

# CHARACTERIZATION OF THE FAR-ULTRAVIOLET SPECTRUM OF Pt/Cr-Ne HOLLOW CATHODE LAMPS AS USED ON THE SPACE TELESCOPE IMAGING SPECTROGRAPH ON BOARD THE *HUBBLE SPACE TELESCOPE*<sup>1</sup>

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## ABSTRACT

We report laboratory measurements to characterize the spectral output of platinum/chromium hollow cathode lamps containing neon carrier gas. The spectra were recorded photographically with the National Institute of Standards and Technology 10.7 m normal-incidence spectrograph. The lamps investigated are equivalent to the lamps used for wavelength calibration of the Space Telescope Imaging Spectrograph (STIS) on board the *Hubble Space Telescope*. Wavelengths and intensities are given for more than 1200 lines in the wavelength range 1132–1827 Å. The uncertainty of the measured wavelengths is estimated to be  $\pm 0.0020$  Å. During an aging test mimicking the operations on board STIS one Pt/Cr-Ne lamp has passed 1000 hr of operation and is still in excellent working condition. This suggests that such a lamp can be operated for significantly more than 10 years and that it will not be a limiting factor for the useful lifetime of STIS.

*Subject headings:* line: identification — methods: laboratory — space vehicles: instruments — standards — techniques: spectroscopic — ultraviolet: general

*On-line material:* machine-readable table

## 1. INTRODUCTION

The selection of wavelength calibration lamps for use in space observatories is based on practical considerations such as size, weight, power consumption, ruggedness, and lifetime, but most importantly the lamp has to provide a very rich spectrum in the range of the spectrograph. Based on these considerations a Pt-Ne hollow cathode lamp was chosen as the on-board emission line source for wavelength calibration for the *International Ultraviolet Explorer (IUE)*, which had a wavelength range of 1130–3100 Å. See Mount et al. (1977) and Fastie & Mount (1978) for details. The lamp worked successfully throughout the entire 18 year lifetime (1978–1996) of the *IUE*, and similar devices were therefore chosen for spectrographs on board the *Hubble Space Telescope (HST)*—the Goddard High Resolution Spectrograph (GHRS; Brandt et al. 1994; Heap et al. 1995), the Faint Object Spectrograph (FOS; Harms et al. 1979; Harms & Fitch 1991), the Space Telescope Imaging Spectrograph (STIS; Woodgate et al. 1998; Kimble et al. 1998), and the Cosmic Origins Spectrograph (COS; Green 2001). See Macchetto (2002) for a brief review of *HST*'s major scientific achievements.

In the mid 1980s, the unprecedentedly high spectral resolution of the GHRS (a few parts in  $10^6$ ) caused some concern

about the accuracy with which wavelengths and intensities of the Pt emission lines in the calibration source were known. It turned out that the best available values dated back to the 1930s and that their quality was not sufficient for use with GHRS. This vital issue was subsequently addressed by the work of Reader et al. (1990) for the Pt-Ne lamp; see their work and references therein for earlier work on the spectrum of Pt.

The spectral output of Pt-Ne lamps is, however, not well suited for the broad wavelength range of a UV-optical spectrograph such as the FOS. Pt has many emission lines from 1130 up to about 3200 Å, and Ne is prominent between 5400 and 8000 Å. This leaves a gap in wavelength coverage of more than 2000 Å. This problem can be resolved by the addition of about 10% Cr to the cathode, which yields a rich spectrum from the far-UV up to  $\approx 5500$  Å. As a result a Pt/Cr-Ne lamp provides a continuous distribution of suitable emission lines for the full range 1150–8000 Å (Klose & Bridges 1987). In preparation for the launch of the *HST* the performance and operational characteristics of the hollow cathode lamps were verified to the extent that their use as secondary radiometric standards was suggested (Klose et al. 1990). Unfortunately, no complete description of the spectrum of these lamps has been published. Although the FOS carried the Pt/Cr-Ne lamp variant, the pure Pt line list has been the basis for wavelength calibration of *all* spectrographs on board *HST*.

The Space Telescope Imaging Spectrograph (STIS) is a second generation *HST* instrument, replacing both GHRS and FOS. It was installed on the *HST* during the second servicing mission (STS-82) in 1997 February. STIS (Woodgate et al.

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1998; Kimble et al. 1998) is the first *HST* spectrograph to provide high-resolution modes ( $R \approx 100,000$ ) as well as large spectral coverage (1150–11000 Å). Like the FOS, STIS has on-board Pt/Cr-Ne lamps for wavelength calibration. During the Post-Operational Archive (POA) project (Rosa 2000), conducted at the Space Telescope European Co-ordinating Facility (ST-ECF), it was already realized that the Pt-Ne line list was—quite naturally—not a good match to the Pt/Cr-Ne lamp spectra of FOS. However, at the lower resolution ( $\approx 1000$ ) of the FOS an adequate wavelength calibration using Pt lines only was possible over most of the wavelength range.

For the STIS Calibration Enhancement (STIS-CE) effort we use a physical instrument model that describes the configuration of the optical elements and the geometrical distortion. In order to fully exploit the capabilities of the model description for wavelength calibration, it is essential to have a complete and accurate line list. This is of particular importance for the STIS Echelle modes, for which it is vital to use lines all across the two-dimensional detector and to have a reasonable number of lines in every order. For Cr the lack of accurate and reliable data was acutely apparent. The best available sources are two publications by Kiess (1951, 1953) on Cr II and Cr I, respectively. For the STIS calibration enhancement the available data are of little use, since the Cr wavelengths for most lines are reported to only 0.01 Å and cover only the wavelength region redward of 2000 Å.

We therefore embarked on a project to fill this gap in our understanding of the spectral output of the Pt/Cr-Ne lamp and provide the laboratory standards that are necessary to achieve the wavelength scale accuracy STIS is potentially capable of. The present paper is concerned with the wavelength range 1150–1800 Å covering the far-UV (FUV) modes of STIS.

## 2. EXPERIMENT AND RESULTS

The spectra were photographed on the 10.7 m normal-incidence vacuum spectrograph at the National Institute of Standards and Technology (NIST). This is the same instrument used by Reader et al. (1990) to measure the wavelengths and intensities of the emission lines of the Pt-Ne hollow cathode lamp. An illustrated description of the experimental setup is given in Kerber et al. (2003). For the present work we used a gold-coated grating having 1200 lines  $\text{mm}^{-1}$ , blazed at 1200 Å in the first order. The region from 1115 to 1827 Å was recorded in the first order on Kodak SWR plates.<sup>4</sup> The plate factor was 0.78 Å  $\text{mm}^{-1}$ , and the resolving power was approximately 100,000.

Three types of sealed hollow cathode lamps were used: Pt-Ne lamps, Pt/Cr-Ne lamps, and Cr-Ne lamps. Two of the Pt/Cr-Ne lamps were lamps that had been used for tests of spectrographs on *HST* before it was launched in 1990. They had been stored at the NASA Goddard Space Flight Center and were transferred to NIST for this experiment. We also used new lamps of all three types manufactured by Imaging and Sensing Technology.<sup>4</sup> Some of the lamps had magnesium fluoride windows cemented directly to the front of the glass envelope with epoxy cement (types WL23502, WL23505, and WL34045). Others had magnesium fluoride windows mounted on a Kovar flange at the front of the lamp (types WL34046

and NY10527), as shown in Figure 1 of Mount et al. (1977). This latter design is practically identical to the lamps used on board STIS. The region of observation at the short-wavelength end is limited by the transmission of the magnesium fluoride window, which decreases rapidly at wavelengths shorter than 1200 Å and cuts off at approximately 1130 Å.

The lamps were mounted to the slit region of the spectrograph by an adapter flange to which was attached a flexible bellows and stainless steel quick-disconnect. Lamps with epoxied windows were inserted directly into the quick disconnect. For lamps with Kovar flanges, an o-ring seal glass joint was inserted into the disconnect. The flange of the lamp was pressed against the o-ring and clamped in place with a specially constructed fixture. With this arrangement, the lamps could be centered on the entrance axis of the spectrograph. Centering of the lamps on the spectrograph axis was carried out by illuminating the grating with light from the lamp and viewing the direct image in the plate chamber through a window in the valve between the plate chamber and evacuated main vacuum chamber of the spectrograph. The lamp was adjusted so that the image was centered vertically between the masks used to define the vertical extension of the lines.

The lamps were operated at a current of 20 mA, which is the recommended maximum operating current for these lamps. This was the current used by Reader et al. (1990). In actual service on *HST*, in order to maximize lifetime, the lamps are operated at a current of only 10 mA. To check a possible difference in the spectrum at these two currents, we photographed the spectrum at both 20 and 10 mA. Exposure times were normally 3 hr at 20 mA and 24 hr at 10 mA. These times produced approximately equal exposures for lines of Pt II. The most significant difference noted was the relative enhancement of lines of Ne II in the 10 mA spectra as compared with those recorded at 20 mA. Figure 1 shows a tracing of the spectrum of a Pt/Cr-Ne lamp in a region near 1420 Å, where this enhancement is apparent. Lines of Pt I were found to be slightly enhanced at the lower current. Wavelengths of the spectral lines display no detectable shift with discharge current at these low currents.

The plates were measured on a semiautomatic comparator. Both 10 and 20 mA exposures were measured, but our final wavelengths are based almost entirely on the 20 mA exposures. The spectra photographed at 10 mA did not appear as sharp owing to a slight instability of the spectrograph over the very long exposure time required at this current. Results for about 90 lines, mostly Ne II and Ne III, that did not appear in the 20 mA exposures are taken from the 10 mA spectra. The positions of the lines were reduced to wavelengths by using a polynomial fit to standard wavelengths of Pt as given by Reader et al. (1990). From the residuals in the fit of the polynomial to the standard lines, we estimate that the measured wavelengths have an uncertainty of about 0.0020 Å (one standard deviation). Intensities for all lines were derived from microdensitometer tracings of the 10 mA spectra. The heights of the lines measured from the tracings were converted to relative intensities by use of a characteristic curve to correct for the nonlinear response of the photographic emulsion and the wavelength dependence of the spectrograph efficiency. This characteristic curve was determined empirically by comparing the heights of Pt II lines from the photometric trace with the intensities of the same lines in the Pt atlas of Sansonetti et al. (1992).

Table 1 gives the wavelengths, wavenumbers, and relative intensities for lines emitted by the Pt/Cr-Ne lamp from 1130 to

<sup>4</sup> Certain commercial equipment and materials are identified in this article to adequately specify the experimental procedure. Such identification does not imply endorsement by the National Institute of Standards and Technology, nor does it imply that they are the best available for the purpose.

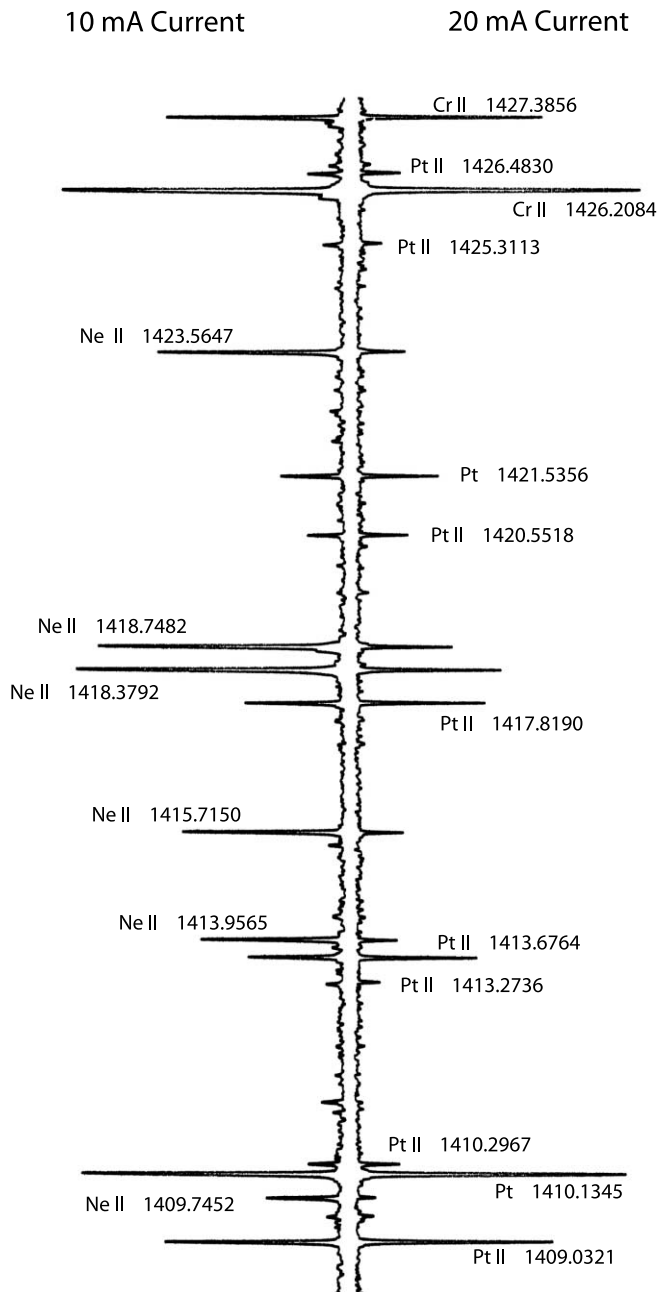


FIG. 1.—Tracings of the spectrum of a Pt/Cr-Ne hollow cathode lamp operated at 10 mA (*left panel*) and 20 mA (*right panel*) around 1420 Å. Lines of different species are identified with wavelengths given in Å. Note that all Ne II lines are enhanced relative to the Pt II in the 10 mA spectrum.

1828 Å. The intensities have been adjusted to the same scale used in Sansonetti et al. (1992). Since the intensities were obtained entirely from photographic observations, the results for very strong and very weak lines may be affected by saturation or threshold effects in the photographic emulsion. Lines belonging to Pt, Cr, and Ne were distinguished by comparing the spectra obtained with the three types of lamps. Line identifications for the Pt and Ne lines are given in the atlas of Sansonetti et al. (1992). The identified lines of Cr all belong to Cr II. Since a description of the Cr II spectrum in this region has not yet been published, we obtained classifications for the lines by using the levels of S. Johansson given in the compilation of atomic energy levels by Sugar & Corliss

(1985) to predict the wavelengths for Cr II in the 1100–1800 Å region. This provided probable identifications for most of the lines attributed to Cr. A few lines may be blends of two predicted transitions, and these are noted as such in the table. Wavelengths for Pt and Ne lines as given by Sansonetti et al. (1992) are also given for comparison in Table 1. These values should be preferred to our present measurements for lines emitted from a Pt-Ne lamp.

A number of contaminant lines are present both in the laboratory spectra and in the STIS spectra. While we have not made an exhaustive study, the contaminants are generally fainter in the STIS spectra, presumably because extra care was taken during the manufacture and selection of the flight lamps. The laboratory and STIS spectra show some differences in the relative intensities of lines. Some of these differences are directly attributable to the current used for operation. Others may be the result of aging of the STIS lamps. In order to investigate these effects we have taken a series of spectra with a NIST Fourier transform spectrometer at currents ranging from 3.8 to 30 mA. These results will be presented elsewhere. In addition, spectra were acquired of the only hollow cathode lamps that have been returned from space after extensive use on orbit (Kerber & Wood 2004). The lamps from FOS and GHRS provided good spectra that will be compared with the prelaunch data and archived orbital spectra to study the effect of aging. These results will also be published elsewhere.

As a further comparison of the far-UV spectra obtained at different currents, we took a few additional spectra at a current of 40 mA. As expected, the main difference in the spectra is the intensity. We estimate that the increase in intensity for the lines of Pt and Cr compared with operation at 10 mA is a factor of 8 for 20 mA, and a factor of 25 for 40 mA. At this higher current the lines of Ne II are further suppressed with respect to the metal lines.

Figure 2 illustrates the impact of the addition of the Cr lines on a STIS Echelle (mode G140H) wavelength calibration exposure. A significant number of previously unidentified lines in the spectrum are emitted from singly ionized Cr (*red squares*). These lines can now be used for wavelength calibration. This is of particular importance when few Pt lines are present in a single Echelle order, see both Figures 2a and 2b. Some of the Cr lines are rather prominent (Fig. 2b, orders 293–295). These closely spaced lines around 1430 Å had been seen as an unidentified broad feature in low-resolution FOS and STIS spectra; see Figure 12 in Kerber et al. (2003) for a STIS sample spectrum. Their presence was one of the indications that a project to properly characterize the Pt/Cr-Ne lamp spectrum was warranted. These particular lines have also been found in absorption in the solar spectrum (Johansson 1982). The region between 1430 and 1500 Å, which will benefit most from the availability of the Cr lines for calibration purposes, contains a number of lines of astrophysical interest. Most notable are the S I lines, which have a number of applications ranging from chromospheric emission from late-type giants (Judge 1988) to studies of the ISM (Federman & Cardelli 1995; Biémont et al. 1998) to comets (Feldman et al. 1991) and the volcanos of Io (Feaga et al. 2002).

It is also interesting to note that in the new Pt/Cr-Ne spectra some of the faintest Pt lines could not be observed (Fig. 2, *green squares*). The reason for this is purely technical. The photographic plates used for the observations are more than 10 years old, and their sensitivity has declined over time. Since they are no longer being produced, and since no plates with

