No. 5 A SEARCH FOR EMISSION IN THE NIGHT SKY OF VENUS

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IN March of 1953, N. A. Kozyrev (1954) obtained a spectrum of Venus showing emission lines, some of which he attributed to the presence of N_2^+ in the night sky of that planet. In 1958, G. Newkirk (1959), using a specially designed instrument, was only able to confirm two of the lines observed by Kozyrev, neither of which could be identified. In addition, he found a band at λ4510 not mentioned by Kozyrev. A re-examination made the following year by Weinberg and Newkirk (1961) with increased dispersion and widened spectra gave "no evidence for the existence of emission lines on the unilluminated portion of the disk." E. H. Richardson (1960) has also reported negative results. Because of these conflicting reports, it was felt that the problem should be reconsidered in the hope that additional data might help at least to clarify some of the reasons for the disagreement.

With this end in mind, an attempt was made to carry out the observations in much the same manner as in the original work. To obtain his (single) spectrum, Kozyrev used a quartz spectrograph with a dispersion of 150A/mm (Hβ) at the Cassegrain focus of the Crimean Observatory's 50-inch reflector. Part of the spectrograph slit was covered with a screen on which the bright crescent of the planet was projected in such a way that the unilluminated portion of the planet's disk was bisected by the uncovered part of the slit. The present observations were made with the 36-inch reflector of the Kitt Peak National Observatory. The Cassegrain grating spectrograph uses an f/1.2 flat-field Schmidt camera and gives a dispersion of 127A/mm in the second order blue. Instead of simply obscuring part of the slit, however, a narrow strip of material was placed across it, having a width just sufficient to prevent light from the crescent from entering the spectrograph directly, as indicated in Fig. 1. The advantage of this technique is that a spectrum consisting only of scattered light from the bright crescent is available for comparison with the spectrum which should include scattered light plus emission. The two spectra are obtained simultaneously and hence under identical conditions.

The observations were made both before and after inferior conjunction (April 10, 1961) although bad weather prevented the acquisition of a good series before conjunction when the planet's position in the sky was more favorable. A total of 10 spectra was obtained, as shown in Table 1. A sample spectrum is reproduced as Plate 5.1. The spectra were examined microscopically and by means of microdensitometer tracings, the region covered being 3500-4900A. A careful comparison of the two spectra obtained in each case failed to reveal any emission lines.

TABLE 1
Spectra of Venus

No.	Date (U. T.) 1961	H. A. (End)	Exposure (Min.)	Emulsion	k*
1	Mar 17.085	$5^h\ 10^m$ W	5.0	IIa-0	0.174
2	.092	5 22 "	1.0	103a-0	
3	.093	5 26 "	3.0	"	
4	.095	5 37 "	9.0	"	
5	.103	5 59 "	12.7	IIa-0	0.119
6	May 1.476	5 56 E	3.0	"	
7	.478	5 52 "	3.0	"	
8	10.464	5 39 "	9.0	"	0.202
9	.469	5 26 "	9.0	"	
10	.476	5 15 "	5.0	"	

* k is the ratio of the area of the illuminated portion of the apparent disk to the area of the entire apparent disk regarded as circular (*Am. Eph. and Naut. Al.* p. 321, 1961).

In attempting to interpret this result, the first thing to consider is the difficulty of the observation. The essential problem is the presence of scattered light from the bright crescent. Newkirk's instrument (1959) was specifically designed to minimize this; for the work presented here an effort was made in this direction by washing the surface of the 36-inch mirror prior to the post-conjunction run of observations. As is evident from the exposure times in Table 1, a large amount of scattered light was, nevertheless, still present. This adds to the second major difficulty in this work, the analysis of the observations. Thus a casual inspection of the dark-side spectrum could lead one to believe that it contained emission lines, but a comparison with the scattered light spectrum indicates that these features are due to rises in intensity between (or at the edges of) narrowly spaced absorption lines. It is conceivable that such features could be mistaken for emission lines if a comparison spectrum were not available. As Newkirk (1959) has pointed out, the N_2^+ bands expected to be most prominent in this region (3914 and 4278A) both fall on 'shoulders' of strong solar absorptions (3934 and 4308A, resp.) making positive identification particularly difficult.

One is thus led to the double conclusion that not only is the presence of emission in the Venus night sky still an unsolved problem, but that the possibility of obtaining unequivocal evidence regarding such emission by the methods described above seems unlikely unless the emission is exceedingly strong. (Kozyrev 1954, and Newkirk 1959, give estimates of intensity of 50 and 80 resp. times the intensity of the 5577A line in the terrestrial night airglow. In both cases the identifications may be regarded as marginal.) The next step would seem to be the application of a new, more sensitive technique with which one could make a definitive, quantitative test for the presence of emission. Such a technique has been proposed by A. B. Meinel (1962) for use during the next elongation and it is to be hoped that results obtained at that time will be conclusive.

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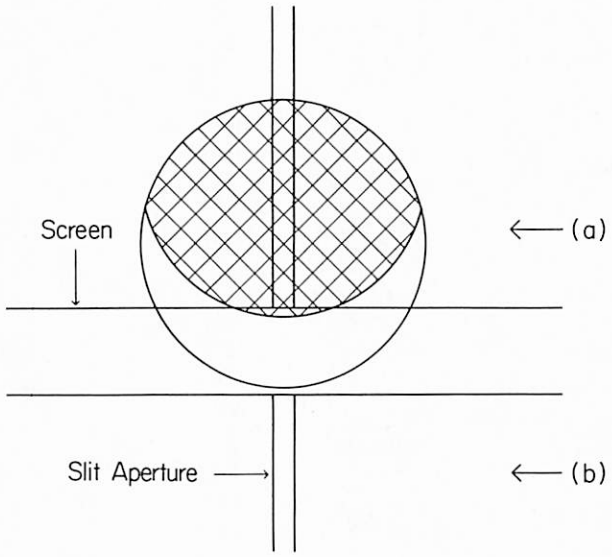

Fig. 1. Arrangement of screen across spectrograph slit for production of double spectrum. The dark-side spectrum (scattered light plus emission) is obtained at (a); the comparison spectrum (scattered light only) at (b).

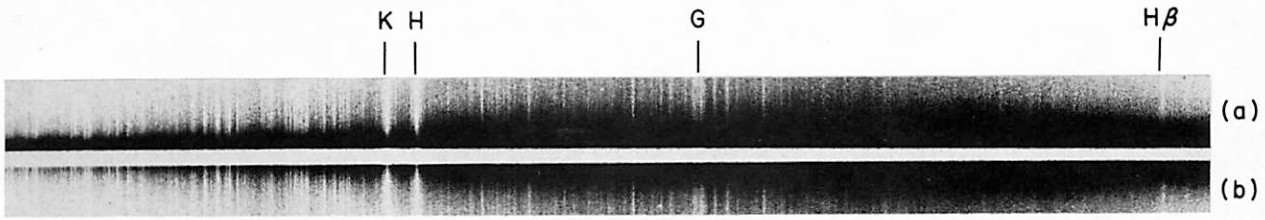

Plate 5.1. Spectrum 5 showing (a) the dark-side spectrum and (b) the comparison spectrum.