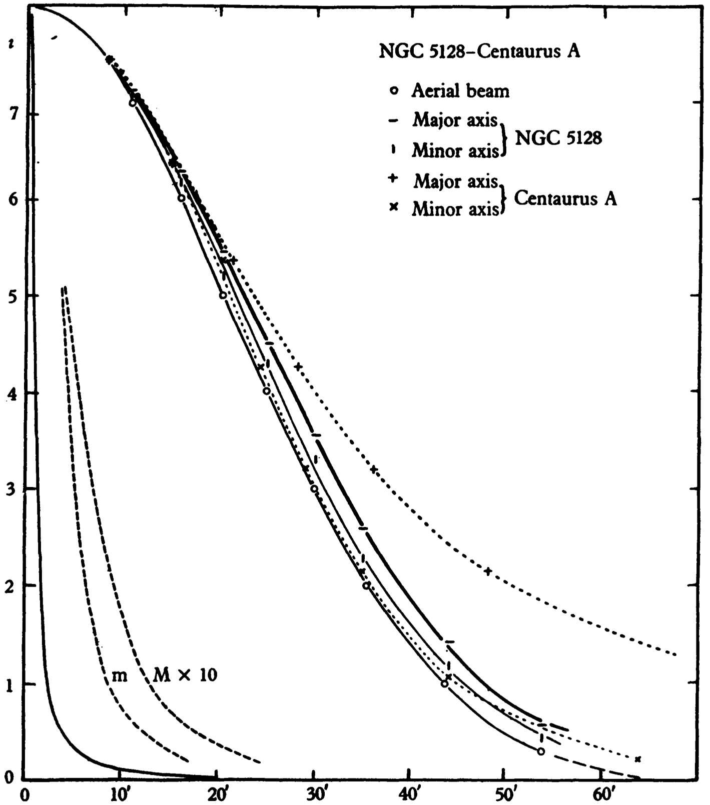

Fig. 3. Apparent intensity distribution along the minor and major axes of the Centaurus source and of the nebula NGC 5128 after smoothing with the 1500-ft. aerial beam pattern.

pattern of the 'point' source where any real discrepancy would tend to vanish. It should be noted that only 2° of the extended source, out of a total length of over 6°, are used here, i.e. a region of fairly high intensity where side lobe effects and uncertainties in the interpolated background should be unimportant.

Dr R. Minkowski has raised, in private discussions before and after the meeting, the question of the reliability of the interpolated background and of the possibility of reconciling the radio and optical distributions by a suitable modification of the background level. The answer to this suggestion appears to be that such an *ad hoc* manipulation of the data would result in producing an extended source of maximum brightness temperature about 2000° K. concentric with Centaurus A and of shape and elongation very much similar to the corona in Fig. 1. Such a coincidence seems at least unlikely, especially when it is recalled that a similar coincidence has been invoked in the case of Fornax A (NGC 1316) which appears to be another example of extra-galactic associations between a point source and an extended source. Fornax A is, however, barely resolved with the present cross-aerial and is too weak for reliable interferometer analysis.

We are indebted to Mr B. Y. Mills for the use of the large cross-aerial and to Dr S. C. B. Gascoigne for that of the Lick photometer on the Reynolds reflector.

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