TABLE 1  
EMISSION LINES FROM A Pt/Cr-Ne HOLLOW CATHODE LAMP OPERATED AT 10 mA

| Wavelength Pt Atlas<br>(Å) | Wavelength<br>(Å)      | Wavenumber<br>(cm <sup>-1</sup> ) | Intensity<br>(Arb. Units) | Comment | Species | Even-Odd           |
|----------------------------|------------------------|-----------------------------------|---------------------------|---------|---------|--------------------|
| 1131.87.....               | 1131.8512 <sup>a</sup> | 88350.84                          | 370                       | G       | Ne II   | ...                |
| 1135.4782.....             | 1135.4776              | 88068.67                          | 770                       |         | Pt II   | 13329-101397       |
| 1138.83.....               | 1138.8112              | 87810.87                          | 650                       |         | ...     | ...                |
|                            | 1139.3643 <sup>a</sup> | 87768.24                          | 710                       |         | ...     | ...                |
| 1141.8885.....             | 1141.8912              | 87574.01                          | 1800                      |         | Pt II   | 13329-100903       |
| 1143.2957.....             | 1143.2984              | 87466.23                          | 6700                      |         | Pt II   | 13329-100795       |
| 1145.7055.....             | 1145.7111              | 87282.04                          | 980                       |         | Pt II   | 13329-100611       |
| 1150.1564.....             | 1150.1550              | 86944.80                          | 1700                      |         | Pt II   | 18097-105042       |
| 1150.6130.....             | 1150.6110              | 86910.35                          | 7900                      |         | Pt II   | 13329-100239       |
| 1150.9198.....             | 1150.9178              | 86887.18                          | 1900                      |         | Pt II   | 15791-102678       |
| 1150.9689.....             | 1150.9670              | 86883.47                          | 2500                      |         | Pt II   | 4786-91669         |
| 1152.4079.....             | 1152.4050              | 86775.05                          | 8200                      |         | Pt II   | 9356-96131         |
| 1152.58.....               | 1152.5713              | 86762.53                          | 520                       |         | Pt II   | 23875-110638       |
| 1152.86.....               | 1152.8586              | 86740.91                          | 770                       |         | Pt II   | 23461-110202       |
| 1153.4526.....             | 1153.4511              | 86696.35                          | 1200                      |         | Pt II   | 16820-103517       |
|                            | 1156.3006              | 86482.70                          | 1100                      |         | Cr      | ...                |
|                            | 1156.4388              | 86472.37                          | 2000                      |         | Cr      | ...                |
| 1156.4898.....             | 1156.4864              | 86468.81                          | 1300                      | P       | Pt II   | 13329-99797        |
| 1157.43.....               | 1157.4380              | 86397.72                          | 590                       |         | Pt II   | 9356-95754         |
| 1159.03.....               | 1159.0298              | 86279.06                          | 280                       |         | ...     | ...                |
| 1159.1308.....             | 1159.1305              | 86271.56                          | 880                       |         | Pt II   | 23461-109733       |
| 1159.2760.....             | 1159.2765              | 86260.70                          | 1400                      |         | Pt II   | 9356-95617         |
| 1159.96.....               | 1159.9564              | 86210.13                          | 650                       |         | Pt II   | 23875-110085       |
| 1161.90.....               | 1161.8925              | 86066.48                          | 520                       |         | Pt II   | 23461-109528       |
| 1161.9681.....             | 1161.9682              | 86060.87                          | 1100                      |         | Pt II   | 18097-104158       |
| 1164.4184.....             | 1164.4196              | 85879.70                          | 10000                     |         | Pt II   | 13329-99209        |
| 1164.5543.....             | 1164.5554              | 85869.68                          | 2900                      |         | Pt II   | 9356-95226         |
| 1164.7198.....             | 1164.7217              | 85857.42                          | 830                       |         | Pt II   | 16820-102678       |
| 1164.8721.....             | 1164.8716              | 85846.37                          | 930                       |         | Pt II   | 23461-109307       |
| 1166.8635.....             | 1166.8631              | 85699.86                          | 10000                     |         | Pt II   | 16820-102520       |
| 1167.0766.....             | 1167.0770              | 85684.15                          | 1500                      |         | Pt II   | 21168-106852       |
| 1168.1346.....             | 1168.1364              | 85606.44                          | 3700                      |         | Pt II   | 15791-101397       |
| 1168.1882.....             | 1168.1872              | 85602.72                          | 3900                      |         | Pt II   | 15791-101394       |
| 1168.2621.....             | 1168.2621              | 85597.23                          | 7200                      |         | ...     | ...                |
| 1168.3067.....             | 1168.3074              | 85593.91                          | 11000                     |         | Pt II   | 16820-102414       |
| 1169.58.....               | 1169.5752              | 85501.13                          | 880                       |         | ...     | ...                |
| 1169.7477.....             | 1169.7493              | 85488.40                          | 28000                     |         | Pt II   | 13329-98817        |
| 1171.4321.....             | 1171.4325              | 85365.57                          | 770                       |         | Pt II   | 18097-103463       |
| 1171.97.....               | 1171.9501              | 85327.86                          | 440                       |         | ...     | ...                |
| 1172.0340.....             | 1172.0345              | 85321.72                          | 2900                      |         | Pt II   | 15791-101113       |
|                            | 1173.2914              | 85230.32                          | 1500                      |         | Cr II   | 20512.10-105742.62 |
| 1174.59.....               | 1174.5976              | 85135.54                          | 370                       |         | Pt II   | 21717-106852       |
| 1175.1429.....             | 1175.1425              | 85096.06                          | 5700                      |         | Pt II   | 16820-101916       |
| 1175.4112.....             | 1175.4103              | 85076.68                          | 880                       |         | Pt II   | 4786-89863         |
|                            | 1175.9146              | 85040.19                          | 1200                      |         | Cr II   | 20519.33-105559.58 |
| 1176.4098.....             | 1176.4096              | 85004.41                          | 5800                      |         | Pt II   | 15791-100795       |
| 1176.9863.....             | 1176.9858              | 84962.79                          | 6700                      |         | Pt II   | 18097-103060       |
| 1177.6448.....             | 1177.6455              | 84915.20                          | 1100                      |         | Pt II   | 9356-94271         |
|                            | 1178.0054              | 84889.25                          | 1300                      |         | Cr II   | 20517.83-105406.99 |
| 1178.3994.....             | 1178.3989              | 84860.90                          | 2200                      | P       | Pt II   | 23461-108322       |
| 1178.4428.....             | 1178.4434              | 84857.70                          | 4300                      |         | Pt II   | 13329-98186        |
| 1178.9614.....             | 1178.9618              | 84820.39                          | 31000                     |         | Pt II   | 15791-100611       |
| 1179.30.....               | 1179.2882              | 84796.91                          | 650                       |         | Pt II   | 23875-108672       |
| 1179.5986.....             | 1179.6021              | 84774.35                          | 520                       | W       | Pt II   | 18097-102872       |
|                            | 1179.6575              | 84770.37                          | 880                       |         | Cr II   | 20512.06-105282.58 |
|                            | 1180.0049              | 84745.41                          | 590                       |         | Cr II   | 20517.83-105263.52 |
| 1180.2490.....             | 1180.2501              | 84727.81                          | 2300                      |         | Pt II   | 21168-105896       |
| 1180.7195.....             | 1180.7209              | 84694.02                          | 2000                      |         | Pt II   | 23461-108155       |
| 1181.1100.....             | 1181.1105              | 84666.09                          | 4100                      |         | Pt II   | 9356-94022         |
| 1182.3552.....             | 1182.3550              | 84576.97                          | 11000                     |         | Pt II   | 16820-101397       |
| 1182.6276.....             | 1182.6306              | 84557.26                          | 1300                      |         | Pt II   | 21168-105726       |
| 1183.9423.....             | 1183.9438              | 84463.47                          | 1300                      |         | Pt II   | 13329-97792        |
| 1184.0298.....             | 1184.0305              | 84457.29                          | 1400                      |         | Pt II   | 13329-97786        |
| 1184.51.....               | 1184.5122              | 84422.94                          | 440                       |         | Pt II   | 18097-102520       |

TABLE I—Continued

| Wavelength Pt Atlas<br>(Å) | Wavelength<br>(Å)      | Wavenumber<br>(cm <sup>-1</sup> ) | Intensity<br>(Arb. Units) | Comment | Species | Even-Odd           |
|----------------------------|------------------------|-----------------------------------|---------------------------|---------|---------|--------------------|
| 1184.9977.....             | 1184.9994              | 84388.23                          | 930                       |         | ...     | ...                |
| 1185.9985.....             | 1185.9988              | 84317.12                          | 1300                      |         | Pt II   | 18097-102414       |
| 1186.2203.....             | 1186.2213              | 84301.30                          | 22000                     |         | Pt II   | 13329-97630        |
| 1188.1761.....             | 1188.1771              | 84162.54                          | 1000                      |         | Pt II   | 23875-108038       |
| 1188.6968.....             | 1188.6924              | 84126.05                          | 3000                      |         | Pt II   | 9356-93482         |
| 1188.95.....               | 1188.9391              | 84108.60                          | 440                       |         | ...     | ...                |
| 1189.3073.....             | 1189.3069              | 84082.59                          | 4700                      |         | Pt II   | 16820-100903       |
| 1189.93.....               | 1189.9281 <sup>a</sup> | 84038.69                          | 1200                      |         | Ne?     | ...                |
| 1190.6418.....             | 1190.6420              | 83988.30                          | 3900                      |         | Pt II   | 18097-102086       |
| 1190.7595.....             | 1190.7591              | 83980.04                          | 2000                      |         | Pt II   | 9356-93336         |
| 1191.5733.....             | 1191.5734              | 83922.65                          | 1100                      |         | Pt II   | 24879-108802       |
| 1192.2690.....             | 1192.2683              | 83873.74                          | 2000                      |         | Pt II   | 21168-105042       |
| 1193.22.....               | 1193.2064 <sup>a</sup> | 83807.80                          | 1300                      |         | Ne?     | ...                |
| 1193.4484.....             | 1193.4480              | 83790.83                          | 25000                     |         | Pt II   | 16820-100611       |
| 1195.05.....               | 1195.0322              | 83679.75                          | 710                       |         | ...     | ...                |
|                            | 1196.0675              | 83607.32                          | 590                       |         | ...     | ...                |
| 1196.5616.....             | 1196.5594              | 83572.95                          | 2800                      |         | ...     | ...                |
| 1197.92.....               | 1197.9212 <sup>a</sup> | 83477.94                          | 1300                      |         | Ne?     | ...                |
| 1198.1623.....             | 1198.1607              | 83461.26                          | 1400                      |         | ...     | ...                |
| 1198.3009.....             | 1198.2989              | 83451.63                          | 880                       |         | Pt II   | 18097-101549       |
| 1198.7745.....             | 1198.7744              | 83418.53                          | 30000                     |         | Pt II   | 16820-100239       |
| 1199.1649.....             | 1199.1640              | 83391.43                          | 1800                      |         | Pt II   | 23461-106852       |
| 1199.5496.....             | 1199.5466              | 83364.83                          | 2500                      | H       | N I     | ...                |
| 1200.00.....               | 1199.9963              | 83333.59                          | 1700                      |         | ...     | ...                |
|                            | 1200.2251              | 83317.71                          | 2000                      | U       | N I     | ...                |
| 1200.2508.....             | 1200.2477              | 83316.13                          | 2400                      | P       | Pt II   | 23875-107191       |
| 1200.4693.....             | 1200.4741              | 83300.42                          | 770                       | WH      | Pt II   | 21717-105018       |
|                            | 1200.7115              | 83283.95                          | 980                       | H       | N I     | ...                |
| 1200.8040.....             | 1200.8044              | 83277.51                          | 4500                      |         | Pt II   | 15791-99068        |
| 1201.2856.....             | 1201.2853              | 83244.17                          | 6700                      |         | Pt II   | 18097-101341       |
|                            | 1201.7952              | 83208.85                          | 710                       |         | Cr      | ...                |
|                            | 1202.3546 <sup>a</sup> | 83170.14                          | 1500                      |         | Cr      | ...                |
|                            | 1202.4659              | 83162.44                          | 930                       |         | Cr      | ...                |
| 1203.7443.....             | 1203.7447              | 83074.09                          | 3300                      |         | Pt II   | 13329-96403        |
|                            | 1203.9196              | 83062.02                          | 1400                      |         | Cr II   | 32854.31-115916.22 |
|                            | 1204.1554              | 83045.76                          | 520                       |         | Cr II   | 32836.68-115882.21 |
| 1205.0270.....             | 1205.0244              | 82985.87                          | 830                       |         | Pt II   | 29261-112247       |
| 1205.1569.....             | 1205.1540              | 82976.95                          | 1000                      |         | Pt II   | 16820-99797        |
| 1206.59.....               | 1206.5882              | 82878.32                          | 520                       |         | ...     | ...                |
|                            | 1207.2027              | 82836.13                          | 770                       |         | Cr II   | 32836.68-115672.84 |
| 1207.2890.....             | 1207.2831              | 82830.62                          | 650                       |         | Pt II   | 21717-104548       |
|                            |                        |                                   |                           |         | Pt II   | 27255-110085       |
| 1207.49.....               | 1207.4908              | 82816.37                          | 710                       |         | ...     | ...                |
| 1207.6458.....             | 1207.6446              | 82805.82                          | 4800                      |         | Pt II   | 18097-100903       |
|                            | 1208.1263              | 82772.80                          | 650                       |         | Cr II   | 12303.86-95076.72  |
| 1208.1902.....             | 1208.1903              | 82768.42                          | 1400                      |         | Pt II   | 23461-106229       |
|                            | 1210.4045              | 82617.01                          | 370                       |         | Cr II   | 32844.76-115461.80 |
| 1210.6999.....             | 1210.6965              | 82597.09                          | 520                       |         | Pt II   | 8419-91016         |
|                            | 1210.7511              | 82593.36                          | 520                       | G       | Cr II   | 32854.31-115447.64 |
| 1212.7905.....             | 1212.7904              | 82454.48                          | 1000                      |         | Pt II   | 29261-111716       |
| 1213.2263.....             | 1213.2260              | 82424.87                          | 2200                      |         | Pt II   | 13329-95754        |
| 1214.7092.....             | 1214.7086              | 82324.27                          | 2000                      |         | Pt II   | 29030-111354       |
| 1214.8648.....             | 1214.8640              | 82313.74                          | 2600                      |         | Pt II   | 9356-91669         |
| 1215.2467.....             | 1215.2457              | 82287.88                          | 4500                      |         | Pt II   | 13329-95617        |
| 1215.6701.....             | 1215.6697              | 82259.19                          | 4400                      | H       | H I     | ...                |
| 1215.7671.....             | 1215.7680              | 82252.53                          | 1800                      |         | Pt II   | 21168-103421       |
| 1215.8369.....             | 1215.8367              | 82247.89                          | 3400                      |         | Pt II   | 16820-99068        |
| 1216.1236.....             | 1216.1232              | 82228.51                          | 2500                      |         | Pt II   | 13329-95557        |
|                            | 1217.1413              | 82159.73                          | 520                       |         | Cr II   | 12496.44-94656.24  |
| 1217.4951.....             | 1217.4950              | 82135.86                          | 2100                      |         | Pt II   | 23461-105597       |
|                            | 1217.7604              | 82117.96                          | 1700                      | U       | Cr II   | 12147.82-94265.99  |
| 1217.7927.....             | 1217.7940              | 82115.70                          | 980                       |         | Pt II   | 24879-106995       |
|                            | 1217.8517              | 82111.80                          | 520                       |         | Cr II   | 12032.58-94144.43  |
|                            | 1218.5349              | 82065.77                          | 590                       |         | Cr II   | 12032.58-94098.13  |
|                            | 1218.6246              | 82059.72                          | 1200                      |         | Cr II   | 12303.86-94363.51  |
|                            | 1218.9072              | 82040.70                          | 880                       |         | Cr II   | 11961.81-94002.56  |

TABLE 1—Continued

| Wavelength Pt Atlas<br>(Å) | Wavelength<br>(Å)      | Wavenumber<br>(cm <sup>-1</sup> ) | Intensity<br>(Arb. Units) | Comment | Species  | Even-Odd           |
|----------------------------|------------------------|-----------------------------------|---------------------------|---------|----------|--------------------|
| 1219.4931.....             | 1219.4904              | 82001.46                          | 40000                     |         | Pt II    | 15791–97792        |
| 1219.5786.....             | 1219.5662              | 81996.37                          | 2000                      | H       | Pt II    | 15791–97786        |
|                            | 1219.9635              | 81969.66                          | 590                       |         | Cr II    | 12147.82–94144.43  |
|                            | 1220.0775              | 81962.01                          | 1900                      |         | Cr II    | 12032.58–94002.56  |
|                            |                        |                                   |                           |         | Cr II    | 12303.86–94265.99  |
|                            |                        |                                   |                           |         | Cr II    | 0.00–81962.29      |
|                            | 1220.1649              | 81956.13                          | 3100                      |         | Cr II    | 12496.44–94452.57  |
|                            | 1220.2524              | 81950.26                          | 980                       |         | Cr II    | 12147.82–94098.13  |
| 1220.7795.....             | 1220.7794              | 81914.88                          | 3700                      |         | Pt II    | 9356–91271         |
| 1221.7369.....             | 1221.7396              | 81850.50                          | 880                       |         | Pt II    | 23875–105726       |
| 1223.1214.....             | 1223.1199              | 81758.14                          | 710                       |         | ...      | ...                |
| 1223.5053.....             | 1223.5071              | 81732.26                          | 1500                      |         | Pt II    | 29030–110762       |
| 1223.6648.....             | 1223.6648              | 81721.73                          | 650                       |         | Pt II    | 23875–105597       |
|                            | 1225.1621              | 81621.85                          | 1100                      |         | Cr II    | 12147.82–93770.10  |
|                            | 1226.2098              | 81552.11                          | 980                       |         | Cr       | ...                |
| 1226.7936.....             | 1226.8000              | 81512.88                          | 2200                      |         | Pt II/Cr | 13329–94842        |
|                            | 1226.9085              | 81505.67                          | 1700                      |         | Cr       | ...                |
| 1226.9816.....             | 1226.9819              | 81500.80                          | 370                       |         | Pt II    | 29261–110762       |
| 1228.5930.....             | 1228.5939              | 81393.86                          | 520                       |         | ...      | ...                |
| 1228.6470.....             | 1228.6470              | 81390.34                          | 1500                      |         | Pt II    | 9356–90746         |
| 1229.0134.....             | 1229.0147              | 81365.99                          | 17000                     |         | Pt II    | 16820–98186        |
| 1229.2515.....             | 1229.2528              | 81350.23                          | 2300                      | P       | Pt II    | 24879–106229       |
| 1229.3001.....             | 1229.3004              | 81347.08                          | 6300                      |         | Pt II    | 29261–110609       |
| 1229.6873.....             | 1229.6868              | 81321.52                          | 2900                      |         | Ne II    | ...                |
| 1229.8367.....             | 1229.8367              | 81311.61                          | 16000                     |         | Ne II    | ...                |
| 1229.9505.....             | 1229.9499              | 81304.12                          | 1000                      |         | Pt II    | 13329–94633        |
| 1231.64.....               | 1231.6408 <sup>a</sup> | 81192.50                          | 710                       |         | Ne III   | ...                |
| 1231.89.....               | 1231.8241 <sup>a</sup> | 81180.42                          | 520                       |         | Ne III   | ...                |
| 1232.0302.....             | 1232.0296              | 81166.88                          | 520                       |         | Pt II    | 23875–105042       |
| 1232.3983.....             | 1232.3988              | 81142.56                          | 980                       |         | Pt II    | 23875–105018       |
| 1232.8739.....             | 1232.8750              | 81111.22                          | 13000                     |         | Pt II    | 18097–99209        |
| 1234.0154.....             | 1234.0163              | 81036.21                          | 710                       |         | Pt II    | 29030–110066       |
| 1234.4019.....             | 1234.3988              | 81011.09                          | 1600                      |         | ...      | ...                |
| 1234.5580.....             | 1234.5573              | 81000.70                          | 4300                      |         | ...      | ...                |
| 1235.0916.....             | 1235.0920              | 80965.63                          | 4600                      |         | Pt II    | 16820–97786        |
| 1235.1607.....             | 1235.1623              | 80961.02                          | 770                       |         | Pt II    | 21717–102678       |
| 1235.8863.....             | 1235.8852              | 80913.67                          | 2400                      |         | Pt II    | 4786–85700         |
| 1236.0630.....             | 1236.0639              | 80901.97                          | 2600                      |         | ...      | ...                |
| 1237.4751.....             | 1237.4761              | 80809.64                          | 3900                      |         | Pt II    | 16820–97630        |
|                            | 1238.2934              | 80756.31                          | 590                       |         | Cr II    | 25033.70–105790.06 |
| 1238.4170.....             | 1238.4167              | 80748.26                          | 520                       |         | Pt II    | 21168–101916       |
| 1238.8499.....             | 1238.8500              | 80720.02                          | 38000                     |         | Pt II    | 18097–98817        |
| 1239.0156.....             | 1239.0147              | 80709.29                          | 6600                      |         | Ne II    | ...                |
|                            | 1239.1692              | 80699.23                          | 2300                      | P       | Ne II    | ...                |
| 1239.2011.....             | 1239.1997              | 80697.24                          | 880                       | P       | Pt II    | 23461–104158       |
| 1239.5438.....             | 1239.5455              | 80674.73                          | 980                       |         | Pt II    | 24879–105554       |
| 1240.5098.....             | 1240.5096              | 80612.03                          | 1200                      |         | Pt II    | 15791–96403        |
| 1240.9502.....             | 1240.9514              | 80583.33                          | 830                       |         | ...      | ...                |
| 1242.1331.....             | 1242.1317              | 80506.76                          | 770                       |         | Pt II    | 9356–89863         |
| 1242.6815.....             | 1242.6828              | 80471.06                          | 1100                      |         | Pt II    | 29261–109733       |
|                            | 1244.1433              | 80376.59                          | 650                       |         | Cr       | ...                |
|                            | 1244.3634              | 80362.37                          | 710                       |         | Pt II    | ...                |
|                            | 1244.5640              | 80349.42                          | 1100                      |         | Cr II    | 12303.86–92653.28  |
|                            |                        |                                   |                           |         | Cr II    | 25042.81–105392.48 |
| 1244.8278.....             | 1244.8279              | 80332.39                          | 1700                      |         | Pt II    | 27255–107588       |
| 1245.6812.....             | 1245.6811              | 80277.37                          | 7700                      |         | Pt II    | 29030–109307       |
|                            | 1245.7474              | 80273.09                          | 980                       |         | Cr II    | 11961.81–92235.35  |
|                            | 1245.7935              | 80270.13                          | 1600                      |         | Cr II    | 12147.82–92417.93  |
| 1246.0801.....             | 1246.0831              | 80251.47                          | 880                       |         | Pt II    | 9356–89607         |
| 1246.3668.....             | 1246.3680              | 80233.12                          | 770                       |         | Pt II    | 34647–114880       |
| 1246.4295.....             | 1246.4297              | 80229.16                          | 2700                      |         | Pt II    | 21168–101397       |
| 1246.6262.....             | 1246.6256              | 80216.55                          | 770                       |         | Pt II    | 23875–104092       |
|                            | 1246.8457              | 80202.38                          | 1300                      |         | Cr II    | 12032.58–92235.35  |
|                            |                        |                                   |                           |         | Cr II    | 35607.50–115810.34 |
|                            | 1247.5545              | 80156.82                          | 5600                      |         | Cr II    | 12496.44–92653.28  |

