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).

It was considered worth while to investigate the possibility that the van Allen belt particles associated with the decimetre radiation (7) might excite Hα in the outer exosphere of the planet, where the relatively low particle flux and low gas densities might produce only a weak aurora, but one which might be observable in 'off-limb' observations, for which the background radiation, in the absence of the planet's direct light, was found to be ~ 1/600 of that on the disk of the planet. In this experiment we were seeking Hα enhancement off the equatorial rather than the polar limbs.

A circular aperture of diameter 0·97 mm was placed at the position of the entrance slit of the spectrograph, and the 1·04 mm diameter primary image of the planet was guiding so that its tangent was 0·3 of the planet's radius from the tangent to this input aperture. With this arrangement, at a dispersion of 6·5 Å/mm at Hα, the resolution was 6·0 Å, while the two reference channels were each of width 20 Å. The results for the ratio ($\times 10^3$) of the light in the signal to that in the reference channels are listed below.

Off-limb position		N	f	S	p
Nov. 19		996	1003	996	1004
Nov. 22		978	994	1017	1011
Combined Nov. 19		polar	9963	equatorial	10037
Combined Nov. 22			9975		10025
	Total		9969		10031

It is not possible to quote errors since these were non-statistical, but it is clear that there is no enhancement over the equator, or over the poles, which is significant at the existing sensitivity limits.

Oxford (1963). *J. V. Jelley and A. D. Petford*

In the belief that an Hα auroral emission from the planet would be expected to have a line-width narrow compared with the reflected Hα solar absorption profile, it was decided to have a further attempt, to search for any 'filling up' of the solar Hα line, using a much higher dispersion. With the high resolution solar spectrograph at the observatory, photo-electric scans were made over a 7 Å band centred on Hα, using again a cooled phototube and pulse-counting. The diameter of the planet's image was 4·3 mm, and a circular entrance aperture of diameter 1·26 mm was automatically guided to straddle the limb of the planet. With an effective entrance-slit width of 0·52 mm, and an exit slit of width 0·61 mm, a resolution of 0·41 Å was obtained at a dispersion of 0·29 Å/mm, with a 600 line/mm Babcock grating operating at fourth order. With the aperture placed centrally on the disk line profiles were taken from 10 scans, and were found to fit closely the profile of the solar Hα line as published in the Utrecht Atlas.

Six scans were then made over ± 1 Å from the Hα wavelength corrected for orbital Doppler shift, from light accepted from the polar limbs. In this experiment, owing to limb-darkening, it was found that the emission over this band was only (10 ± 3) per cent of that from the centre of the disk, at a wavelength of −3·3 Å from the line-centre wavelength (i.e. close to the continuum level). There was no detectable enhancement within this 2 Å band.

In conclusion, in view of Öpik's view (8) that ~ 97 per cent of the atmospheric content of Jupiter is He, a limited number of scans were carried out on the He I lines at 6678 Å, and 5876 Å again without any positive results.

We would like to suggest finally that an experiment should be done in which short-exposure spectrograms are taken on the polar regions with an instrument of high light-grasp at high resolution, possibly with the aid of an intensifier, and that these exposures should be triggered directly from adjacent radio-storm detecting equipment.

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Session scientifique II

NATURE ET STRUCTURE DU SOL LUNAIRE

1. *Radiometric and photometric mapping of the Moon through a lunation*

R. W. Shortill, J. M. Saari

Measurements

Mapping of the illuminated lunar disk has been accomplished simultaneously at two wavelengths for more than 20 phases of the Moon. Isothermal and isophotic contours are produced which can be related to visible surface features. The specific goals of the program are:

(1) To investigate the radiometric properties of the lunar surface.
(2) To provide more photometric information taken photo-electrically.
(3) To investigate the relationship between albedo and surface temperature.
(4) To follow the temperature curves of specific areas of interest such as rayed craters.
(5) To search for areas which are thermally anomalous under illumination. A photomultiplier was used for measuring the reflected light, its peak response chosen to be 4450 Å corresponding to that used by Rougier in his measurements of the light curve for the illuminated disk as a function of phase. The photometric data from each complete scanning can be integrated and normalized to his curve. A mercury doped germanium photodetector, cooled to liquid hydrogen temperature, was used with a 10–12 micron filter and calibrated with black bodies at known temperatures. Corrections for atmospheric transmission can be made using ground and balloon-sonde meteorological data.

Both detectors had a spatial resolution of 8″ of arc and were placed at the Newtonian focus of the Mount Wilson 60-inch telescope. The Moon was scanned at 530″ of arc per second of time with a separation between scan lines equal to the aperture diameter; therefore the entire lunar disk was covered, a full Moon requiring about 240 scan lines.

It took a half hour or less to perform a scan program, depending on the phase of the Moon and the orientation of the scanning device. The signals were recorded in analog form on magnetic tape for subsequent data reduction by an IBM 7094 computer, giving position versus brightness temperature and light intensity to a scale such that $\frac{3}{8}$ inch is equal to 8″ of arc. Four or five pairs of contours have been reduced. It will require about a year to process and construct all the isothermal and isophotic charts.

Thermal anomalies

While the above measurements were being made, it was possible to make some infra-red measurements on the dark side of the Moon with minor modifications to the equipment. Thermal anomalies were found on the rayed craters Proclus and Strabo, in agreement with