and 150°K. The small atmospheric opacity is supported by the absence of appreciable limb darkening in the measurements of Murray, Wildey and Westphal (3). (*Münch* indicated in discussion that the amount of limb-darkening at large air-masses is still questionable).

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13. *A search for Jovian H-alpha auroral activity*

(Abstract of remarks from *Harlan J. Smith*)

Radio observations, particularly at decametric wavelengths, have shown the existence of strong Jovian radiation belts. Dumping of such particles into the Jovian atmosphere must occur from time to time, if not continuously, presumably producing a Jovian analogue to terrestrial auroras; optical detection of such auroras would permit direct location of Jupiter's magnetic poles.

Search for Jovian auroral activity was undertaken at Yale originally in the H-alpha line among other reasons because the Balmer lines are relatively conspicuous in many terrestrial auroras and because hydrogen is presumably an abundant constituent of Jupiter's atmosphere. A photo-electric comparison spectrophotometer largely designed and constructed by James Rodman (1) was used with the Yale Observatory 20-inch reflector to compare 15Å centered on H-alpha with a pair of flanking 100Å comparison bands having edges separated 40Å from the edges of the H-alpha band. Separate EMI 9558 photomultipliers simultaneously registered the H-alpha and the combined comparison beams, reading into pulse-counting electronics, normally with 2-minute integration times.

Observations were made by setting the edge of a 6 second square slit barely onto the limb of Jupiter at a well-defined position angle on the apparent disk, with subsequent readings advancing by 22°·5 around the limb. In this way the maximum light path through Jupiter's atmosphere was continually sampled over the complete range of latitudes and, with the rotation of Jupiter, over all longitudes. Calibrated reduced ratios of H-alpha intensity to the adjacent continuum were mapped by computer onto a Jovian coordinate system.

More than 3000 observations over the period August–December 1962 (Smith, **2**, 3) gave H-alpha intensity maps showing no significant average systematic enhancement of H-alpha as great as ·003 over any latitude belt or any small circle that might reasonably be interpreted as an auroral ring surrounding a magnetic pole. That is, this program detected no continuous auroral enhancement of the H-alpha light reflected from the Jovian atmosphere as great as an average of about 3 kilorayleighs.

Factors which may contribute to this failure to detect Jovian auroras to this reasonably high level of sensitivity include the low state of solar activity in late 1962, the possibility that auroras may physically be a night (back-side) phenomenon, and (as suggested by Spitzer) the hydrogen present in Jupiter's atmosphere and ionosphere may be almost entirely molecular.

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DISCUSSION

Münch et Smith: La valeur de 3 kilorayleighs justifie l'échec à l'égard de la détection d'aurores probablement à cause de la présence d'hydrogène moléculaire ionisé sur Jupiter.

Menzel: Est-ce qu'on observe des aurores sur Jupiter lors d'une éruption solaire?

H. J. Smith: On n'a rien observé.

14. *A further search for Hα aurorae on Jupiter*

J. V. Jelley

Continuing our search (1) for Hα emission aurorae from Jupiter, which it is felt might exist in association with the decametre radio storms (at least if we assume these originate down at ionospheric levels), experiments were carried out at the Observatories, Cambridge, during the Opposition of 1962, and at the University Observatory, the Department of Astrophysics, Oxford, during the Opposition of 1963.

Cambridge (1962). *D. W. Dewhirst, R. F. Griffin, J. V. Jelley, and A. D. Petford*

(1) Equipment. A 15-inch refractor fed from a siderostat was used in conjunction with a two-channel photo-electric photometer, the light being switched alternately, at 1 cycle per second, through two interference filters, and detected in a single cooled phototube with a tri-alkali cathode, and used in conjunction with a photon pulse counting system.

The signal channel filter had a bandwidth of 12 Å and could be 'tuned' from Hα, at λ 6563 Å, to λ 6547 Å, while the reference channel filter was fixed at λ 6440 Å, with a passband of 20 Å.

Since in 1962 the orientation of the planet's magnetic axis had barely been established, the observations with this instrument were made through an input slit of width 0·043 mm and length 1·2 mm placed centrally on the meridian of the planet's primary image, whose equatorial diameter was 1·04 mm. The observations were made between September 13 and October 9 and no attempt was made to correlate them with periods of known radio-storm activity. If γ is the ratio of the light in the Hα channel to that in the reference channel, with the signal channel 'on tune', to the same quantity with the signal channel 'off tune', it was found that when averaged over the whole System III longitude range, $\gamma = 0{\cdot}8870 \pm 0{\cdot}0012$. The difference between this quantity and unity is consistent with the depth and width of the reflected solar Hα absorption line, taking into account the width of the signal-channel filter. We assumed that any auroral activity would appear approximately in the same longitude range as the storm activities, namely λ (System III, 1957·0) = 227°, with an effective $\Delta\lambda$ of ± 22°, which figures were the mean of observations by several radio groups. In this longitude range it was found that $\gamma = 0{\cdot}8894 \pm 0{\cdot}0018$. From these figures for γ, we deduce that any excess Hα emission within the main lobe of the decametre radiation can only have an intensity of (0·27 ± 0·25) per cent of the reflected-light continuum within the narrow strip accepted by the input slit, and covering the full range of latitude on the planet.

These experiments were complementary to others carried out previously (2) (3) (4), all of which have also failed to detect an Hα aurora. In contrast to the works (3) and (4), our limiting sensitivity was lowered by the decision to embrace all latitudes on the planet simultaneously, thus diluting any Hα enhancements restricted to auroral zones. Our light collection and resolution were, however, comparable, to that used in (3) and (4), with the grating instrument described elsewhere (5).

(2) An entirely different type of experiment was then attempted, in November 1963, using the three-channel photo-electric spectrograph at the coudé focus of the 36-inch reflector (6).