TABLE 1—Continued

| Wavelength Pt Atlas<br>(Å) | Wavelength<br>(Å)      | Wavenumber<br>(cm <sup>-1</sup> ) | Intensity<br>(Arb. Units) | Comment | Species | Even-Odd           |
|----------------------------|------------------------|-----------------------------------|---------------------------|---------|---------|--------------------|
| 1247.6173.....             | 1247.6185              | 80152.71                          | 1200                      |         | Pt II   | 13329-93482        |
|                            | 1248.2196              | 80114.11                          | 2400                      |         | Cr II   | 12303.86-92417.93  |
| 1248.6069.....             | 1248.6075              | 80089.22                          | 70000                     |         | Pt II   | 18097-98186        |
| 1249.0069.....             | 1249.0072              | 80063.59                          | 1600                      |         | ...     | ...                |
| 1249.1314.....             | 1249.1313              | 80055.63                          | 710                       |         | Pt II   | 23461-103517       |
| 1249.8897.....             | 1249.8885              | 80007.14                          | 520                       |         | Pt II   | 13329-93336        |
| 1249.9718.....             | 1249.9704              | 80001.89                          | 650                       |         | Pt II   | 23461-103463       |
| 1250.6310.....             | 1250.6293              | 79959.75                          | 590                       |         | Pt II   | 23461-103421       |
| 1250.7471.....             | 1250.7487              | 79952.11                          | 980                       |         | Pt II   | 24879-104831       |
| 1250.8692.....             | 1250.8712              | 79944.28                          | 1100                      |         | Pt II   | 21168-101113       |
| 1252.0617.....             | 1252.0624              | 79868.22                          | 1100                      |         | Pt II   | 13329-93197        |
| 1254.2439.....             | 1254.2441              | 79729.30                          | 1100                      |         | ...     | ...                |
| 1254.7526.....             | 1254.7554              | 79696.81                          | 1200                      | U       | Pt II   | 29030-108727       |
| 1254.7815.....             | 1254.7827              | 79695.07                          | 1200                      | P       | Pt II   | 18097-97792        |
| 1254.8469.....             | 1254.8452              | 79691.11                          | 1600                      |         | ...     | ...                |
| 1255.0214.....             | 1255.0210 <sup>a</sup> | 79679.94                          | 1400                      |         | Ne III  | ...                |
| 1255.6911.....             | 1255.6929              | 79637.31                          | 4700                      |         | Ne III  | ...                |
| 1255.8557.....             | 1255.8576              | 79626.86                          | 370                       |         | Pt II   | 21168-100795       |
| 1256.3246.....             | 1256.3267              | 79597.13                          | 1300                      |         | Pt II   | 27255-106852       |
| 1256.5583.....             | 1256.5593              | 79582.40                          | 3200                      |         | Pt II   | 16820-96403        |
| 1257.2214.....             | 1257.2220              | 79540.45                          | 14000                     | S       | Pt II   | 29261-108802       |
| 1258.7640.....             | 1258.7652              | 79442.94                          | 830                       |         | Pt II   | 21168-100611       |
| 1258.8332.....             | 1258.8339              | 79438.60                          | 830                       |         | Pt II   | 13329-92767        |
| 1259.1328.....             | 1259.1320              | 79419.79                          | 2400                      |         | Pt II   | 13329-92749        |
| 1259.2740.....             | 1259.2757              | 79410.73                          | 1200                      |         | Pt II   | 23461-102872       |
| 1259.5111.....             | 1259.5122              | 79395.82                          | 10000                     |         | Pt II   | 4786-84182         |
|                            |                        |                                   |                           |         | Pt II   | 21717-101113       |
| 1262.0962.....             | 1262.0966              | 79233.24                          | 590                       | G       | Pt II   | 9356-88589         |
| 1264.3492.....             | 1264.3469              | 79092.21                          | 1300                      |         | Pt II   | 0-79092            |
| 1264.5677.....             | 1264.5663              | 79078.50                          | 17000                     |         | Pt II   | 21717-100795       |
| 1264.6904.....             | 1264.6888              | 79070.83                          | 8300                      |         | Pt II   | 21168-100239       |
| 1264.8691.....             | 1264.8660              | 79059.76                          | 650                       | H       | Pt II   | 23461-102520       |
| 1265.2074.....             | 1265.2079              | 79038.39                          | 1300                      |         | Pt II   | 15791-94829        |
| 1265.7145.....             | 1265.7129              | 79006.86                          | 2800                      |         | Pt II   | 29030-108037       |
| 1266.8932.....             | 1266.8931              | 78933.26                          | 1000                      |         | Pt II   | 16820-95754        |
| 1268.3599.....             | 1268.3588 <sup>a</sup> | 78842.04                          | 650                       |         | Pt II   | 15791-94633        |
| 1268.7589.....             | 1268.7578              | 78817.25                          | 880                       |         | Pt II   | 9356-88173         |
| 1269.0742.....             | 1269.0692              | 78797.91                          | 650                       | HU      | Pt II   | 32918-111716       |
| 1269.0973.....             | 1269.0966              | 78796.21                          | 930                       | P       | Pt II   | 16820-95617        |
| 1269.4345.....             | 1269.4306              | 78775.47                          | 710                       |         | Pt II   | 29261-108037       |
| 1269.8121.....             | 1269.8115              | 78751.84                          | 590                       |         | Pt II   | 4786-83538         |
| 1271.7939.....             | 1271.7918              | 78629.22                          | 17000                     |         | Pt II   | 21168-99797        |
| 1274.3665.....             | 1274.3714              | 78470.06                          | 650                       |         | Pt II   | 27255-105726       |
| 1274.6091.....             | 1274.6079              | 78455.50                          | 3000                      |         | Pt II   | 23461-101916       |
| 1274.6566.....             | 1274.6563              | 78452.52                          | 1100                      | P       | Pt II   | 0-78452            |
| 1275.4940.....             | 1275.4930              | 78401.06                          | 980                       |         | Pt II   | 32237-110638       |
| 1276.2289.....             | 1276.2314              | 78355.70                          | 880                       |         | Pt II   | 29030-107386       |
| 1277.0472.....             | 1277.0486              | 78305.55                          | 880                       |         | Pt II   | 18097-96403        |
| 1277.1026.....             | 1277.1017              | 78302.30                          | 710                       |         | Pt II   | 21168-99471        |
| 1278.6998.....             | 1278.6979              | 78204.56                          | 830                       |         | ...     | ...                |
| 1279.0832.....             | 1279.0850              | 78180.89                          | 370                       |         | Pt II   | 24879-103060       |
| 1280.0116.....             | 1280.0115              | 78124.30                          | 710                       |         | Pt II   | 29261-107386       |
| 1281.3463.....             | 1281.3446              | 78043.02                          | 2900                      |         | Pt II   | 0-78043            |
| 1281.3888.....             | 1281.3875              | 78040.41                          | 1300                      |         | Pt II   | 21168-99209        |
| 1281.6965.....             | 1281.6966              | 78021.59                          | 830                       |         | Pt II   | 16820-94842        |
| 1282.6318.....             | 1282.6316              | 77964.71                          | 3500                      |         | Pt II   | 29030-106995       |
| 1283.6978.....             | 1283.6962              | 77900.05                          | 13000                     |         | Pt II   | 21168-99068        |
| 1284.5438.....             | 1284.5431              | 77848.69                          | 830                       |         | Pt II   | 32237-110085       |
|                            | 1285.8106              | 77771.95                          | 980                       |         | Cr II   | 38269.59-116041.70 |
| 1285.9670.....             | 1285.9675              | 77762.46                          | 650                       |         | Pt II   | 27255-105018       |
| 1286.1117.....             | 1286.1103              | 77753.83                          | 2500                      |         | Pt II   | 21717-99471        |
| 1286.4510.....             | 1286.4506              | 77733.26                          | 5400                      |         | Pt II   | 29261-106995       |
|                            | 1287.8009              | 77651.76                          | 440                       |         | Cr II   | 38314.86-115966.70 |
| 1289.9515.....             | 1289.9511              | 77522.32                          | 32000                     |         | Pt II   | 23875-101397       |
| 1290.0131.....             | 1290.0128              | 77518.61                          | 12000                     |         | Pt II   | 23875-101394       |
|                            |                        |                                   |                           |         | Pt II   | 18097-95617        |

TABLE 1—Continued

| Wavelength Pt Atlas<br>(Å) | Wavelength<br>(Å)      | Wavenumber<br>(cm <sup>-1</sup> ) | Intensity<br>(Arb. Units) | Comment | Species   | Even-Odd           |
|----------------------------|------------------------|-----------------------------------|---------------------------|---------|-----------|--------------------|
| 1291.1450.....             | 1291.1437              | 77450.71                          | 1700                      |         | Pt II     | 16820–94271        |
| 1291.7007.....             | 1291.6986              | 77417.44                          | 1500                      |         | Pt II     | 13329–90746        |
| 1292.7998.....             | 1292.7983              | 77351.58                          | 11000                     |         | Pt II     | 21717–99068        |
| 1293.0896.....             | 1293.0887              | 77334.22                          | 9000                      |         | Pt II     | 23461–100795       |
| 1293.9021.....             | 1293.9027              | 77285.56                          | 4700                      |         | Ne II     | ...                |
| 1293.9679.....             | 1293.9644              | 77281.88                          | 520                       |         | ...       | ...                |
| 1294.7073.....             | 1294.7074              | 77237.53                          | 1800                      |         | Pt II     | 23875–101113       |
| 1295.2268.....             | 1295.2279              | 77206.49                          | 710                       |         | Pt II     | 24879–102086       |
| 1295.3461.....             | 1295.3489              | 77199.28                          | 440                       |         | Pt II     | 29030–106229       |
| 1295.8881.....             | 1295.8913              | 77166.96                          | 590                       |         | Pt II     | 32918–110085       |
| 1296.5416.....             | 1296.5407              | 77128.32                          | 1300                      |         | Pt II     | 18097–95226        |
| 1296.8298.....             | 1296.8310              | 77111.05                          | 1100                      |         | Pt II     | 4786–81897         |
| 1298.0460.....             | 1298.0462              | 77038.86                          | 2400                      |         | Ne II     | ...                |
| 1299.2423.....             | 1299.2442              | 76967.83                          | 2600                      |         | Pt II     | 29261–106229       |
| 1300.0501.....             | 1300.0488              | 76920.19                          | 770                       |         | Pt II     | 23875–100795       |
| 1301.4882.....             | 1301.4880              | 76835.13                          | 650                       |         | Pt II     | 32918–109753       |
| 1301.8075.....             | 1301.8087              | 76816.20                          | 440                       |         | ...       | ...                |
| 1302.1685.....             | 1302.1677              | 76795.02                          | 5000                      | HS      | O I       | ...                |
| 1302.4578.....             | 1302.4573              | 76777.95                          | 21000                     |         | Pt II     | 23461–100239       |
| 1303.1187.....             | 1303.1191              | 76738.96                          | 15000                     |         | Pt II     | 24879–101618       |
| 1303.1669.....             | 1303.1659              | 76736.20                          | 1500                      | P       | Pt II     | 23875–100611       |
| 1304.4422.....             | 1304.4411              | 76661.18                          | 650                       |         | Pt II     | 16820–93482        |
| 1304.8576.....             | 1304.8571              | 76636.74                          | 2600                      | H       | O I       | ...                |
| 1305.0718.....             | 1305.0733              | 76624.05                          | 3900                      |         | Pt II     | 21168–97792        |
| 1305.1778.....             | 1305.1794              | 76617.82                          | 4000                      |         | Pt II     | 21168–97786        |
| 1305.3118.....             | 1305.3113              | 76610.08                          | 7500                      |         | Pt II     | 0–76610            |
| 1306.0286.....             | 1306.0301              | 76567.91                          | 1100                      |         | O I       | ...                |
|                            | 1307.3014              | 76493.45                          | 770                       |         | Cr II     | 30298.51–106791.84 |
| 1307.8326.....             | 1307.8321              | 76462.42                          | 650                       |         | Pt II     | 24879–101341       |
|                            | 1308.2933              | 76435.46                          | 1000                      |         | Cr II     | 30391.83–106827.42 |
| 1309.3000.....             | 1309.3039              | 76376.46                          | 770                       |         | Pt II     | 16820–93197        |
| 1309.5198.....             | 1309.5186              | 76363.94                          | 8000                      |         | Pt II     | 23875–100239       |
| 1309.9932.....             | 1309.9938              | 76336.24                          | 880                       |         | Pt II     | 23461–99797        |
| 1310.9818.....             | 1310.9818              | 76278.71                          | 520                       |         | Pt II     | 13329–89607        |
| 1312.7858.....             | 1312.7872 <sup>a</sup> | 76173.81                          | 720                       |         | Pt II     | 18097–94271        |
| 1312.9308.....             | 1312.9312              | 76165.45                          | 970                       |         | Pt II     | 27255–103421       |
| 1314.5907.....             | 1314.5911              | 76069.28                          | 1100                      |         | Pt II     | 21717–97786        |
| 1315.5348.....             | 1315.5362              | 76014.63                          | 2200                      |         | Pt II     | 21168–97183        |
| 1316.4501.....             | 1316.4523              | 75961.73                          | 540                       | W       | Pt II     | 34647–110609       |
| 1317.2032.....             | 1317.2038              | 75918.40                          | 720                       |         | Pt II     | 32237–108155       |
| 1319.2429.....             | 1319.2421              | 75801.10                          | 810                       |         | Pt II/Cr? | 29030–104831       |
| 1319.2429.....             |                        |                                   |                           |         | Pt II     | 32237–108038       |
| 1320.1754.....             | 1320.1762              | 75747.46                          | 3000                      |         | Pt II     | 23461–99209        |
| 1322.8372.....             | 1322.8349              | 75595.23                          | 7600                      |         | Pt II     | 23875–99471        |
| 1323.0765.....             | 1323.0744              | 75581.54                          | 810                       |         | Pt II     | 0–75581            |
| 1323.2831.....             | 1323.2820              | 75569.68                          | 9300                      |         | Pt II     | 29261–104831       |
| 1324.8562.....             | 1324.8559              | 75479.91                          | 2000                      |         | Pt II     | 15791–91271        |
| 1325.0971.....             | 1325.0978              | 75466.13                          | 2800                      |         | Pt II     | 21717–97183        |
| 1326.0723.....             | 1326.0717              | 75410.71                          | 2300                      |         | Pt II     | 4786–80197         |
| 1326.1916.....             | 1326.1926              | 75403.83                          | 1800                      |         | Pt II     | 32918–108322       |
| 1326.8620.....             | 1326.8598              | 75365.91                          | 1200                      |         | Pt II     | 0–75365            |
| 1327.0833.....             | 1327.0861              | 75353.06                          | 1100                      |         | Pt II     | 24879–100232       |
| 1327.4314.....             | 1327.4310              | 75333.48                          | 19000                     |         | Pt II     | 23875–99209        |
| 1328.7227.....             | 1328.7209              | 75260.35                          | 1500                      |         | Pt II     | 13329–88589        |
| 1329.1748.....             | 1329.1758              | 75234.59                          | 640                       |         | Pt II     | 21168–96403        |
|                            | 1329.5811 <sup>a</sup> | 75211.66                          | 1300                      |         | C I       | ...                |
| 1329.9067.....             | 1329.9061              | 75193.28                          | 2800                      |         | Pt II     | 23875–99068        |
| 1330.0547.....             | 1330.0528              | 75184.98                          | 12000                     |         | Pt II     | 0–75184            |
| 1334.1414.....             | 1334.1416              | 74954.56                          | 1000                      |         | Pt II     | 32237–107191       |
|                            | 1335.7092              | 74866.60                          | 1800                      | W       | C II      | ...                |
| 1336.2452.....             | 1336.2491              | 74836.35                          | 890                       |         | Pt II     | 36484–111320       |
| 1337.8657.....             | 1337.8650              | 74745.96                          | 6200                      |         | Pt II     | 0–74745            |
| 1338.2103.....             | 1338.2123              | 74726.56                          | 810                       |         | Pt II     | 21717–96443        |
| 1340.1393.....             | 1340.1379              | 74619.18                          | 3500                      |         | Pt II     | 0–74619            |
| 1341.3300.....             | 1341.3294              | 74552.90                          | 1300                      |         | Pt II     | 8419–82972         |



TABLE 1—Continued

| Wavelength Pt Atlas<br>(Å) | Wavelength<br>(Å)      | Wavenumber<br>(cm <sup>-1</sup> ) | Intensity<br>(Arb. Units) | Comment | Species | Even-Odd           |
|----------------------------|------------------------|-----------------------------------|---------------------------|---------|---------|--------------------|
| 1342.5224.....             | 1342.5224              | 74486.65                          | 1000                      |         | Pt II   | 29030-103517       |
| 1343.3742.....             | 1343.3760              | 74439.33                          | 890                       |         | Pt II   | 18097-92537        |
| 1344.0117.....             | 1344.0095              | 74404.24                          | 2100                      |         | Pt II   | 8419-82824         |
| 1344.2837.....             | 1344.2857              | 74388.95                          | 1300                      |         | Pt II   | 21168-95557        |
| 1345.3272.....             | 1345.3273              | 74331.35                          | 1400                      |         | Pt II   | 23461-97792        |
| 1345.4403.....             | 1345.4412              | 74325.06                          | 7400                      |         | Pt II   | 23461-97786        |
| 1346.9559.....             | 1346.9549              | 74241.54                          | 9400                      |         | Pt II   | 0-74241            |
| 1347.2391.....             | 1347.2397              | 74225.84                          | 1300                      |         | Cl I    | ...                |
|                            | 1347.6719              | 74202.04                          | 810                       |         | Cr II   | 35610.35-109812.06 |
| 1348.2704.....             | 1348.2696              | 74169.14                          | 6200                      |         | Pt II   | 23461-97630        |
|                            | 1348.4217              | 74160.78                          | 1000                      |         | Cr II   | 30307.44-104467.83 |
| 1348.5261.....             | 1348.5270              | 74154.98                          | 1500                      |         | Pt II   | 34647-108802       |
| 1348.8300.....             | 1348.8290              | 74138.38                          | 16000                     |         | Pt II   | 27255-101394       |
| 1349.1657.....             | 1349.1653              | 74119.90                          | 5100                      |         | Pt II   | 4786-78906         |
| 1349.2366.....             | 1349.2363              | 74116.00                          | 1700                      |         | Pt II   | 8419-82535         |
|                            | 1351.2984              | 74002.90                          | 720                       |         | Cr II   | 20519.33-94522.31  |
| 1351.3531.....             | 1351.3538              | 73999.87                          | 1500                      |         | Pt II   | 0-73999            |
| 1352.4797.....             | 1352.4812              | 73938.18                          | 970                       |         | Pt II   | 24879-98817        |
| 1352.8623.....             | 1352.8635              | 73917.29                          | 1700                      |         | Pt II   | 23875-97792        |
| 1352.9768.....             | 1352.9782              | 73911.02                          | 12000                     |         | Pt II   | 23875-97786        |
| 1353.9613.....             | 1353.9581              | 73857.53                          | 450                       |         | Pt II   | 27255-101113       |
|                            | 1354.1446              | 73847.36                          | 450                       |         | ...     | ...                |
| 1354.2487.....             | 1354.2577              | 73841.19                          | 1000                      | H       | Pt II   | 29030-102872       |
| 1354.2620.....             |                        |                                   |                           |         | Pt II   | 21717-95557        |
| 1354.4510.....             | 1354.4500 <sup>a</sup> | 73830.71                          | 1300                      |         | Ne III? | ...                |
| 1354.7077.....             | 1354.7094              | 73816.57                          | 720                       |         | Pt II   | 15791-89607        |
| 1355.0378.....             | 1355.0395              | 73798.59                          | 1200                      |         | Pt II   | 29261-103060       |
| 1355.7164.....             | 1355.7143              | 73761.85                          | 9300                      |         | Pt II   | 0-73761            |
| 1361.5367.....             | 1361.5369              | 73446.41                          | 1700                      |         | Pt II   | 41434-114880       |
| 1362.5820.....             | 1362.5832              | 73390.02                          | 230                       |         | Pt II   | 34647-108037       |
| 1362.6878.....             | 1362.6869              | 73384.43                          | 2500                      |         | Pt II   | 29030-102414       |
|                            | 1362.8375              | 73376.32                          | 1200                      |         | Cr      | ...                |
|                            | 1363.1348              | 73360.32                          | 1000                      |         | Pt II   | ...                |
| 1363.3059.....             | 1363.3072              | 73351.04                          | 10000                     |         | Pt II   | 29261-102613       |
| 1364.0463.....             | 1364.0452              | 73311.35                          | 2000                      |         | Pt II   | 32918-106229       |
| 1364.1171.....             | 1364.1154              | 73307.58                          | 11000                     |         | Pt II   | 24879-98186        |
| 1365.0223.....             | 1365.0236              | 73258.81                          | 1400                      |         | Pt II   | 29261-102520       |
|                            | 1366.0604              | 73203.20                          | 1000                      |         | Cr      | ...                |
|                            | 1366.5317              | 73177.96                          | 1300                      |         | Cr II   | 32854.31-106032.24 |
|                            | 1367.3626              | 73133.49                          | 810                       |         | Cr II   | 33694.15-106827.42 |
|                            | 1367.5818              | 73121.77                          | 720                       |         | Cr II   | 30391.83-103513.67 |
| 1368.8213.....             | 1368.8207              | 73055.59                          | 1700                      |         | Pt II   | 29030-102086       |
| 1369.3682.....             | 1369.3668              | 73026.45                          | 7600                      |         | Pt II   | 0-73026            |
| 1369.7039.....             | 1369.7039              | 73008.48                          | 1400                      |         | ...     | ...                |
|                            | 1370.5972              | 72960.90                          | 810                       |         | ...     | ...                |
|                            | 1370.7400              | 72953.30                          | 540                       |         | Cr II   | 45669.37-118622.60 |
|                            | 1372.3097              | 72869.85                          | 450                       |         | Cr II   | 32854.95-105724.77 |
| 1372.7084.....             | 1372.7091              | 72848.64                          | 640                       |         | Pt II   | 42031-114880       |
| 1373.1724.....             | 1373.1726              | 72824.06                          | 11000                     |         | Pt II   | 29261-102086       |
| 1374.8896.....             | 1374.8890              | 72733.15                          | 7400                      |         | Pt II   | 4786-77519         |
| 1375.0230.....             | 1375.0223 <sup>a</sup> | 72726.09                          | 1200                      |         | Ne III  | ...                |
| 1376.4844.....             | 1376.4844              | 72648.84                          | 540                       |         | Pt II   | 18097-90746        |
| 1376.7307.....             | 1376.7310              | 72635.83                          | 640                       |         | Pt II   | 32918-105554       |
| 1378.0080.....             | 1378.0089              | 72568.47                          | 2600                      |         | Pt II   | 23875-96443        |
| 1378.9572.....             | 1378.9552              | 72518.67                          | 50000                     |         | Pt II   | 29030-101549       |
| 1379.5267.....             | 1379.5271              | 72488.61                          | 890                       |         | Cl I    | ...                |
| 1380.4782.....             | 1380.4781              | 72438.67                          | 2900                      |         | Pt II   | 8419-80858         |
| 1381.5073.....             | 1381.5064 <sup>a</sup> | 72384.75                          | 1700                      |         | Ne II   | ...                |
| 1381.8382.....             | 1381.8380              | 72367.38                          | 1700                      |         | Pt II   | 29030-101397       |
| 1382.0460.....             | 1382.0455              | 72356.52                          | 39000                     |         | Pt II   | 29261-101618       |
| 1382.1820.....             | 1382.1821              | 72349.37                          | 970                       |         | Pt II   | 34647-106996       |
| 1382.9080.....             | 1382.9069              | 72311.45                          | 540                       |         | Pt II   | 29030-101341       |
| 1383.2676.....             | 1383.2665              | 72292.65                          | 4600                      |         | Pt II   | 23461-95754        |
| 1383.9627.....             | 1383.9640              | 72256.21                          | 540                       |         | ...     | ...                |
| 1384.7471.....             | 1384.7465              | 72215.38                          | 810                       |         | Pt II   | 27255-99471        |

