PAPER 78

THE LUNAR OCCULTATION OF A RADIO STAR AND THE DERIVATION OF AN UPPER LIMIT FOR THE DENSITY OF THE LUNAR ATMOSPHERE

B. ELSMORE
Cavendish Laboratory, Cambridge, England

Observations were made at Cambridge on 26 April 1955 of the lunar occultation of the large-diameter radio source in the constellation of Gemini. This radio source, having R.A. $06^h\ 13^m\ 37^s$ and DEC. $22^\circ\ 38'$ (1950·0), has been identified by Baldwin and Dewhirst (1954) [1] as the galactic nebulosity IC443, which consists of a filamentary structure contained within a circular region of $24'.5$ radius. Baldwin and Dewhirst also succeeded in measuring the distribution of radio 'brightness' across the source using an interferometric method; their measurements indicate that the diameter of the radio source is approximately the same as that of the visible nebulosity.

The position of the moon, as seen from Cambridge on 26 April 1955, in relation to IC443, is shown in Fig. 1. Observations were made at a wave-length of 7·9 metres during the period $16^h\ 05^m$ to $16^h\ 15^m$ U.T., using large fixed-aerial systems. At a wave-length of 3·7 metres the two pairs of the large Cambridge Radio Telescope (Ryle and Hewish, 1955) [2] were used as interferometers of low resolving power. In order to increase the period of observation, phasing cables were introduced into one pair of aerials. In this way it was possible to observe the source continuously from $16^h\ 08^m$ to $16^h\ 35^m$ U.T.

The observed relative intensity showed good agreement with that predicted from the 'brightness' distribution derived by Baldwin and Dewhirst, but the reduction was less. At $16^h\ 30^m$ U.T. a marked discontinuity occurred which corresponded to an increase in radio emission of about 5 %.

This rise might be due to the scattering by the moon's surface of enhanced solar radiation, but the absence of any evidence for solar activity on this day indicates that this explanation is most improbable.

https://doi.org/10.1017/S0074180900049536 Published online by Cambridge University Press

At $16^h\ 30^m$ U.T. the moon's west limb is uncovering a part of the well-defined filament near η Geminorum, as shown in the figure. This indicates that the radio emission may originate mainly in regions of strong H_α emission. This hypothesis is consistent with the evidence from the smaller reduction than predicted near the time of maximum phase, since the moon was then covering relatively few areas of H_α emission.

If the identification of the increase of radio intensity with the uncovering of the bright arch is correct, then their relative times may be used to

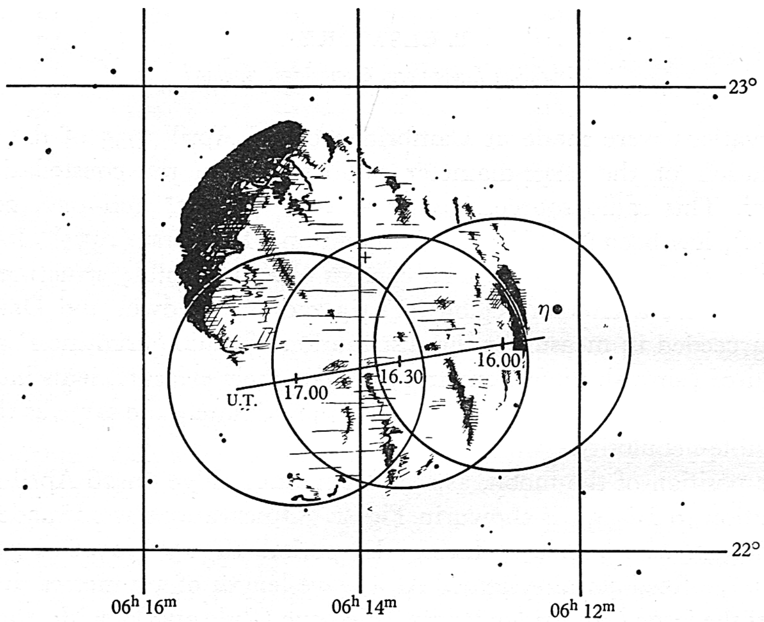

Fig. 1. The moon's position, as seen from Cambridge on 26 April 1955, in relation to IC443.

estimate the density of the lunar atmosphere. Two effects would delay the radio occurrence: diffraction at the moon's limb, which at 3·7 metres wave-length is about one minute of time, and refraction in the lunar atmosphere.

The observations show that the total delay cannot exceed four minutes of time. Using results computed by Link [3] (see also paper 77), the electron density in the lunar atmosphere cannot exceed 10^5 cm.^{3} for a scale height between 50 and 1500 km.

It seems probable that on this sun-lit side of the moon the degree of ionization would be as great as that of the *F*-region of the ionosphere. On this supposition the density of the lunar atmosphere must be less than 10^{-12} of the density of the terrestrial atmosphere at sea level; a figure 1/1000 of the previous upper limit.

REFERENCES

[1] Baldwin, J. E. and Dewhirst, D. W. *Nature*, **173**, 164, 1954.
[2] Ryle, M. and Hewish, A. *Mem. Roy. Astr. Soc.* **67**, 97, 1955.
[3] Link, F. *Bull. Astr. Czech.* **7**, 1, 1956.

Discussion

Hoyle: Would not most of the gas be on the dark side of the moon?

Elsmore: Since the age of the moon was four days, the west limb which uncovered the bright filament is sun-lit and if any gas were present there, it would be ionized. We have no information about the dark side of the moon, but it seems unlikely that the difference in temperature would cause a large difference in density.