TABLE 1—Continued

| Wavelength Pt Atlas<br>(Å)  | Wavelength<br>(Å)      | Wavenumber<br>(cm <sup>-1</sup> ) | Intensity<br>(Arb. Units) | Comment | Species | Even-Odd           |
|-----------------------------|------------------------|-----------------------------------|---------------------------|---------|---------|--------------------|
| 1385.9355.....              | 1385.9334 <sup>a</sup> | 72153.54                          | 1600                      |         | Ne II   | ...                |
| 1387.5158.....              | 1387.5138              | 72071.35                          | 8900                      |         | Ne II   | ...                |
| 1388.4901.....              | 1388.4883              | 72020.77                          | 2000                      |         | Ne II   | ...                |
| 1389.8750.....              | 1389.8739              | 71948.97                          | 7800                      |         | Pt II   | 0-71948            |
| 1391.2877.....              | 1391.2884              | 71875.83                          | 1700                      |         | Pt II   | 37877-109753       |
| 1391.3435.....              | 1391.3430              | 71873.00                          | 1800                      |         | Pt II   | 29030-100903       |
| 1391.7029.....              | 1391.7042              | 71854.35                          | 2900                      |         | Ne II   | ...                |
| 1391.8544.....              | 1391.8540              | 71846.62                          | 5800                      |         | Ne II   | ...                |
|                             | 1392.3767              | 71819.64                          | 640                       |         | Cr II   | 30864.46-102684.02 |
| 1392.5021.....              | 1392.5047              | 71813.04                          | 890                       |         | Pt II   | 27255-99068        |
| 1393.3666.....              | 1393.3676              | 71768.57                          | 540                       |         | Pt II   | 16820-88589        |
|                             | 1394.3225              | 71719.42                          | 640                       |         | ...     | ...                |
| 1394.6032.....              | 1394.6081              | 71704.73                          | 540                       |         | ...     | ...                |
| 1395.0473.....              | 1395.0489              | 71682.08                          | 1300                      |         | Pt II   | 23875-95557        |
|                             | 1396.4087              | 71612.27                          | 810                       |         | Cr II   | 31219.35-102831.62 |
| 1396.6602.....              | 1396.6623              | 71599.27                          | 1100                      |         | Pt II   | 21168-92767        |
| 1396.9879.....              | 1396.9868              | 71582.64                          | 450                       |         | Pt II   | 34647-106229       |
|                             | 1398.4286              | 71508.83                          | 3300                      |         | Cr II   | 30391.83-101900.82 |
| 1398.5581.....              | 1398.5558              | 71502.33                          | 640                       |         | Pt II   | 9356-80858         |
|                             | 1398.9053              | 71484.47                          | 2100                      |         | Cr II   | 30298.51-101783.20 |
| 1399.5333.....              | 1399.5326              | 71452.43                          | 9700                      |         | Ne II   | ...                |
| 1400.8097.....              | 1400.8092 <sup>a</sup> | 71387.31                          | 1600                      |         | Ne II   | ...                |
| 1400.868 <sup>b</sup> ..... | 1400.8658 <sup>a</sup> | 71384.43                          | 970                       |         | Ne II   | ...                |
| 1401.2517.....              | 1401.2521              | 71364.74                          | 720                       |         | Pt II   | 0-71364            |
| 1402.2375.....              | 1402.2391              | 71314.52                          | 970                       |         | Pt II   | 0-71314            |
| 1403.2407.....              | 1403.2408              | 71263.61                          | 1000                      |         | Pt II   | 8419-79683         |
| 1403.4752.....              | 1403.4741              | 71251.76                          | 9100                      |         | Pt II   | 24879-96131        |
| 1403.6827.....              | 1403.6824              | 71241.19                          | 22000                     |         | Ne II   | ...                |
| 1403.9006.....              | 1403.8993              | 71230.18                          | 61000                     |         | Pt II   | 24879-96109        |
| 1404.3180.....              | 1404.3182              | 71208.93                          | 2100                      |         | Pt II   | 29030-100239       |
| 1404.4507.....              | 1404.4509              | 71202.21                          | 7500                      |         | Pt II   | 29030-100232       |
| 1404.7383.....              | 1404.7380              | 71187.65                          | 1200                      |         | Pt II   | 8419-79607         |
| 1405.3752.....              | 1405.3746              | 71155.41                          | 8700                      |         | Ne II   | ...                |
| 1406.3906.....              | 1406.3904              | 71104.01                          | 1800                      |         | Pt II   | 36484-107588       |
| 1407.7103.....              | 1407.7073              | 71037.49                          | 1000                      |         | ...     | ...                |
| 1407.8209.....              | 1407.8197              | 71031.82                          | 640                       |         | Pt II   | 21717-92749        |
| 1407.9315.....              | 1407.9336              | 71026.08                          | 720                       |         | ...     | ...                |
|                             | 1408.1801              | 71013.64                          | 720                       |         | ...     | ...                |
| 1409.0315.....              | 1409.0321              | 70970.71                          | 7300                      |         | Pt II   | 29261-100232       |
| 1409.4407.....              | 1409.4417              | 70950.08                          | 970                       |         | Pt II   | 34647-105597       |
| 1409.7467.....              | 1409.7452              | 70934.81                          | 3100                      |         | Ne II   | ...                |
| 1410.1346.....              | 1410.1345              | 70915.22                          | 18000                     | S       | ...     | ...                |
| 1410.2951.....              | 1410.2967              | 70907.06                          | 1500                      |         | Pt II   | 34647-105554       |
| 1411.3059.....              | 1411.3051 <sup>a</sup> | 70856.40                          | 1300                      |         | Ne II   | ...                |
| 1412.2278.....              | 1412.2284              | 70810.07                          | 450                       |         | Pt II   | 23461-94271        |
| 1413.2736.....              | 1413.2738              | 70757.70                          | 970                       |         | Pt II   | 23875-94633        |
| 1413.6768.....              | 1413.6764              | 70737.55                          | 3800                      |         | Pt II   | 24879-95617        |
| 1413.9570.....              | 1413.9565              | 70723.53                          | 5800                      |         | Ne II   | ...                |
| 1414.3241.....              | 1414.3247              | 70705.12                          | 540                       |         | ...     | ...                |
| 1415.7144.....              | 1415.7150              | 70635.69                          | 6700                      |         | Ne II   | ...                |
| 1417.8186.....              | 1417.8190              | 70530.86                          | 4000                      |         | Pt II   | 27255-97786        |
| 1418.3779.....              | 1418.3792              | 70503.01                          | 22000                     |         | Ne II   | ...                |
| 1418.7471.....              | 1418.7482              | 70484.67                          | 16000                     |         | Ne II   | ...                |
| 1419.6208.....              | 1419.6227              | 70441.25                          | 540                       |         | Pt II   | 32237-102678       |
| 1420.5511.....              | 1420.5518              | 70395.18                          | 1800                      |         | Pt II   | 34647-105042       |
| 1421.5372.....              | 1421.5356              | 70346.46                          | 2600                      |         | ...     | ...                |
| 1423.5645.....              | 1423.5647              | 70246.19                          | 8300                      |         | Ne II   | ...                |
| 1425.3086.....              | 1425.3113              | 70160.11                          | 1200                      |         | Pt II   | 37877-108038       |
|                             | 1426.2084              | 70115.98                          | 34000                     |         | Cr II   | 12496.44-82612.69  |
|                             | 1426.4830              | 70102.48                          | 1300                      |         | Pt II   | ...                |
|                             | 1427.3856              | 70058.15                          | 7400                      |         | Cr II   | 12303.86-82362.19  |
| 1428.1530.....              | 1428.1548              | 70020.42                          | 1000                      |         | Pt II   | 23461-93482        |
| 1428.5822.....              | 1428.5830              | 69999.43                          | 36000                     |         | Ne II   | ...                |
| 1429.0200.....              | 1429.0207              | 69977.99                          | 1600                      |         | Pt II   | 34647-104625       |
| 1429.5248.....              | 1429.5246              | 69953.33                          | 34000                     |         | Pt II   | 0-69953            |

TABLE 1—Continued

| Wavelength Pt Atlas<br>(Å) | Wavelength<br>(Å)      | Wavenumber<br>(cm <sup>-1</sup> ) | Intensity<br>(Arb. Units) | Comment | Species | Even-Odd           |
|----------------------------|------------------------|-----------------------------------|---------------------------|---------|---------|--------------------|
| 1430.6657.....             | 1430.6671 <sup>a</sup> | 69897.46                          | 1200                      |         | Ne?     | ...                |
|                            | 1430.8523              | 69888.42                          | 15000                     |         | Cr II   | 12303.86–82192.59  |
| 1431.1564.....             | 1431.1557              | 69873.60                          | 2500                      |         | ...     | ...                |
|                            | 1431.3227              | 69865.45                          | 26000                     |         | Cr II   | 12496.44–82362.19  |
|                            | 1431.3851              | 69862.40                          | 2700                      |         | Cr II   | 11961.81–81824.40  |
|                            | 1431.8648              | 69839.00                          | 21000                     |         | Cr II   | 12303.86–82143.15  |
| 1431.9499.....             | 1431.9491              | 69834.89                          | 1200                      |         | Pt II   | 8419–78254         |
|                            | 1432.0559              | 69829.67                          | 20000                     |         | Cr II   | 12147.82–81978.08  |
|                            | 1432.3742              | 69814.16                          | 13000                     |         | Cr II   | 12147.82–81962.29  |
|                            | 1432.8376              | 69791.58                          | 2800                      |         | Cr II   | 12032.58–81824.40  |
| 1432.9262.....             | 1432.9265              | 69787.25                          | 4300                      |         | Pt II   | 29030–98817        |
|                            | 1433.0045              | 69783.45                          | 18000                     |         | Cr II   | 12032.58–81816.29  |
| 1433.22.....               | 1433.2135 <sup>a</sup> | 69773.28                          | 1200                      |         | ...     | ...                |
|                            | 1433.7806              | 69745.68                          | 12000                     |         | Cr II   | 11961.81–81707.87  |
|                            |                        |                                   |                           |         | Cr II   | 20512.06–90258.20  |
|                            | 1434.6769              | 69702.10                          | 9400                      |         | Cr II   | 12032.58–81735.02  |
|                            | 1434.8080              | 69695.74                          | 19000                     |         | Cr II   | 12496.44–82192.59  |
|                            | 1434.9897              | 69686.91                          | 6800                      |         | Cr II   | 11961.81–81649.19  |
| 1435.1336.....             | 1435.1340              | 69679.90                          | 6900                      | S       | Pt II   | 32237–101916       |
|                            | 1435.2073              | 69676.34                          | 15000                     |         | Cr II   | 12147.82–81824.40  |
|                            |                        |                                   |                           |         | Cr II   | 116581.74–46905.17 |
|                            | 1435.2604              | 69673.77                          | 6200                      | P       | Cr II   | 12303.86–81978.08  |
|                            | 1435.5825              | 69658.13                          | 12000                     |         | Cr II   | 12303.86–81962.29  |
|                            | 1435.8251              | 69646.36                          | 6100                      |         | Cr II   | 12496.44–82143.15  |
| 1436.0813.....             | 1436.0826              | 69633.88                          | 7400                      |         | Ne II   | ...                |
| 1436.3096.....             | 1436.3111              | 69622.80                          | 11000                     |         | Pt II   | 4786–74409         |
| 1436.7340.....             | 1436.7362              | 69602.20                          | 540                       |         | Pt II   | 32918–102520       |
|                            | 1437.6153              | 69559.64                          | 2400                      |         | Cr II   | 12147.82–81707.87  |
| 1437.6951.....             | 1437.6949              | 69555.79                          | 5600                      |         | Pt II   | 29261–98817        |
| 1437.8100.....             | 1437.8085 <sup>a</sup> | 69550.29                          | 1100                      |         | Pt II   | 9356–78906         |
|                            | 1438.5989              | 69512.08                          | 5100                      |         | Cr II   | 12303.86–81816.29  |
| 1439.1596.....             | 1439.1613              | 69484.91                          | 2300                      |         | ...     | ...                |
|                            | 1439.2409              | 69481.07                          | 5100                      |         | Cr II   | 12496.44–81978.08  |
| 1440.6635.....             | 1440.6644              | 69412.42                          | 890                       |         | Pt II   | 36484–105896       |
| 1441.1876.....             | 1441.1900 <sup>a</sup> | 69387.10                          | 1300                      |         | Ne II   | ...                |
|                            | 1441.9944              | 69348.40                          | 890                       |         | Cr II   | 0.00–69348.18      |
|                            |                        |                                   |                           |         | Cr II   | 116253.35–46905.17 |
|                            |                        |                                   |                           |         | Cr II   | 116171.71–46823.39 |
|                            | 1442.0654              | 69344.98                          | 400                       |         | Cr      | ...                |
| 1442.0911.....             | 1442.0966              | 69343.48                          | 400                       |         | Pt II   | 8419–77763         |
|                            | 1442.8321              | 69308.13                          | 1500                      |         | Cr II   | 116213.38–46905.17 |
|                            | 1443.5513              | 69273.60                          | 2800                      |         | Cr II   | 117672.56–48398.95 |
| 1444.0351.....             | 1444.0380              | 69250.25                          | 2200                      |         | Pt II   | 41434–110684       |
|                            | 1444.2198              | 69241.54                          | 1800                      |         | Cr II   | 116281.95–47040.35 |
|                            | 1445.4756              | 69181.38                          | 5200                      |         | Cr II   | 117672.56–48491.10 |
|                            | 1445.8882              | 69161.64                          | 2200                      |         | Cr II   | 116388.95–47227.24 |
|                            | 1445.9584              | 69158.28                          | 890                       | U       | Cr II   | 116385.67–47227.24 |
| 1445.9958.....             | 1445.9951              | 69156.53                          | 2100                      |         | Pt II   | 29030–98186        |
|                            | 1446.1868 <sup>a</sup> | 69147.36                          | 1500                      |         | Ne?     | ...                |
| 1446.2820.....             | 1446.2814              | 69142.84                          | 5700                      |         | Pt II   | 24879–94022        |
|                            | 1446.4038              | 69136.99                          | 720                       |         | Cr II   | 116601.65–47464.55 |
| 1446.7921.....             | 1446.7946              | 69118.31                          | 340                       |         | Pt II   | 8419–77538         |
| 1446.9019.....             | 1446.9015              | 69113.21                          | 2000                      |         | Pt II   | 36484–105597       |
|                            | 1447.6534              | 69077.31                          | 970                       |         | Cr II   | 116829.01–47751.62 |
| 1447.8030.....             | 1447.8032              | 69070.16                          | 12000                     |         | Pt II   | 36484–105554       |
|                            | 1447.8781              | 69066.59                          | 3100                      |         | Cr II   | 116531.26–47464.55 |
|                            | 1448.4280              | 69040.37                          | 10000                     |         | Cr II   | 117672.56–48632.12 |
|                            | 1448.6160              | 69031.41                          | 810                       |         | Cr II   | 33694.15–102725.66 |
| 1449.8015.....             | 1449.8001              | 68975.03                          | 1900                      |         | Pt II   | 4786–73761         |
| 1449.8015.....             |                        |                                   |                           |         | Pt II   | 37877–106852       |
|                            | 1450.1799              | 68956.96                          | 4300                      |         | Cr II   | 116708.67–47751.62 |
| 1450.55.....               | 1450.5316 <sup>a</sup> | 68940.24                          | 1000                      |         | Ne?     | ...                |
| 1451.5382.....             | 1451.5396              | 68892.37                          | 890                       |         | Pt II   | 23875–92767        |
| 1451.8840.....             | 1451.8851              | 68875.97                          | 1500                      |         | Pt II   | 32237–101113       |
| 1452.0129.....             | 1452.0146              | 68869.83                          | 810                       |         | Pt II   | 34647–103517       |

TABLE 1—Continued

| Wavelength Pt Atlas<br>(Å)  | Wavelength<br>(Å)      | Wavenumber<br>(cm <sup>-1</sup> ) | Intensity<br>(Arb. Units) | Comment | Species | Even-Odd           |
|-----------------------------|------------------------|-----------------------------------|---------------------------|---------|---------|--------------------|
| 1452.49.....                | 1452.4933 <sup>a</sup> | 68847.13                          | 1900                      |         | Ne?     | ...                |
| 1453.5678.....              | 1453.5670              | 68796.28                          | 1900                      |         | ...     | ...                |
| 1454.1586.....              | 1454.1606              | 68768.19                          | 890                       |         | Pt II   | 41434-110202       |
| 1454.2866.....              | 1454.2862              | 68762.26                          | 9100                      |         | Pt II   | 29030-97792        |
| 1454.2866.....              |                        |                                   |                           |         | Pt II   | 41434-110196       |
| 1455.8872.....              | 1455.8854              | 68686.72                          | 1800                      |         | Pt II   | 9356-78043         |
| 1457.5951.....              | 1457.5955              | 68606.14                          | 1700                      |         | Pt II   | 42031-110638       |
| 1457.6721.....              | 1457.6728              | 68602.50                          | 7300                      |         | Pt II   | 24879-93482        |
| 1458.6050.....              | 1458.6090              | 68558.47                          | 2000                      |         | Pt II   | 32237-100795       |
| 1459.6348.....              | 1459.6350              | 68510.28                          | 1400                      |         | Pt II   | 43737-112247       |
| 1460.1052.....              | 1460.1039              | 68488.28                          | 1300                      |         | Ne III  | ...                |
| 1460.2955.....              | 1460.2958              | 68479.28                          | 2300                      |         | Pt II   | 32918-101397       |
| 1460.716 <sup>a</sup> ..... | 1460.7172 <sup>a</sup> | 68459.52                          | 1500                      |         | Ne II   | ...                |
| 1460.7751.....              | 1460.7749              | 68456.82                          | 1500                      |         | Pt II   | 24879-93336        |
| 1461.0786.....              | 1461.0769              | 68442.67                          | 11000                     |         | Pt II   | 24879-93322        |
| 1461.24.....                | 1461.2403 <sup>a</sup> | 68435.01                          | 1200                      |         | Ne III  | ...                |
| 1461.4903.....              | 1461.4897              | 68423.34                          | 2300                      |         | Pt II   | 32918-101341       |
| 1461.7043.....              | 1461.7050              | 68413.26                          | 890                       |         | Pt II   | 34647-103060       |
| 1462.5295.....              | 1462.5298              | 68374.67                          | 2000                      |         | Pt II   | 32237-100611       |
| 1462.6591.....              | 1462.6601              | 68368.58                          | 10000                     |         | Pt II   | 29261-97630        |
| 1462.744 <sup>a</sup> ..... | 1462.7445 <sup>a</sup> | 68364.64                          | 1300                      |         | Ne II   | ...                |
| 1463.7090.....              | 1463.7098              | 68319.56                          | 1100                      |         | Pt II   | 41434-109753       |
| 1464.0013.....              | 1464.0032              | 68305.86                          | 3900                      |         | ...     | ...                |
| 1464.1508.....              | 1464.1507              | 68298.98                          | 3300                      |         | Pt II   | 41434-109733       |
| 1466.4859.....              | 1466.4852              | 68190.26                          | 970                       |         | Pt II   | 8419-76610         |
| 1467.0387.....              | 1467.0511              | 68163.95                          | 970                       | WG      | Pt II   | 42031-110196       |
| 1467.0619.....              |                        |                                   |                           |         | Pt II   | 9356-77519         |
|                             | 1467.1760              | 68158.15                          | 1000                      |         | Cr II   | 116790.31-48632.12 |
|                             | 1468.0636              | 68116.94                          | 970                       |         | Cr II   | 115581.62-47464.55 |
| 1468.5551.....              | 1468.5562              | 68094.09                          | 1700                      |         | Pt II   | 41434-109528       |
| 1469.2036.....              | 1469.2050              | 68064.02                          | 2500                      |         | Pt II   | 36484-104548       |
|                             | 1469.7953              | 68036.68                          | 1300                      |         | Cr II   | 115788.38-47751.62 |
| 1470.1835.....              | 1470.1850              | 68018.65                          | 1300                      |         | Pt II   | 37877-105896       |
| 1470.9150.....              | 1470.9135              | 67984.96                          | 2900                      |         | Pt II   | 32918-100903       |
| 1471.0423.....              | 1471.0408              | 67979.08                          | 2000                      |         | Pt II   | 43737-111716       |
| 1471.7535.....              | 1471.7523              | 67946.22                          | 8400                      |         | Ne?     | ...                |
|                             | 1472.8526 <sup>a</sup> | 67895.46                          | 810                       | W       | ...     | ...                |
| 1473.0500.....              | 1473.0497              | 67886.37                          | 1600                      |         | Ne III  | ...                |
| 1473.2508.....              | 1473.2512              | 67877.09                          | 3300                      |         | Pt II   | 32918-100795       |
| 1473.3251.....              | 1473.3278              | 67873.56                          | 2300                      |         | Pt II   | 41434-109307       |
| 1473.8839.....              | 1473.9008 <sup>a</sup> | 67847.17                          | 1300                      |         | Pt II   | 37877-105726       |
| 1473.894 <sup>a</sup> ..... |                        |                                   |                           |         | Ne II   | ...                |
| 1474.1931.....              | 1474.1941              | 67833.67                          | 2100                      |         | Pt I    | 823-68657          |
|                             | 1474.3009              | 67828.76                          | 2800                      |         | Cr II   | 40202.12-108031.16 |
| 1475.6306.....              | 1475.6295              | 67767.69                          | 21000                     | H       | Pt II   | 34647-102414       |
| 1475.9603.....              | 1475.9607              | 67752.48                          | 7400                      |         | Ne II   | ...                |
| 1476.2492.....              | 1476.2491              | 67739.25                          | 2300                      |         | Pt II   | 46046-113785       |
| 1476.6290.....              | 1476.6301              | 67721.77                          | 1300                      |         | Pt II   | 42031-109753       |
| 1476.6796.....              | 1476.6800              | 67719.48                          | 540                       |         | Pt II   | 37877-105597       |
| 1477.2547.....              | 1477.2559              | 67693.08                          | 3500                      |         | Pt II   | 32918-100611       |
| 1478.0338.....              | 1478.0313              | 67657.57                          | 4500                      |         | Pt II   | 24879-92537        |
| 1478.2534.....              | 1478.2557              | 67647.30                          | 640                       |         | Pt II   | 24879-92526        |
|                             | 1478.8106              | 67621.91                          | 1600                      |         | Cr II   | 40228.33-107850.50 |
| 1478.9117.....              | 1478.9111              | 67617.32                          | 4300                      |         | Pt II   | 43737-111354       |
|                             | 1479.4380              | 67593.24                          | 1100                      |         | Cr II   | 31219.35-98812.67  |
| 1479.6034.....              | 1479.6034              | 67585.68                          | 1800                      |         | Pt II   | ...                |
| 1480.1489.....              | 1480.1464              | 67560.89                          | 1100                      | W       | Pt II   | 32237-99797        |
| 1481.5602.....              | 1481.5662              | 67496.14                          | 810                       |         | Pt II   | 42031-109528       |
| 1482.8256.....              | 1482.8244              | 67438.87                          | 32000                     |         | Pt II   | 34647-102086       |
| 1483.5029.....              | 1483.5034 <sup>a</sup> | 67408.00                          | 1800                      |         | Ne II   | ...                |
| 1483.5530.....              | 1483.5513              | 67405.82                          | 890                       |         | ...     | ...                |
| 1484.2254.....              | 1484.2277 <sup>a</sup> | 67375.11                          | 1100                      |         | Ne?     | ...                |
|                             | 1485.2515              | 67328.66                          | 970                       |         | Cr II   | 39824.38-107153.15 |
|                             |                        |                                   |                           |         | Cr II   | 42986.62-110315.08 |
| 1486.0308.....              | 1486.0298              | 67293.40                          | 5600                      |         | Pt II   | 41434-108727       |

TABLE 1—Continued

| Wavelength Pt Atlas<br>(Å) | Wavelength<br>(Å)      | Wavenumber<br>(cm <sup>-1</sup> ) | Intensity<br>(Arb. Units) | Comment | Species | Even-Odd           |
|----------------------------|------------------------|-----------------------------------|---------------------------|---------|---------|--------------------|
| 1486.2117.....             | 1486.2148 <sup>a</sup> | 67285.03                          | 640                       |         | Pt II   | 23461-90746        |
| 1487.8620.....             | 1487.8623              | 67210.52                          | 1300                      |         | ...     | ...                |
| 1487.9804.....             | 1487.9824              | 67205.10                          | 3100                      |         | Pt II   | 41434-108639       |
| 1488.8805.....             | 1488.8822              | 67164.48                          | 1700                      |         | Pt II   | 37877-105042       |
| 1488.9770.....             | 1488.9789              | 67160.12                          | 2800                      |         | ...     | ...                |
|                            | 1489.0662              | 67156.18                          | 890                       |         | Cr II   | 115788.38-48632.12 |
|                            | 1489.3289              | 67144.33                          | 640                       |         | Cr II   | 116790.31-49645.77 |
| 1489.4179.....             | 1489.4178              | 67140.33                          | 1000                      |         | Pt II   | 37877-105018       |
| 1490.27.....               | 1490.2747              | 67101.72                          | 1100                      |         | Cr II   | 30391.83-97493.70  |
|                            | 1490.5265              | 67090.39                          | 640                       |         | Cr II   | 115581.62-48491.10 |
| 1491.34.....               | 1491.3253 <sup>a</sup> | 67054.45                          | 640                       |         | ...     | ...                |
| 1491.5097.....             | 1491.5119              | 67046.06                          | 720                       |         | ...     | ...                |
|                            | 1491.6227              | 67041.08                          | 540                       |         | Cr II   | 116687.20-49645.77 |
|                            | 1491.7700              | 67034.46                          | 640                       | U       | Cr II   | 116385.67-49351.80 |
|                            |                        |                                   |                           |         | Cr II   | 30298.51-97333.28  |
| 1491.8030.....             | 1491.8004              | 67033.10                          | 1800                      |         | Pt II   | 36484-103517       |
| 1491.8030.....             |                        |                                   |                           |         | Pt II   | 15791-82824        |
| 1491.9735.....             | 1491.9727              | 67025.36                          | 8200                      |         | Pt II   | 43737-110762       |
|                            | 1492.6860              | 66993.33                          | 1400                      |         | Cr II   | 116831.84-49838.38 |
|                            | 1492.7484              | 66990.53                          | 1700                      |         | Cr II   | 116829.01-49838.38 |
| 1492.9990.....             | 1492.9986              | 66979.30                          | 3100                      |         | Pt II   | 36484-103463       |
| 1493.1612.....             | 1493.1608              | 66972.03                          | 2000                      |         | Pt II   | 32237-99209        |
|                            | 1493.2395              | 66968.49                          | 1100                      |         | Cr II   | 30218.81-97187.28  |
|                            |                        |                                   |                           |         | Cr II   | 38314.86-105283.47 |
| 1493.3508.....             | 1493.3510              | 66963.49                          | 540                       |         | ...     | ...                |
|                            | 1493.4476              | 66959.16                          | 1400                      |         | Cr      | ...                |
|                            | 1493.5256              | 66955.67                          | 1300                      |         | Cr II   | 116601.65-49645.77 |
| 1493.7402.....             | 1493.7423              | 66945.95                          | 1400                      |         | Pt II   | 8419-75365         |
|                            | 1494.0923              | 66930.27                          | 1300                      |         | Cr II   | 116281.95-49351.80 |
|                            | 1494.4556              | 66914.00                          | 1000                      |         | Cr II   | 42897.99-109812.06 |
| 1494.7256.....             | 1494.7253              | 66901.93                          | 47000                     |         | Pt II   | 34647-101549       |
| 1495.0297.....             | 1495.0301              | 66888.29                          | 1600                      |         | Pt II   | 41434-108322       |
| 1495.4014.....             | 1495.4019              | 66871.65                          | 4400                      |         | Pt II   | 43737-110609       |
| 1495.4796.....             | 1495.4806              | 66868.13                          | 1400                      |         | Pt II   | 13329-80197        |
| 1495.9363.....             | 1495.9366              | 66847.75                          | 2800                      |         | Pt II   | 29261-96109        |
| 1496.2958.....             | 1496.2952              | 66831.73                          | 1700                      |         | Pt II   | 32237-99068        |
| 1497.2192.....             | 1497.2189              | 66790.50                          | 1700                      |         | Pt II   | 24879-91669        |
| 1498.1132.....             | 1498.1121              | 66750.68                          | 25000                     |         | Pt II   | 34647-101397       |
| 1498.7213.....             | 1498.7232              | 66723.46                          | 890                       |         | Pt II   | 29030-95754        |
| 1498.8389.....             | 1498.8385              | 66718.33                          | 2800                      |         | ...     | ...                |
| 1499.0024.....             | 1499.0022              | 66711.04                          | 2600                      |         | Ne II   | ...                |
| 1499.3707.....             | 1499.3701              | 66694.67                          | 39000                     |         | Pt II   | 34647-101341       |
| 1499.9177.....             | 1499.9204              | 66670.21                          | 810                       |         | Pt II   | 37877-104548       |
| 1500.5854.....             | 1500.5860              | 66640.63                          | 2200                      |         | Pt II   | 42031-108672       |
| 1501.3350.....             | 1501.3358              | 66607.35                          | 3100                      |         | Pt II   | 42031-108639       |
| 1501.4245.....             | 1501.4238              | 66603.45                          | 3000                      | H       | Pt II   | 41434-108038       |
| 1501.4245.....             |                        |                                   |                           |         | Pt II   | 41434-108037       |
| 1501.7275.....             | 1501.7286              | 66589.93                          | 2000                      |         | Pt I    | 823-67413          |
| 1502.9149.....             | 1502.9163              | 66537.30                          | 1300                      |         | ...     | ...                |
| 1503.3439.....             | 1503.3426              | 66518.43                          | 540                       |         | ...     | ...                |
| 1504.02.....               | 1504.0201 <sup>a</sup> | 66488.47                          | 1100                      |         | Ne?     | ...                |
| 1504.5514.....             | 1504.5530              | 66464.92                          | 1900                      |         | Pt II   | 43737-110202       |
| 1505.2462.....             | 1505.2450              | 66434.37                          | 45000                     |         | Pt II   | 0-66434            |
| 1506.2923.....             | 1506.2925              | 66388.17                          | 24000                     |         | Pt II   | 36484-102872       |
| 1507.4998.....             | 1507.4997              | 66335.01                          | 640                       |         | Pt II   | 8419-74754         |
| 1507.6288.....             | 1507.6290              | 66329.31                          | 9700                      |         | Pt II   | 43737-110066       |
| 1508.3427.....             | 1508.3444              | 66297.85                          | 890                       |         | Pt I    | 823-67121          |
| 1508.5129.....             | 1508.5128              | 66290.46                          | 3100                      |         | Pt II   | 32918-99209        |
| 1508.7309.....             | 1508.7310              | 66280.87                          | 1700                      |         | Pt II   | 37877-104158       |
| 1508.7910.....             | 1508.7926              | 66278.16                          | 2000                      |         | Pt II   | 13329-79607        |
| 1509.2920.....             | 1509.2898              | 66256.33                          | 120000                    |         | Pt II   | 34647-100903       |
| 1510.5903.....             | 1510.5943              | 66199.11                          | 1500                      |         | Pt II   | 8419-74619         |
| 1510.7023.....             | 1510.7034              | 66194.33                          | 1100                      |         | Pt II   | 36484-102678       |
| 1511.2021.....             | 1511.2030              | 66172.45                          | 2800                      |         | ...     | ...                |
| 1511.6233.....             | 1511.6230              | 66154.06                          | 1200                      |         | Pt II   | 41434-107588       |

TABLE 1—Continued

| Wavelength Pt Atlas<br>(Å) | Wavelength<br>(Å)      | Wavenumber<br>(cm <sup>-1</sup> ) | Intensity<br>(Arb. Units) | Comment | Species | Even-Odd           |
|----------------------------|------------------------|-----------------------------------|---------------------------|---------|---------|--------------------|
| 1512.0895.....             | 1512.0883              | 66133.71                          | 2300                      |         | ...     | ...                |
|                            | 1513.8939              | 66054.83                          | 1700                      |         | Cr II   | 20024.01–86078.90  |
| 1514.5087.....             | 1514.5072              | 66028.08                          | 5500                      |         | Pt II   | 0–66028            |
| 1515.0089.....             | 1515.0091              | 66006.21                          | 4000                      |         | Pt II   | 42031–108038       |
| 1515.2502.....             | 1515.2514              | 65995.65                          | 4100                      |         | Pt II   | 43737–109733       |
|                            | 1515.5900 <sup>a</sup> | 65980.91                          | 970                       |         | Cr II   | 19797.88–85778.69  |
| 1515.9776.....             | 1515.9809              | 65963.89                          | 450                       |         | Pt II   | 29261–95226        |
|                            | 1516.0479              | 65960.98                          | 1500                      |         | Cr II   | 40202.12–106163.16 |
|                            | 1516.3004              | 65949.99                          | 1100                      |         | Cr II   | 115788.38–49838.38 |
|                            | 1516.6000 <sup>a</sup> | 65936.96                          | 1300                      |         | Cr II   | 40228.33–106165.30 |
| 1516.7411.....             | 1516.7415              | 65930.81                          | 4500                      |         | Pt II   | 36484–102414       |
| 1517.4695.....             | 1517.4685              | 65899.22                          | 5200                      |         | Pt II   | 32918–98817        |
| 1517.9314.....             | 1517.9291              | 65879.23                          | 890                       |         | ...     | ...                |
| 1518.5424.....             | 1518.5401              | 65852.72                          | 810                       |         | Pt I    | 0–65852            |
| 1519.5970.....             | 1519.5968              | 65806.93                          | 2400                      |         | ...     | ...                |
| 1520.0051.....             | 1520.0044              | 65789.28                          | 7600                      |         | ...     | ...                |
| 1520.6947.....             | 1520.6980              | 65759.28                          | 1700                      | U       | Pt II   | 37877–103637       |
| 1520.7414.....             | 1520.7416              | 65757.39                          | 11000                     |         | Pt II   | 41434–107191       |
| 1521.3202.....             | 1521.3214              | 65732.33                          | 540                       |         | Pt II   | 23875–89607        |
| 1523.0737.....             | 1523.0772              | 65656.56                          | 890                       |         | Pt I    | 775–66432          |
| 1524.5715.....             | 1524.5695              | 65592.29                          | 69000                     |         | Pt II   | 34647–100239       |
| 1524.7295.....             | 1524.7277              | 65585.48                          | 380000                    |         | Pt II   | 37877–103463       |
| 1524.8543.....             | 1524.8501              | 65580.22                          | 3800                      | P       | Pt II   | 8419–73999         |
| 1525.0764.....             | 1525.0753              | 65570.53                          | 2200                      |         | Pt II   | 43737–109307       |
| 1525.2635.....             | 1525.2623              | 65562.49                          | 1700                      |         | Pt II   | 41434–106996       |
| 1525.3983.....             | 1525.3972              | 65556.70                          | 3300                      |         | ...     | ...                |
|                            | 1525.6489              | 65545.88                          | 1100                      |         | Cr II   | 117488.50–51942.70 |
| 1525.7082.....             | 1525.7073              | 65543.37                          | 640                       |         | Pt II   | 37877–103421       |
| 1526.4791.....             | 1526.4773              | 65510.31                          | 1800                      |         | Pt I    | 0–65510            |
| 1526.8391.....             | 1526.8373              | 65494.86                          | 810                       |         | ...     | ...                |
| 1528.2831.....             | 1528.2822              | 65432.94                          | 27000                     |         | Pt II   | 36484–101916       |
| 1528.5153.....             | 1528.5172 <sup>a</sup> | 65422.88                          | 1400                      |         | Pt I    | 775–66198          |
|                            | 1529.0592              | 65399.69                          | 2300                      |         | Cr II   | 117342.41–51942.70 |
| 1529.2942.....             | 1529.2961              | 65389.56                          | 640                       |         | Pt II   | 9356–74745         |
| 1529.4582.....             | 1529.4574              | 65382.66                          | 3100                      |         | ...     | ...                |
|                            | 1530.1580              | 65352.73                          | 2100                      | U       | Cr II   | 117141.58–51788.88 |
| 1530.1969.....             | 1530.1954              | 65351.13                          | 47000                     |         | Pt II   | 0–65351            |
|                            | 1531.0192              | 65315.97                          | 1300                      |         | Cr II   | 116985.30–51669.48 |
| 1531.5395.....             | 1531.5382              | 65293.83                          | 3800                      |         | Pt II   | 24879–90173        |
| 1532.1348.....             | 1532.1344              | 65268.43                          | 890                       |         | Pt II   | 32918–98186        |
| 1532.2657.....             | 1532.2653              | 65262.85                          | 1100                      |         | Pt II   | 9356–74619         |
| 1532.8689.....             | 1532.8722 <sup>a</sup> | 65237.01                          | 970                       |         | ...     | ...                |
| 1534.6947.....             | 1534.6929              | 65159.61                          | 1700                      |         | Pt II   | 42031–107191       |
| 1534.9063.....             | 1534.9049              | 65150.62                          | 41000                     |         | Pt II   | 34647–99797        |
| 1535.4357.....             | 1535.4341              | 65128.16                          | 890                       |         | Pt II   | 23461–88589        |
| 1535.5495.....             | 1535.5494              | 65123.27                          | 640                       |         | Pt II   | 13329–78452        |
| 1535.8589.....             | 1535.8588              | 65110.15                          | 720                       |         | Pt II   | ...                |
| 1536.7059.....             | 1536.7060              | 65074.26                          | 1600                      |         | Pt I    | 775–65850          |
| 1536.9303.....             | 1536.9304              | 65064.75                          | 640                       |         | Pt II   | 43737–108802       |
| 1537.7781.....             | 1537.7791              | 65028.84                          | 3000                      |         | Pt I    | 823–65852          |
| 1538.6968.....             | 1538.6964              | 64990.08                          | 1100                      |         | Pt II   | 43737–108727       |
| 1538.8457.....             | 1538.8461              | 64983.76                          | 640                       |         | Pt II   | 24879–89863        |
| 1540.5040.....             | 1540.5037              | 64913.83                          | 19000                     | L       | Pt II   | 36484–101397       |
| 1541.5940.....             | 1541.5925              | 64867.99                          | 3100                      |         | Pt II   | 32918–97786        |
| 1541.8337.....             | 1541.8356              | 64857.76                          | 23000                     |         | Pt II   | 36484–101341       |
| 1542.7098.....             | 1542.7093              | 64821.03                          | 11000                     |         | Pt II   | 42031–106852       |
| 1543.1986.....             | 1543.1972              | 64800.53                          | 890                       |         | Pt II   | 37877–102678       |
| 1543.2521.....             | 1543.2525              | 64798.21                          | 1700                      |         | ...     | ...                |
| 1543.3098.....             | 1543.3102              | 64795.79                          | 2200                      |         | Pt II   | 41434–106229       |
| 1544.1529.....             | 1544.1534              | 64760.40                          | 4300                      |         | Pt II   | 29261–94022        |
| 1544.4116.....             | 1544.4145              | 64749.46                          | 720                       |         | ...     | ...                |
| 1544.7755.....             | 1544.7775 <sup>a</sup> | 64734.24                          | 890                       |         | Pt I    | 775–65510          |
| 1545.1807.....             | 1545.1806              | 64717.35                          | 2600                      |         | ...     | ...                |
| 1545.2656.....             | 1545.2648              | 64713.83                          | 720                       |         | Pt II   | 13329–78043        |

TABLE 1—Continued

| Wavelength Pt Atlas<br>(Å)  | Wavelength<br>(Å)      | Wavenumber<br>(cm <sup>-1</sup> ) | Intensity<br>(Arb. Units) | Comment | Species   | Even-Odd           |
|-----------------------------|------------------------|-----------------------------------|---------------------------|---------|-----------|--------------------|
| 1545.3155.....              | 1545.3116              | 64711.87                          | 640                       |         | Pt II     | 23461–88173        |
|                             | 1546.0909              | 64679.25                          | 720                       |         | Cr        | ...                |
| 1546.1695.....              | 1546.1720              | 64675.86                          | 890                       |         | Pt I      | 0–64675            |
| 1546.8248.....              | 1546.8274              | 64648.45                          | 15000                     |         | Pt II     | 23461–88110        |
| 1548.3465.....              | 1548.3479              | 64584.97                          | 1700                      |         | Pt II     | 43737–108322       |
| 1548.9038.....              | 1548.9044              | 64561.76                          | 7500                      |         | Pt II     | 34647–99209        |
| 1549.4972.....              | 1549.4983              | 64537.02                          | 6900                      |         | Pt II     | 37877–102414       |
| 1550.0109.....              | 1550.0111              | 64515.67                          | 2100                      |         | Pt I      | 0–64515            |
| 1551.2918.....              | 1551.2916              | 64462.41                          | 1700                      |         | Pt II     | 41434–105896       |
|                             | 1552.2260              | 64423.61                          | 720                       |         | Cr        | ...                |
| 1552.3268.....              | 1552.3273              | 64419.40                          | 47000                     |         | Pt II     | 36484–100903       |
| 1552.7442.....              | 1552.7443              | 64402.10                          | 3000                      |         | ...       | ...                |
| 1553.0689.....              | 1553.0685              | 64388.66                          | 6400                      |         | Pt II     | 0–64388            |
| 1553.5288.....              | 1553.5299              | 64369.54                          | 1200                      |         | ...       | ...                |
| 1554.7412.....              | 1554.7426              | 64319.33                          | 4400                      |         | Pt I      | 0–64319            |
| 1554.9285.....              | 1554.9296              | 64311.59                          | 81000                     |         | Pt II     | 36484–100795       |
| 1556.0618.....              | 1556.0612              | 64264.82                          | 810                       |         | Pt II     | 32918–97183        |
| 1556.1592.....              | 1556.1625              | 64260.64                          | 1200                      |         | ...       | ...                |
| 1556.3424.....              | 1556.3450 <sup>a</sup> | 64253.11                          | 1500                      |         | ...       | ...                |
| 1557.1462.....              | 1557.1469              | 64220.02                          | 1800                      |         | Pt II     | 29261–93482        |
| 1557.4129.....              | 1557.4150              | 64208.96                          | 450                       |         | Pt II     | 13329–77538        |
| 1557.4721.....              | 1557.4813 <sup>a</sup> | 64206.39                          | 2000                      |         | Pt II     | 32237–96443        |
| 1557.487 <sup>a</sup> ..... |                        | 64206.23                          |                           |         | Ne II     | ...                |
| 1558.3479.....              | 1558.3478              | 64170.53                          | 10000                     |         | Pt II     | 34647–98817        |
| 1558.5216.....              | 1558.5247              | 64163.24                          | 4000                      |         | Pt II     | 41434–105597       |
| 1559.2806.....              | 1559.2854              | 64131.94                          | 450                       |         | ...       | ...                |
| 1559.3893.....              | 1559.3906              | 64127.61                          | 14000                     |         | Pt II     | 36484–100611       |
| 1559.5696.....              | 1559.5706              | 64120.21                          | 2400                      |         | Pt II     | 41434–105554       |
|                             | 1559.9369              | 64105.16                          | 1500                      |         | Cr II     | 116047.90–51942.70 |
|                             | 1560.3094              | 64089.85                          | 1800                      | W       | C I       | ...                |
| 1560.3614.....              | 1560.3617              | 64087.71                          | 1200                      |         | ...       | ...                |
| 1560.5351.....              | 1560.5355              | 64080.57                          | 15000                     |         | Pt I      | 823–64904          |
| 1560.6822.....              | 1560.6828              | 64074.52                          | 5200                      | H       | C I       | ...                |
| 1561.0312.....              | 1561.0303              | 64060.25                          | 4900                      |         | Pt II     | 29261–93322        |
|                             | 1561.3429              | 64047.43                          | 1400                      |         | C I       | ...                |
| 1561.4384.....              | 1561.4372              | 64043.56                          | 8900                      | H       | C I       | ...                |
| 1561.5450.....              | 1561.5447              | 64039.15                          | 15000                     |         | Pt II     | 37877–101916       |
| 1561.5450.....              |                        |                                   |                           |         | Pt II     | 46046–110085       |
|                             | 1561.7769              | 64029.63                          | 1100                      |         | Cr II     | 115818.49–51788.88 |
| 1562.3865.....              | 1562.3893 <sup>a</sup> | 64004.53                          | 1300                      |         | ...       | ...                |
|                             | 1563.2117              | 63970.86                          | 340                       |         | Cr II     | 115640.42–51669.48 |
| 1563.56.....                | 1563.5575 <sup>a</sup> | 63956.71                          | 1400                      |         | ...       | ...                |
|                             | 1565.2847              | 63886.14                          | 2100                      |         | Cr II     | 54867.61–118753.64 |
| 1565.8087.....              | 1565.8108              | 63864.68                          | 1200                      |         | Pt II     | 42031–105896       |
| 1565.91.....                | 1565.9164 <sup>a</sup> | 63860.37                          | 1000                      |         | Ne?       | ...                |
| 1566.1156.....              | 1566.1155              | 63852.25                          | 3500                      |         | Pt I      | 823–64675          |
| 1566.7334.....              | 1566.7343              | 63827.03                          | 6400                      | P       | ...       | ...                |
| 1566.7475.....              | 1566.7467              | 63826.53                          | 4500                      | U       | Pt I      | 0–63826            |
| 1567.5248.....              | 1567.5245              | 63794.86                          | 6600                      |         | Ne II     | ...                |
|                             | 1567.5642              | 63793.24                          | 1200                      |         | Cr        | ...                |
| 1568.4948.....              | 1568.4947              | 63755.39                          | 7400                      |         | Pt II     | 36484–100239       |
|                             | 1568.5727              | 63752.23                          | 2300                      |         | Cr II     | 54887.97–118640.08 |
| 1568.9021.....              | 1568.9000              | 63738.93                          | 23000                     |         | Pt II/Cr? | 0–63738            |
| 1569.015 <sup>a</sup> ..... | 1569.0148 <sup>a</sup> | 63734.26                          | 1100                      |         | Ne II     | ...                |
| 1569.09.....                | 1569.1010              | 63730.76                          | 2100                      |         | Cr II/Pt? | 55023.10–118753.64 |
| 1569.7820.....              | 1569.7814              | 63703.14                          | 540                       |         | ...       | ...                |
| 1570.9275.....              | 1570.9269              | 63656.68                          | 1100                      |         | Pt II     | 48591–112247       |
| 1571.1196.....              | 1571.1194              | 63648.89                          | 2600                      |         | Pt II     | 43737–107386       |
| 1571.8842.....              | 1571.8925              | 63617.58                          | 890                       | H       | Pt II?    | 117493–53875       |
| 1572.1223.....              | 1572.1216              | 63608.31                          | 1400                      |         | Pt II     | 41434–105042       |
| 1572.1752.....              | 1572.1723              | 63606.26                          | 890                       |         | ...       | ...                |
| 1572.7201.....              | 1572.7178              | 63584.20                          | 1500                      |         | Pt II     | 41434–105018       |
| 1573.1802.....              | 1573.1807              | 63565.49                          | 10000                     |         | Pt II     | 42031–105597       |
| 1573.8180.....              | 1573.8181              | 63539.74                          | 17000                     |         | Pt II     | 34647–98186        |

TABLE 1—Continued

| Wavelength Pt Atlas<br>(Å) | Wavelength<br>(Å)      | Wavenumber<br>(cm <sup>-1</sup> ) | Intensity<br>(Arb. Units) | Comment | Species | Even-Odd           |
|----------------------------|------------------------|-----------------------------------|---------------------------|---------|---------|--------------------|
| 1574.0819.....             | 1574.0831              | 63529.05                          | 1100                      |         | Pt II   | 8419-71948         |
| 1574.3059.....             | 1574.3052              | 63520.09                          | 96000                     |         | Pt II   | 37877-101397       |
| 1574.4002.....             | 1574.3995              | 63516.28                          | 6400                      |         | Pt II   | 37877-101394       |
|                            | 1574.5826              | 63508.89                          | 1200                      |         | Cr      | ...                |
| 1574.6393.....             | 1574.6403              | 63506.57                          | 540                       |         | Pt II   | 29030-92537        |
| 1574.9089.....             | 1574.9091              | 63495.73                          | 7500                      |         | Pt I    | 823-64319          |
| 1575.4706.....             | 1575.4709 <sup>a</sup> | 63473.09                          | 1100                      |         | Pt I    | 775-64248          |
| 1575.86.....               | 1575.8558 <sup>a</sup> | 63457.58                          | 890                       |         | ...     | ...                |
| 1577.2202.....             | 1577.2196              | 63402.71                          | 450                       |         | ...     | ...                |
|                            | 1577.3287              | 63398.33                          | 2400                      |         | Cr      | ...                |
| 1577.8723.....             | 1577.8719              | 63376.50                          | 1900                      |         | Pt II   | 16820-80197        |
|                            | 1578.3698              | 63356.51                          | 890                       |         | Cr      | ...                |
|                            | 1579.0345              | 63329.84                          | 1800                      |         | Cr II   | 52297.81-115627.76 |
|                            | 1579.3938              | 63315.43                          | 1500                      | U       | Cr      | ...                |
| 1579.4357.....             | 1579.4358              | 63313.75                          | 33000                     |         | Pt II   | 36484-99797        |
| 1580.4001.....             | 1580.3998              | 63275.13                          | 970                       |         | Pt II   | 29261-92537        |
| 1580.6548.....             | 1580.6538              | 63264.96                          | 540                       |         | Pt II   | 29261-92526        |
| 1580.7121.....             | 1580.7083              | 63262.78                          | 1200                      |         | ...     | ...                |
| 1580.8013.....             | 1580.7987              | 63259.16                          | 2800                      |         | Pt II   | 43737-106996       |
| 1580.8322.....             | 1580.8338              | 63257.76                          | 1500                      | P       | Pt II   | 43737-106995       |
|                            | 1581.1626              | 63244.60                          | 970                       | U       | Cr II   | 38269.59-101514.29 |
|                            | 1581.2078              | 63242.79                          | 3100                      |         | Cr      | ...                |
|                            | 1581.2382              | 63241.58                          | 1700                      | U       | Cr II   | 55398.74-118640.08 |
| 1581.3980.....             | 1581.3987              | 63235.16                          | 39000                     |         | Pt II   | 37877-101113       |
|                            | 1581.6808              | 63223.88                          | 1500                      |         | Cr II   | 55398.74-118622.60 |
|                            | 1581.7455              | 63221.30                          | 890                       |         | Cr      | ...                |
|                            | 1582.9213              | 63174.33                          | 2100                      |         | Cr      | ...                |
| 1583.0953.....             | 1583.0959              | 63167.37                          | 1700                      |         | Pt I    | 0-63167            |
|                            | 1583.1886              | 63163.67                          | 340                       |         | ...     | ...                |
|                            | 1583.2767              | 63160.16                          | 2500                      |         | Cr      | ...                |
| 1583.6406.....             | 1583.6413              | 63145.61                          | 4300                      |         | Pt II   | 34647-97792        |
| 1584.2474.....             | 1584.2491              | 63121.39                          | 3600                      |         | Pt I    | 823-63945          |
| 1585.42.....               | 1585.4019 <sup>a</sup> | 63075.49                          | 640                       |         | Ne III  | ...                |
| 1585.68.....               | 1585.6754 <sup>a</sup> | 63064.61                          | 1400                      |         | Ne III  | ...                |
| 1586.0312.....             | 1586.0319              | 63050.43                          | 1000                      |         | Pt I    | 775-63826          |
|                            | 1586.4021              | 63035.72                          | 1400                      |         | Cr      | ...                |
| 1587.0368.....             | 1587.0355              | 63010.56                          | 1700                      |         | Pt II   | 42031-105042       |
|                            | 1587.3457              | 62998.25                          | 1200                      |         | Cr      | ...                |
|                            | 1587.3893              | 62996.52                          | 1200                      |         | Cr II   | 55626.21-118622.60 |
| 1587.4559.....             | 1587.4563              | 62993.86                          | 3000                      |         | Pt II   | 4786-67780         |
| 1587.6482.....             | 1587.6456              | 62986.35                          | 2800                      |         | Pt II   | 18097-81083        |
| 1587.6482.....             |                        |                                   |                           |         | Pt II   | 42031-105018       |
| 1587.7205.....             | 1587.7197              | 62983.41                          | 14000                     |         | Pt II   | 34647-97630        |
|                            | 1588.2682              | 62961.66                          | 1300                      |         | Cr      | ...                |
| 1588.6920.....             | 1588.6905              | 62944.92                          | 2600                      |         | Pt II   | 8419-71364         |
| 1589.3735.....             | 1589.3738              | 62917.86                          | 16000                     |         | Pt II   | 37877-100795       |
| 1590.9851.....             | 1590.9836              | 62854.20                          | 3100                      |         | ...     | ...                |
|                            | 1591.1979              | 62845.74                          | 1300                      |         | Cr      | ...                |
|                            | 1593.9771              | 62736.16                          | 1300                      | P       | Cr II   | 54784.48-117520.75 |
| 1594.0344.....             | 1594.0347              | 62733.89                          | 15000                     |         | Pt II   | 37877-100611       |
|                            | 1594.1625              | 62728.86                          | 450                       |         | ...     | ...                |
| 1594.2611.....             | 1594.2607              | 62725.00                          | 12000                     |         | Pt II   | 36484-99209        |
|                            | 1594.7936              | 62704.04                          | 2000                      |         | Cr II   | 117488.50-54784.48 |
| 1595.1388.....             | 1595.1413 <sup>a</sup> | 62690.37                          | 720                       |         | Pt I    | 775-63466          |
|                            | 1595.5743              | 62673.36                          | 890                       |         | Cr      | ...                |
| 1595.8834.....             | 1595.8843              | 62661.18                          | 1300                      |         | Pt II   | 15791-78452        |
| 1595.9644.....             | 1595.9654              | 62658.00                          | 1700                      |         | Pt II   | 41434-104092       |
| 1596.3988.....             | 1596.3986              | 62641.00                          | 2500                      |         | Ne II   | ...                |
| 1596.4379.....             | 1596.4391              | 62639.41                          | 1300                      |         | Pt II   | 29030-91669        |
|                            | 1596.4796              | 62637.82                          | 970                       |         | Cr II   | 117263.48-54625.62 |
| 1596.7767.....             | 1596.7772              | 62626.14                          | 1800                      |         | Pt II   | 46046-108672       |
| 1597.6295.....             | 1597.6303              | 62592.70                          | 1000                      |         | Pt II   | 9356-71948         |
| 1597.6295.....             |                        |                                   |                           |         | Pt II   | 32237-94829        |
| 1597.8343.....             | 1597.8352              | 62584.68                          | 3100                      |         | Pt II   | 36484-99068        |
| 1597.9705.....             | 1597.9700              | 62579.40                          | 29000                     |         | Ne II   | ...                |
| 1599.5835.....             | 1599.5837 <sup>a</sup> | 62516.27                          | 720                       |         | Pt II   | 42031-104548       |



TABLE 1—Continued

| Wavelength Pt Atlas<br>(Å) | Wavelength<br>(Å)      | Wavenumber<br>(cm <sup>-1</sup> ) | Intensity<br>(Arb. Units) | Comment | Species | Even-Odd           |
|----------------------------|------------------------|-----------------------------------|---------------------------|---------|---------|--------------------|
| 1600.0814.....             | 1600.0799 <sup>a</sup> | 62496.88                          | 2600                      |         | Ne II   | ...                |
| 1600.1934.....             | 1600.1927              | 62492.47                          | 720                       |         | Pt II   | 43737-106229       |
| 1601.2962.....             | 1601.2935              | 62449.51                          | 720                       |         | ...     | ...                |
|                            | 1602.6507              | 62396.63                          | 1500                      |         | Cr II   | 32854.31-95250.69  |
| 1602.7837.....             | 1602.7831              | 62391.47                          | 20000                     |         | Pt I    | 775-63167          |
| 1603.5502.....             | 1603.5497              | 62361.65                          | 6300                      |         | Pt II   | 37877-100239       |
| 1604.0102.....             | 1604.0093              | 62343.78                          | 75000                     |         | Ne II   | ...                |
| 1604.0102.....             |                        |                                   |                           |         | Pt I    | 823-63167          |
| 1604.0927.....             | 1604.0898 <sup>a</sup> | 62340.65                          | 2700                      |         | Ne II   | ...                |
| 1604.2682.....             | 1604.2695              | 62333.67                          | 810                       |         | Pt II   | 36484-98817        |
| 1604.5702.....             | 1604.5725              | 62321.89                          | 1700                      |         | Pt I    | 0-62321            |
| 1604.7337.....             | 1604.7338              | 62315.63                          | 22000                     |         | Ne III  | ...                |
| 1605.3536.....             | 1605.3524              | 62291.62                          | 18000                     |         | Pt I    | 775-63067          |
| 1606.1550.....             | 1606.1547              | 62260.50                          | 970                       |         | ...     | ...                |
| 1606.2741.....             | 1606.2763              | 62255.79                          | 3300                      |         | ...     | ...                |
|                            | 1606.6821              | 62240.06                          | 720                       |         | Cr II   | 32836.68-95076.72  |
| 1608.5173.....             | 1608.5146 <sup>a</sup> | 62169.16                          | 970                       |         | Ne II   | ...                |
| 1609.6647.....             | 1609.6649              | 62124.73                          | 810                       |         | ...     | ...                |
| 1609.8562.....             | 1609.8568 <sup>a</sup> | 62117.33                          | 810                       |         | Ne?     | ...                |
| 1610.0697.....             | 1610.0692              | 62109.13                          | 970                       |         | Pt II   | 46046-108155       |
| 1610.1405.....             | 1610.1401              | 62106.40                          | 9700                      |         | Pt I    | 0-62106            |
| 1610.7448.....             | 1610.7454              | 62083.06                          | 1300                      |         | Pt II   | 41434-103517       |
| 1610.7907.....             | 1610.7921              | 62081.26                          | 1000                      |         | ...     | ...                |
| 1611.2844.....             | 1611.2844              | 62062.29                          | 1100                      |         | Pt I    | 0-62062            |
| 1611.8840.....             | 1611.8830 <sup>a</sup> | 62039.24                          | 640                       |         | Pt I    | 6567-68606         |
| 1612.5934.....             | 1612.5911 <sup>a</sup> | 62012.00                          | 810                       |         | Pt I    | 823-62835          |
|                            | 1612.9857              | 61996.83                          | 1300                      |         | Cr      | ...                |
| 1613.2389.....             | 1613.2396              | 61987.07                          | 810                       |         | Pt II   | 41434-103421       |
| 1613.9653.....             | 1613.9625              | 61959.31                          | 970                       | U       | Pt II   | 8419-70379         |
| 1613.9882.....             | 1613.9882              | 61958.32                          | 5500                      | P       | Pt II   | 9356-71314         |
| 1614.4078.....             | 1614.4072              | 61942.24                          | 9400                      |         | Pt I    | 0-61942            |
| 1614.8843.....             | 1614.8824              | 61924.01                          | 1000                      |         | Pt II   | 32918-94842        |
| 1615.3211.....             | 1615.3170              | 61907.35                          | 450                       |         | ...     | ...                |
|                            | 1615.6831              | 61893.32                          | 810                       |         | Cr      | ...                |
| 1619.2728.....             | 1619.2723              | 61756.13                          | 640                       |         | Pt II   | 34647-96403        |
|                            | 1619.9539              | 61730.15                          | 890                       |         | Cr II   | 40202.12-101932.27 |
| 1620.6682.....             | 1620.6681              | 61702.95                          | 5600                      |         | Pt II   | 36484-98186        |
| 1621.1049.....             | 1621.0980              | 61686.58                          | 2300                      | L       | Pt?/Cr? | ...                |
| 1621.1897.....             | 1621.1892              | 61683.12                          | 3600                      |         | Pt II   | 50564-112247       |
|                            | 1621.6012              | 61667.44                          | 890                       | U       | Cr II   | 32854.95-94522.31  |
| 1621.6590.....             | 1621.6596              | 61665.22                          | 69000                     | H       | Pt II   | 0-61665            |
| 1621.6590.....             |                        |                                   |                           |         | Pt II   | 9356-71021         |
| 1622.1204.....             | 1622.1207              | 61647.69                          | 5500                      |         | Pt II   | 4786-66434         |
| 1622.1824.....             | 1622.1815              | 61645.38                          | 4800                      |         | Pt I    | 0-61645            |
| 1622.5440.....             | 1622.5413              | 61631.71                          | 810                       |         | Pt II   | 16820-78452        |
| 1623.5577.....             | 1623.5577              | 61593.13                          | 890                       |         | Pt II   | 37877-99471        |
|                            | 1624.2953              | 61565.16                          | 640                       |         | Cr      | ...                |
| 1624.7988.....             | 1624.8000              | 61546.04                          | 2200                      |         | Pt I    | 775-62321          |
| 1624.9144.....             | 1624.9152              | 61541.67                          | 1400                      |         | Pt II   | 46046-107588       |
| 1626.4387.....             | 1626.4379              | 61484.06                          | 1700                      |         | Pt II   | 34647-96131        |
| 1627.6535.....             | 1627.6520              | 61438.19                          | 1200                      |         | Pt II   | 41434-102872       |
| 1627.7656.....             | 1627.7658              | 61433.90                          | 640                       |         | Pt II   | 16820-78254        |
| 1627.8299.....             | 1627.8296              | 61431.49                          | 1100                      |         | Pt II   | 42031-103463       |
| 1630.4910.....             | 1630.4986              | 61330.93                          | 14000                     | H       | Pt II   | 37877-99209        |
| 1630.5063.....             |                        |                                   |                           |         | Pt I    | 775-62106          |
| 1631.0903.....             | 1631.0897              | 61308.71                          | 32000                     |         | Pt II   | 36484-97792        |
| 1631.5907.....             | 1631.5889              | 61289.95                          | 720                       |         | Pt II   | 13329-74619        |
| 1631.7814.....             | 1631.7836              | 61282.64                          | 1100                      |         | Pt I    | 823-62106          |
|                            | 1631.9549              | 61276.20                          | 1500                      |         | Cr      | ...                |
|                            | 1632.2945              | 61263.46                          | 970                       |         | Cr II   | 116047.90-54784.48 |
| 1632.8049.....             | 1632.8077              | 61244.20                          | 720                       |         | Pt II   | 41434-102678       |
| 1634.2337.....             | 1634.2281              | 61190.97                          | 49000                     |         | Pt II   | 37877-99068        |
| 1635.4147.....             | 1635.4157              | 61146.53                          | 3700                      |         | Pt II   | 36484-97630        |
| 1636.1647.....             | 1636.1657              | 61118.50                          | 96000                     |         | Pt I    | 823-61942          |
| 1636.7302.....             | 1636.7287              | 61097.48                          | 1400                      |         | Pt I    | 0-61097            |
| 1636.8152.....             | 1636.8159              | 61094.22                          | 2300                      |         | Pt II   | 43737-104831       |

TABLE 1—Continued

| Wavelength Pt Atlas<br>(Å) | Wavelength<br>(Å)      | Wavenumber<br>(cm <sup>-1</sup> ) | Intensity<br>(Arb. Units) | Comment | Species | Even-Odd           |
|----------------------------|------------------------|-----------------------------------|---------------------------|---------|---------|--------------------|
| 1637.0168.....             | 1637.0168              | 61086.73                          | 5200                      |         | Pt II   | 41434-102520       |
| 1638.18.....               | 1638.1752 <sup>a</sup> | 61043.53                          | 720                       |         | Ne III  | ...                |
|                            | 1638.8457 <sup>a</sup> | 61018.56                          | 640                       |         | Cr II   | 55023.10-116041.70 |
| 1639.8606.....             | 1639.8639              | 60980.67                          | 1300                      |         | Pt II   | 41434-102414       |
| 1640.1553.....             | 1640.1551              | 60969.84                          | 1000                      |         | Pt II   | 34647-95617        |
| 1640.41.....               | 1640.4144              | 60960.21                          | 720                       |         | Pt II   | 32237-93197        |
| 1640.7691.....             | 1640.7680              | 60947.07                          | 720                       |         | Pt II   | 24879-85826        |
| 1641.7317.....             | 1641.7289              | 60911.40                          | 720                       |         | Pt II   | 29261-90173        |
|                            | 1641.9438              | 60903.42                          | 890                       |         | Cr II   | 109394.47-48491.10 |
|                            |                        |                                   |                           |         | Cr II   | 33618.94-94522.31  |
| 1642.8597.....             | 1642.8595              | 60869.48                          | 720                       |         | Pt I    | 775-61645          |
| 1644.1761.....             | 1644.1732              | 60820.84                          | 1300                      |         | Pt II   | 24879-85700        |
| 1644.2292.....             | 1644.2269              | 60818.86                          | 1500                      |         | Pt II   | 15791-76610        |
| 1644.3084.....             | 1644.3071              | 60815.89                          | 8800                      |         | Pt II   | 8419-69235         |
| 1644.4634.....             | 1644.4621              | 60810.16                          | 34000                     |         | Pt I    | 823-61633          |
| 1645.0044.....             | 1645.0033              | 60790.15                          | 3300                      |         | Pt II   | 50564-111354       |
|                            | 1645.7539              | 60762.43                          | 1200                      |         | Cr II   | 109394.47-48632.12 |
| 1646.9762.....             | 1646.9787              | 60717.24                          | 640                       |         | Pt II   | 16820-77538        |
| 1648.2494.....             | 1648.2495              | 60670.43                          | 2300                      |         | Pt II   | 13329-73999        |
| 1650.2455.....             | 1650.2452              | 60597.06                          | 3000                      |         | Pt II   | 9356-69953         |
| 1651.1608.....             | 1651.1639              | 60563.34                          | 540                       |         | Pt II   | 32918-93482        |
| 1652.1112.....             | 1652.1108              | 60528.63                          | 4600                      |         | Pt I    | 823-61352          |
| 1653.3618.....             | 1653.3620              | 60482.82                          | 890                       |         | Pt II   | 41434-101916       |
|                            | 1654.0595 <sup>a</sup> | 60457.32                          | 810                       |         | Cr      | ...                |
| 1654.2659.....             | 1654.2652              | 60449.80                          | 26000                     |         | ...     | ...                |
| 1654.4140.....             | 1654.4154              | 60444.31                          | 970                       |         | Pt?/Cr? | ...                |
| 1654.7384.....             | 1654.7393              | 60432.48                          | 4900                      |         | Pt II   | 13329-73761        |
| 1654.9743.....             | 1654.9721              | 60423.98                          | 810                       |         | Pt I    | 0-60423            |
| 1655.1434.....             | 1655.1419              | 60417.78                          | 1000                      |         | Pt II   | 32918-93336        |
| 1656.0959.....             | 1656.0957              | 60382.99                          | 1300                      |         | Pt II   | 42031-102414       |
|                            | 1656.2669              | 60376.74                          | 4500                      | H       | C I     |                    |
|                            | 1656.4468              | 60370.19                          | 1000                      |         | Cr II   | 107597.65-47227.24 |
| 1656.9283.....             | 1656.9350              | 60352.40                          | 11000                     | U       | C I     |                    |
| 1657.0082.....             | 1657.0082              | 60349.73                          | 28000                     | HP      | C I     |                    |
|                            | 1657.3764              | 60336.32                          | 2500                      | H       | C I     |                    |
| 1657.6053.....             | 1657.6046              | 60328.02                          | 5300                      |         | Pt I    | 0-60328            |
|                            | 1657.9043              | 60317.11                          | 3600                      | H       | C I     |                    |
| 1658.14.....               | 1658.1262              | 60309.04                          | 5700                      | SH      | C I/Pt? |                    |
| 1659.4860.....             | 1659.4879              | 60259.55                          | 39000                     |         | Pt II   | 4786-65046         |
| 1661.2608.....             | 1661.2584              | 60195.33                          | 2800                      |         | Pt II   | 34647-94842        |
|                            | 1662.2643              | 60158.91                          | 540                       |         | Cr II   | 107386.22-47227.24 |
| 1664.6312.....             | 1664.6310              | 60073.37                          | 1500                      |         | Pt II   | 50564-110638       |
|                            | 1664.8434 <sup>a</sup> | 60065.71                          | 640                       |         | ...     | ...                |
|                            | 1665.1721              | 60053.85                          | 1000                      |         | Cr II   | 106877.20-46823.39 |
|                            | 1665.9934              | 60024.25                          | 1500                      |         | Cr II   | 106929.42-46905.17 |
|                            | 1666.7299              | 59997.72                          | 720                       |         | Cr      | ...                |
|                            | 1666.9183              | 59990.94                          | 970                       |         | Cr II   | 107455.55-47464.55 |
| 1667.0557.....             | 1667.0553              | 59986.01                          | 450                       |         | Pt II   | 34647-94633        |
|                            | 1667.6120              | 59965.99                          | 2300                      |         | Cr II   | 107006.29-47040.35 |
| 1667.6740.....             | 1667.6735              | 59963.78                          | 970                       |         | Pt II   | 41434-101397       |
|                            | 1668.0651              | 59949.70                          | 1800                      |         | Cr II   | 107701.34-47751.62 |
|                            | 1668.1988 <sup>a</sup> | 59944.89                          | 640                       |         | ...     | ...                |
| 1668.9014.....             | 1668.8965              | 59919.83                          | 3200                      | P       | Pt II   | 36484-96403        |
| 1668.9014.....             | 1668.9121              | 59919.27                          | 2300                      | U       | Pt I    | 0-59920            |
| 1668.9782.....             | 1668.9775              | 59916.93                          | 18000                     |         | Pt I    | 0-59916            |
| 1669.0350.....             | 1669.0320              | 59914.97                          | 5500                      |         | Pt II   | 37877-97792        |
| 1669.2312.....             | 1669.2328              | 59907.76                          | 75000                     |         | Pt II   | 41434-101341       |
|                            | 1669.7536              | 59889.07                          | 890                       |         | Cr II   | 106929.42-47040.35 |
|                            | 1669.8759              | 59884.69                          | 5900                      | H       | Cr II   | 107111.84-47227.24 |
|                            |                        |                                   |                           |         | Cr II   | 106924.84-47040.35 |
|                            | 1670.4231              | 59865.07                          | 3500                      |         | Pt I    | ...                |
| 1670.7878.....             | 1670.7883              | 59851.99                          | 4600                      |         | Al II   |                    |
|                            | 1670.8412              | 59850.09                          | 4000                      |         | Pt II   | 46046-105896       |
|                            | 1672.7384              | 59782.21                          | 5200                      |         | Cr II   | 107246.87-47464.55 |
|                            | 1673.5122              | 59754.57                          | 1900                      |         | Cr      | ...                |
| 1674.2916.....             | 1674.2919 <sup>a</sup> | 59726.74                          | 1900                      |         | Ne II   | ...                |

TABLE 1—Continued

| Wavelength Pt Atlas<br>(Å) | Wavelength<br>(Å)      | Wavenumber<br>(cm <sup>-1</sup> ) | Intensity<br>(Arb. Units) | Comment | Species | Even-Odd           |
|----------------------------|------------------------|-----------------------------------|---------------------------|---------|---------|--------------------|
| 1676.0154.....             | 1676.0141              | 59665.37                          | 17000                     |         | Pt I    | 775-60441          |
|                            | 1676.1519              | 59660.46                          | 7000                      |         | Cr II   | 107412.09-47751.62 |
| 1677.8443.....             | 1677.8458              | 59600.23                          | 94000                     |         | Pt I    | 823-60423          |
| 1679.2007.....             | 1679.2018              | 59552.10                          | 4500                      |         | Pt I    | 775-60328          |
| 1680.5783.....             | 1680.5797              | 59503.28                          | 3400                      |         | ...     | ...                |
| 1680.8886.....             | 1680.8887              | 59492.34                          | 28000                     |         | Pt I    | 0-59492            |
| 1681.0350.....             | 1681.0346 <sup>a</sup> | 59487.18                          | 1500                      |         | Ne II   | ...                |
| 1681.5384.....             | 1681.5371              | 59469.40                          | 5000                      |         | Pt II   | 41434-100903       |
| 1681.6840.....             | 1681.6842              | 59464.20                          | 120000                    |         | Ne II   | ...                |
| 1681.7207.....             | 1681.7263              | 59462.71                          | 5000                      | U       | Ne?     | ...                |
| 1684.4637.....             | 1684.4678              | 59365.93                          | 760                       | W       | Pt II   | 42031-101397       |
| 1684.5867.....             | 1684.5900              | 59361.62                          | 23000                     |         | Pt II   | 41434-100795       |
| 1684.5867.....             |                        |                                   |                           |         | Pt II   | 42031-101394       |
| 1685.6828.....             | 1685.6836              | 59323.11                          | 1300                      |         | Pt II   | 43737-103060       |
| 1686.2510.....             | 1686.2495              | 59303.20                          | 3500                      |         | Pt II   | 24879-84182        |
|                            | 1687.0193              | 59276.14                          | 2500                      |         | Cr II   | 50667.24-109943.57 |
| 1688.3553.....             | 1688.3566              | 59229.19                          | 330000                    | H       | Ne II   | ...                |
| 1688.3945.....             | 1688.3986              | 59227.72                          | 3200                      | U       | Ne?     | ...                |
| 1690.55.....               | 1690.5477              | 59152.43                          | 2700                      |         | Ne?     | ...                |
| 1690.7825.....             | 1690.7858              | 59144.10                          | 28000                     |         | Pt I    | 775-59920          |
| 1690.8699.....             | 1690.8730              | 59141.05                          | 7400                      |         | Pt I    | 775-59916          |
| 1691.1034.....             | 1691.1011              | 59133.07                          | 760                       |         | Pt II   | 36484-95617        |
| 1691.1787.....             | 1691.1851              | 59130.13                          | 3200                      |         | Pt I    | 6567-65697         |
| 1692.1497.....             | 1692.1518              | 59096.35                          | 7300                      |         | Pt I    | 823-59920          |
| 1692.5845.....             | 1692.5861              | 59081.19                          | 4000                      |         | Pt II   | 42031-101113       |
|                            | 1693.0734              | 59064.19                          | 470                       |         | Cr II   | 107696.31-48632.12 |
|                            | 1694.4004              | 59017.93                          | 3200                      |         | Cr      | ...                |
| 1694.5987.....             | 1694.5989              | 59011.01                          | 6800                      |         | Ne II   | ...                |
| 1694.7864.....             | 1694.7865              | 59004.48                          | 18000                     |         | Ne II   | ...                |
| 1694.8828.....             | 1694.8815 <sup>a</sup> | 59001.18                          | 2000                      |         | Ne II   | ...                |
| 1696.2887.....             | 1696.2894              | 58952.20                          | 14000                     |         | Pt II   | 4786-63738         |
|                            | 1697.4802              | 58910.85                          | 3900                      |         | Cr      | ...                |
| 1698.4958.....             | 1698.4967              | 58875.59                          | 9400                      |         | Pt II   | 43737-102613       |
| 1698.8732.....             | 1698.8741              | 58862.51                          | 4000                      |         | Pt I    | 823-59686          |
|                            | 1700.1069              | 58819.83                          | 3900                      |         | Cr      | ...                |
| 1700.8188.....             | 1700.8191              | 58795.20                          | 1800                      |         | Pt II   | 48591-107386       |
|                            | 1701.5257              | 58770.78                          | 1100                      |         | Cr      | ...                |
|                            | 1703.7648              | 58693.55                          | 1300                      |         | Cr      | ...                |
| 1704.7667.....             | 1704.7672              | 58659.04                          | 9000                      |         | Pt II   | 24879-83538        |
|                            | 1705.7166              | 58626.39                          | 1100                      |         | Cr II   | 107025.34-48398.95 |
|                            | 1705.7952              | 58623.68                          | 1600                      |         | Cr II   | 107114.75-48491.10 |
| 1705.9115.....             | 1705.9112              | 58619.70                          | 6300                      |         | Pt II   | 13329-71948        |
| 1706.1353.....             | 1706.1430 <sup>a</sup> | 58611.73                          | 1600                      |         | ...     | ...                |
|                            | 1706.8380 <sup>a</sup> | 58587.87                          | 1300                      |         | Cr      | ...                |
| 1707.0710.....             | 1707.0731              | 58579.80                          | 37000                     |         | Pt II   | 42031-100611       |
|                            | 1707.1206              | 58578.17                          | 1600                      | U       | Cr      | ...                |
| 1708.2132.....             | 1708.2132              | 58540.70                          | 7600                      |         | Pt I    | 10116-68657        |
| 1708.6568.....             | 1708.6552              | 58525.56                          | 1600                      |         | Pt II   | 37877-96403        |
| 1708.7393.....             | 1708.7416              | 58522.60                          | 2300                      |         | Pt I    | 823-59346          |
| 1709.12.....               | 1709.1399 <sup>a</sup> | 58508.96                          | 1400                      |         | Pt II   | 32237-90746        |
| 1709.93.....               | 1709.9089              | 58482.65                          | 1300                      |         | Pt I    | 0-58482            |
| 1710.1391.....             | 1710.1346              | 58474.93                          | 1300                      | W       | Pt I    | 10131-68606        |
| 1710.8580.....             | 1710.8583              | 58450.19                          | 3000                      |         | Pt II   | 15791-74241        |
| 1711.6209.....             | 1711.6217              | 58424.12                          | 1800                      |         | Pt II   | 9356-67780         |
| 1712.0665.....             | 1712.0676              | 58408.91                          | 3200                      |         | ...     | ...                |
| 1712.2098.....             | 1712.2100              | 58404.05                          | 1300                      |         | Pt II   | 48591-106995       |
| 1712.6670.....             | 1712.6660              | 58388.50                          | 16000                     |         | Pt I    | 0-58388            |
| 1713.3934.....             | 1713.3921              | 58363.76                          | 4200                      |         | Pt II   | 41434-99797        |
| 1713.3934.....             |                        |                                   |                           |         | Pt II   | 18097-76461        |
| 1713.3934.....             |                        |                                   |                           |         | Pt II   | 16820-75184        |
| 1713.8364.....             | 1713.8364              | 58348.63                          | 14000                     |         | Pt II   | 43737-102086       |
| 1714.1842.....             | 1714.1850              | 58336.76                          | 5000                      |         | Pt I    | 6567-64904         |
| 1714.4801.....             | 1714.4784              | 58326.78                          | 25000                     |         | Pt I    | 0-58326            |
|                            | 1715.0129 <sup>a</sup> | 58308.60                          | 1100                      |         | Cr      | ...                |
|                            | 1715.1826              | 58302.83                          | 2700                      |         | Cr      | ...                |
|                            | 1716.6229 <sup>a</sup> | 58253.91                          | 1000                      |         | Cr II   | 107259.87-49005.93 |

TABLE 1—Continued

| Wavelength Pt Atlas<br>(Å) | Wavelength<br>(Å)      | Wavenumber<br>(cm <sup>-1</sup> ) | Intensity<br>(Arb. Units) | Comment | Species | Even-Odd           |
|----------------------------|------------------------|-----------------------------------|---------------------------|---------|---------|--------------------|
| 1716.7118.....             | 1716.7069 <sup>a</sup> | 58251.06                          | 1600                      |         | ...     | ...                |
|                            | 1716.8790              | 58245.22                          | 320                       |         | Cr II   | 105285.37–47040.35 |
|                            | 1717.0619              | 58239.02                          | 1000                      |         | ...     | ...                |
| 1717.1032.....             | 1717.1039              | 58237.59                          | 760                       |         | Pt II   | 50564–108802       |
|                            | 1717.6284              | 58219.81                          | 1300                      |         | Cr II   | 105447.05–47227.24 |
| 1717.9693.....             | 1717.9622              | 58208.50                          | 890                       | U       | Pt II   | 15791–73999        |
| 1717.9888.....             | 1717.9879              | 58207.63                          | 5000                      |         | Pt II   | 42031–100239       |
|                            | 1718.4710 <sup>a</sup> | 58191.26                          | 1100                      |         | ...     | ...                |
| 1719.7159.....             | 1719.7138              | 58149.21                          | 1800                      |         | Pt II   | 36484–94633        |
|                            | 1720.3246              | 58128.57                          | 760                       |         | Cr II   | 105168.82–47040.35 |
| 1720.9199.....             | 1720.9191              | 58108.48                          | 1700                      |         | Pt I    | 6567–64675         |
| 1721.9209.....             | 1721.9252              | 58074.53                          | 890                       |         | Pt II   | 50564–108639       |
| 1722.40.....               | 1722.4115              | 58058.14                          | 1300                      |         | Cr II   | 105285.37–47227.24 |
| 1723.0983.....             | 1723.0900              | 58035.27                          | 5900                      | U       | ...     | ...                |
| 1723.1314.....             | 1723.1304              | 58033.91                          | 190000                    | P       | Pt II   | 4786–62820         |
|                            | 1723.5693              | 58019.14                          | 2300                      |         | Cr II   | 107025.34–49005.93 |
| 1723.9935.....             | 1723.9910              | 58004.94                          | 7200                      |         | Pt I    | 775–58780          |
| 1724.5730.....             | 1724.5730              | 57985.37                          | 6500                      |         | Pt II   | 13329–71314        |
|                            | 1724.6625              | 57982.36                          | 1900                      |         | Cr II   | 105447.05–47464.55 |
| 1724.9840.....             | 1724.9807              | 57971.66                          | 760                       |         | Al II   |                    |
| 1726.3697.....             | 1726.3688              | 57925.05                          | 3200                      |         | Pt II   | 16820–74745        |
| 1726.5970.....             | 1726.5953 <sup>a</sup> | 57917.45                          | 1500                      |         | Ne?     | ...                |
|                            | 1727.1461              | 57898.98                          | 2400                      |         | Cr II   | 105650.58–47751.62 |
| 1727.4189.....             | 1727.4177              | 57889.88                          | 1300                      |         | Pt II   | 34647–92537        |
| 1727.6799.....             | 1727.6783              | 57881.15                          | 19000                     |         | Pt II   | 43737–101618       |
| 1727.8258.....             | 1727.8230              | 57876.30                          | 1800                      |         | Pt II   | 37877–95754        |
|                            | 1728.2214              | 57862.96                          | 2900                      |         | Cr II   | 107701.34–49838.38 |
|                            | 1728.3716              | 57857.93                          | 2000                      |         | Cr II   | 107696.31–49838.38 |
|                            | 1729.8133              | 57809.71                          | 2200                      |         | Cr II   | 107455.55–49645.77 |
| 1730.6473.....             | 1730.6442              | 57781.95                          | 4300                      |         | Ne II   | ...                |
| 1730.8544.....             | 1730.8535              | 57774.96                          | 2100                      |         | Pt II   | 41434–99209        |
| 1731.1250.....             | 1731.1235              | 57765.95                          | 1500                      |         | Pt II   | 42031–99797        |
|                            | 1731.3701              | 57757.73                          | 470                       |         | ...     | ...                |
| 1731.4175.....             | 1731.4153              | 57756.22                          | 1100                      |         | ...     | ...                |
|                            | 1732.0711              | 57734.35                          | 1600                      |         | Cr II   | 121335.25–63600.91 |
| 1733.7099.....             | 1733.7073              | 57679.86                          | 1100                      |         | Pt II   | 37877–95557        |
|                            | 1735.0385              | 57635.61                          | 890                       |         | Cr II   | 32854.31–90489.86  |
| 1735.8642.....             | 1735.8639              | 57608.20                          | 45000                     |         | Pt II   | 8419–66028         |
| 1735.9774.....             | 1735.9744              | 57604.54                          | 5200                      | S       | Pt II   | 43737–101341       |
|                            | 1736.2381              | 57595.79                          | 1500                      |         | Cr II   | 32854.95–90450.62  |
| 1737.1732.....             | 1737.1725              | 57564.81                          | 47000                     |         | Pt I    | 823–58388          |
| 1737.3402.....             | 1737.3393 <sup>a</sup> | 57559.28                          | 2300                      |         | Ne II   | ...                |
| 1737.5956.....             | 1737.5926              | 57550.89                          | 7100                      |         | Pt I    | 775–58326          |
| 1738.7356.....             | 1738.7354              | 57513.06                          | 8100                      |         | Ne II   | ...                |
| 1738.9433.....             | 1738.9424              | 57506.22                          | 3500                      |         | Pt I    | 0–57506            |
| 1740.3637.....             | 1740.3614              | 57459.33                          | 1100                      |         | Pt II   | 29030–86489        |
|                            | 1742.7216              | 57381.51                          | 1000                      |         | Cr      | ...                |
|                            | 1742.8718              | 57376.57                          | 5200                      |         | Ne II   | ...                |
|                            | 1743.8108              | 57345.67                          | 1100                      |         | Cr II   | 53923.60–111269.22 |
|                            | 1744.2641              | 57330.77                          | 3200                      |         | Cr II   | 34812.95–92144.24  |
| 1744.2756.....             |                        |                                   |                           |         | Ne II   | ...                |
| 1744.4305.....             | 1744.4308              | 57325.29                          | 36000                     | H       | Pt I    | 775–58101          |
| 1745.8874.....             | 1745.8855              | 57277.53                          | 6300                      |         | Pt I    | 823–58101          |
|                            | 1746.1289              | 57269.54                          | 2500                      |         | Cr      | ...                |
| 1746.4563.....             | 1746.4557              | 57258.83                          | 3400                      |         | Pt I    | 6567–63826         |
| 1747.1795.....             | 1747.1807              | 57235.07                          | 5700                      |         | Pt II   | 15791–73026        |
|                            | 1747.3067              | 57230.94                          | 1600                      |         | Cr II   | 50687.62–107918.49 |
|                            | 1748.5210              | 57191.19                          | 1900                      |         | Cr      | ...                |
| 1748.9496.....             | 1748.9496              | 57177.18                          | 3600                      |         | Pt II   | 42031–99209        |
|                            | 1750.6609              | 57121.28                          | 1800                      |         | Cr II   | 34630.95–91752.27  |
| 1751.2164.....             | 1751.2210              | 57103.02                          | 2000                      |         | Ne II   | ...                |
| 1751.7022.....             | 1751.7002              | 57087.40                          | 20000                     |         | Pt II   | 18097–75184        |
| 1751.7022.....             |                        |                                   |                           |         | Ne II   | ...                |
|                            | 1752.1723              | 57072.01                          | 1600                      |         | Cr II   | 50667.24–107739.20 |
|                            | 1752.5846              | 57058.59                          | 6100                      |         | Cr II   | 30391.83–87450.47  |

TABLE 1—Continued

| Wavelength Pt Atlas<br>(Å)  | Wavelength<br>(Å)      | Wavenumber<br>(cm <sup>-1</sup> ) | Intensity<br>(Arb. Units) | Comment | Species | Even-Odd           |
|-----------------------------|------------------------|-----------------------------------|---------------------------|---------|---------|--------------------|
| 1752.8546.....              | 1752.8545              | 57049.80                          | 3900                      | S       | Pt II   | 13329-70379        |
| 1753.2526.....              | 1753.2512              | 57036.89                          | 9000                      |         | Pt II   | 42031-99068        |
| 1753.8286.....              | 1753.8292              | 57018.10                          | 87000                     |         | Pt II   | 0-57018            |
| 1753.8286.....              |                        |                                   |                           |         | Pt II   | 24879-81897        |
|                             | 1755.7450              | 56955.88                          | 620                       |         | Cr II   | 105447.05-48491.10 |
| 1756.2086.....              | 1756.2102              | 56940.79                          | 2400                      |         | Pt II   | 16820-73761        |
| 1756.3952.....              | 1756.3961              | 56934.77                          | 4300                      |         | Pt II   | 53749-110684       |
| 1756.5046.....              | 1756.5042              | 56931.26                          | 3800                      |         | Pt II   | 8419-65351         |
| 1756.6264.....              | 1756.6271              | 56927.28                          | 2000                      |         | Pt I    | 6140-63067         |
| 1756.8363.....              | 1756.8363              | 56920.50                          | 6500                      |         | Ne II   | ...                |
| 1757.5047.....              | 1757.5060              | 56898.81                          | 2800                      |         | Pt I    | 6567-63466         |
|                             | 1757.6414              | 56894.43                          | 1400                      |         | Cr II   | 33694.15-90588.59  |
| 1758.105 <sup>a</sup> ..... |                        |                                   |                           |         | Ne II   | ...                |
| 1758.1220.....              | 1758.1228              | 56878.85                          | 18000                     | H       | Pt II   | 4786-61665         |
| 1758.5549.....              | 1758.5553              | 56864.86                          | 9800                      |         | Ne II   | ...                |
|                             | 1758.8867              | 56854.15                          | 1400                      |         | Cr II   | 31219.35-88073.49  |
| 1758.9451.....              | 1758.9450              | 56852.26                          | 1100                      |         | Pt II   | 36484-93336        |
|                             | 1760.7472              | 56794.07                          | 6300                      |         | Cr II   | 30298.51-87092.65  |
|                             | 1760.8117              | 56791.99                          | 1100                      |         | Cr      | ...                |
| 1761.9446.....              | 1761.9481              | 56755.36                          | 760                       |         | Pt II   | 37877-94633        |
|                             | 1762.1729              | 56748.12                          | 890                       |         | Cr II   | 31168.58-87916.67  |
|                             | 1762.3650              | 56741.93                          | 760                       |         | Cr II   | 53923.60-110665.54 |
| 1762.4146.....              | 1762.4171              | 56740.26                          | 2000                      |         | ...     | ...                |
| 1762.5591.....              | 1762.5571              | 56735.75                          | 4100                      | L       | Pt II   | 23461-80197        |
| 1762.5591.....              |                        |                                   |                           |         | Pt II   | 21717-78452        |
| 1762.7266.....              | 1762.7267              | 56730.29                          | 2700                      |         | Pt I    | 775-57506          |
| 1764.2127.....              | 1764.2115              | 56682.55                          | 5900                      |         | Pt I    | 823-57506          |
| 1764.5948.....              | 1764.5973              | 56670.15                          | 59000                     |         | Pt I    | 0-56670            |
| 1765.0132.....              | 1765.0138 <sup>a</sup> | 56656.78                          | 1500                      |         | Ne II   | ...                |
|                             | 1765.2557 <sup>a</sup> | 56649.02                          | 890                       |         | ...     | ...                |
| 1765.8981.....              | 1765.8985              | 56628.40                          | 4000                      |         | Ne II   | ...                |
| 1766.0328.....              | 1766.0338              | 56624.06                          | 9700                      |         | Pt II   | 13329-69953        |
| 1766.7883.....              | 1766.7890              | 56599.85                          | 3500                      |         | Pt I    | 6567-63167         |
| 1767.1612.....              | 1767.1608              | 56587.95                          | 49000                     |         | Pt II   | 0-56587            |
|                             | 1767.4571              | 56578.46                          | 5400                      |         | Cr II   | 30218.81-86797.35  |
| 1769.4841.....              | 1769.4840              | 56513.65                          | 3500                      |         | Pt II   | 29261-85775        |
| 1769.9101.....              | 1769.9156              | 56499.87                          | 1600                      |         | Pt I    | 6567-63067         |
| 1770.0610.....              | 1770.0611              | 56495.23                          | 4300                      |         | Pt II   | 43737-100232       |
| 1771.4140.....              | 1771.4144              | 56452.07                          | 1100                      |         | ...     | ...                |
| 1771.89.....                | 1771.8981              | 56436.65                          | 1400                      |         | Ne?     | ...                |
|                             | 1772.0191 <sup>a</sup> | 56432.80                          | 1000                      |         | ...     | ...                |
|                             | 1772.7443              | 56409.71                          | 4500                      |         | Cr II   | 30156.79-86566.55  |
| 1774.0082.....              | 1774.0089              | 56369.50                          | 1000                      |         | Pt II   | 21168-77538        |
| 1774.5470.....              | 1774.5463              | 56352.43                          | 2900                      |         | Pt II   | 41434-97786        |
| 1775.0160.....              | 1775.0168              | 56337.49                          | 75000                     |         | Pt II   | 8419-64757         |
|                             | 1775.0596              | 56336.14                          | 2300                      | U       | ...     | ...                |
| 1776.1777.....              | 1776.1811              | 56300.57                          | 4800                      |         | Pt I    | 10131-66432        |
| 1776.5571.....              | 1776.5567              | 56288.66                          | 94000                     |         | Pt I    | 0-56288            |
| 1776.7088.....              | 1776.7076              | 56283.88                          | 2000                      |         | Pt II   | 36484-92767        |
| 1777.0866.....              | 1777.0879              | 56271.84                          | 190000                    |         | Pt II   | 4786-61058         |
| 1777.2783.....              | 1777.2777              | 56265.83                          | 53000                     |         | Pt I    | 775-57041          |
|                             | 1778.3766              | 56231.06                          | 1600                      |         | Cr II   | 31219.35-87450.47  |
| 1778.7495.....              | 1778.7477 <sup>a</sup> | 56219.33                          | 1400                      |         | Ne II   | ...                |
| 1779.1858.....              | 1779.1862              | 56205.47                          | 5300                      | P       | Pt II   | 16820-73026        |
| 1779.2172.....              | 1779.2188              | 56204.44                          | 4600                      | P       | Pt II   | 24879-81083        |
| 1779.4723.....              | 1779.4716              | 56196.46                          | 3300                      |         | Pt II   | 41434-97630        |
| 1780.7016.....              | 1780.7027              | 56157.61                          | 1700                      |         | Pt II   | 15791-71948        |
| 1781.8617.....              | 1781.8630              | 56121.04                          | 100000                    |         | Pt II   | 4786-60907         |
| 1783.7849.....              | 1783.7877 <sup>a</sup> | 56060.48                          | 1300                      |         | Ne II   | ...                |
| 1785.8803.....              | 1785.8805              | 55994.79                          | 14000                     |         | Pt II   | 9356-65351         |
| 1786.6480.....              | 1786.6481              | 55970.73                          | 59000                     |         | Pt I    | 823-56794          |
|                             | 1788.1412              | 55923.99                          | 890                       |         | ...     | ...                |
| 1789.0922.....              | 1789.0915              | 55894.29                          | 11000                     |         | Pt I    | 775-56670          |
|                             | 1790.4649              | 55851.42                          | 1100                      |         | Cr II   | 107794.15-51942.70 |
|                             | 1790.7246              | 55843.32                          | 1000                      |         | Cr II   | 107632.26-51788.88 |
|                             | 1791.1243              | 55830.85                          | 760                       |         | Cr II   | 107500.37-51669.48 |

TABLE 1—Continued

| Wavelength Pt Atlas<br>(Å) | Wavelength<br>(Å)      | Wavenumber<br>(cm <sup>-1</sup> ) | Intensity<br>(Arb. Units) | Comment | Species | Even–Odd           |
|----------------------------|------------------------|-----------------------------------|---------------------------|---------|---------|--------------------|
|                            | 1791.5730              | 55816.87                          | 890                       |         | Cr II   | 107400.84–51584.15 |
|                            |                        |                                   |                           |         | Cr II   | 105168.82–49351.80 |
|                            | 1791.7247              | 55812.15                          | 1100                      |         | Cr II   | 105650.58–49838.38 |
| 1791.8624.....             | 1791.8631              | 55807.84                          | 1100                      |         | Pt II   | 23875–79683        |
|                            | 1792.0754              | 55801.22                          | 470                       |         | Cr II   | 105447.05–49645.77 |
| 1792.8041.....             | 1792.8002              | 55778.67                          | 1100                      |         | Pt II   | 53749–109528       |
| 1794.0655.....             | 1794.0638              | 55739.38                          | 3600                      |         | ...     | ...                |
| 1794.1811.....             | 1794.1805              | 55735.75                          | 15000                     |         | Pt I    | 10116–65852        |
| 1794.3043.....             | 1794.3033              | 55731.94                          | 2600                      |         | Pt II   | 23875–79607        |
| 1794.75.....               | 1794.7423 <sup>a</sup> | 55718.31                          | 760                       |         | Pt I    | 10131–65850        |
| 1795.91.....               | 1795.9794 <sup>a</sup> | 55679.93                          | 1000                      |         | ...     | ...                |
| 1796.4925.....             | 1796.5081 <sup>a</sup> | 55663.54                          | 4300                      | L       | Pt II   | 18097–73761        |
| 1796.5171.....             |                        |                                   |                           |         | Ne II   | ...                |
|                            | 1796.7638              | 55655.62                          | 1600                      |         | Cr II   | 38563.01–94218.66  |
| 1797.0175.....             | 1797.0173              | 55647.77                          | 1100                      |         | ...     | ...                |
| 1798.2814.....             | 1798.2832              | 55608.59                          | 7300                      |         | Ne II   | ...                |
| 1798.8757.....             | 1798.8750              | 55590.30                          | 1500                      |         | ...     | ...                |
| 1799.6692.....             | 1799.6697              | 55565.75                          | 2300                      |         | Pt I    | 10131–65697        |
| 1800.5413.....             | 1800.5422              | 55538.83                          | 3400                      |         | Pt I    | 6567–62106         |
|                            | 1800.6899              | 55534.27                          | 1300                      |         | Cr II   | 105098.94–49564.60 |
|                            |                        |                                   |                           |         | Cr II   | 29951.88–85486.24  |
|                            | 1800.7358              | 55532.85                          | 2800                      |         | Ne II   | ...                |
| 1800.9569.....             | 1800.9574              | 55526.02                          | 1000                      |         | Pt II   | 34647–90173        |
| 1801.9716.....             | 1801.9714              | 55494.78                          | 5700                      |         | Pt I    | 6567–62062         |
|                            | 1802.7373              | 55471.20                          | 2400                      |         | Cr II   | 35607.50–91078.72  |
|                            |                        |                                   |                           |         | Cr II   | 30307.44–85778.69  |
| 1802.9398.....             | 1802.9426              | 55464.88                          | 45000                     |         | Pt I    | 823–56288          |
| 1803.1160.....             | 1803.1155 <sup>a</sup> | 55459.56                          | 1300                      |         | Ne II   | ...                |
| 1803.7301.....             | 1803.7311              | 55440.64                          | 2900                      |         | Ne II   | ...                |
| 1805.0193.....             | 1805.0203              | 55401.04                          | 2300                      |         | Pt II   | 9356–64757         |
|                            | 1805.6509              | 55381.69                          | 1000                      |         | Cr II   | 38508.93–93890.64  |
| 1806.7624.....             | 1806.7605              | 55347.68                          | 3600                      |         | Pt II   | 46046–101394       |
| 1807.6755.....             | 1807.6749              | 55319.68                          | 2100                      |         | Pt II   | 37877–93197        |
| 1808.5524.....             | 1808.5512              | 55292.88                          | 1300                      |         | Pt II   | 21168–76461        |
|                            | 1809.0011 <sup>a</sup> | 55279.13                          | 1500                      |         | Cr II   | 30307.44–85586.60  |
|                            | 1809.6421              | 55259.55                          | 1000                      |         | Cr II   | 38314.86–93574.44  |
|                            | 1811.1217              | 55214.40                          | 4100                      |         | Cr II   | 30864.46–86078.90  |
| 1812.8819.....             | 1812.8804              | 55160.84                          | 53000                     |         | Pt I    | 823–55984          |
| 1813.1658.....             | 1813.1642              | 55152.20                          | 1800                      |         | Pt II   | 29030–84182        |
| 1815.6120.....             | 1815.6109              | 55077.88                          | 12000                     |         | Pt I    | 6567–61645         |
| 1815.9818.....             | 1815.9833              | 55066.59                          | 2000                      |         | Pt II   | 46046–101113       |
| 1817.8736.....             | 1817.8732              | 55009.34                          | 42000                     | H       | Pt I    | 0–55009            |
| 1820.8082.....             | 1820.8063              | 54920.73                          | 3300                      |         | Pt II   | 29261–84182        |
|                            | 1821.0216 <sup>a</sup> | 54914.23                          | 890                       |         | ...     | ...                |
| 1821.7330.....             | 1821.7321              | 54892.81                          | 2000                      |         | Pt II   | 21717–76610        |
| 1821.8212.....             | 1821.8215              | 54890.12                          | 2300                      |         | Pt II   | 37877–92767        |
| 1822.0375.....             | 1822.0360              | 54883.66                          | 3000                      |         | ...     | ...                |
| 1822.47.....               | 1822.4647 <sup>a</sup> | 54870.75                          | 1300                      |         | Ne III  | ...                |
| 1822.55.....               | 1822.5471 <sup>a</sup> | 54868.27                          | 1300                      |         | Ne III  | ...                |
| 1822.66.....               | 1822.6559 <sup>a</sup> | 54864.99                          | 760                       | W       | Ne III  | ...                |
| 1822.75.....               | 1822.7508 <sup>a</sup> | 54862.13                          | 620                       |         | Ne III  | ...                |
|                            | 1822.8390              | 54859.48                          | 2800                      |         | Cr II   | 31219.35–86078.90  |
| 1823.5129.....             | 1823.5137              | 54839.18                          | 4900                      |         | Pt I    | 0–54839            |
| 1825.3262.....             | 1825.3247              | 54784.77                          | 22000                     |         | Pt I    | 6567–61352         |
| 1826.1377.....             | 1826.1392              | 54760.34                          | 28000                     | H       | Pt I    | 775–55536          |
| 1826.5063.....             | 1826.5084              | 54749.27                          | 3800                      |         | Pt II   | 46046–100795       |
| 1826.8324.....             | 1826.8350 <sup>a</sup> | 54739.48                          | 5200                      |         | Ne II   | ...                |
| 1827.7326.....             | 1827.7348              | 54712.53                          | 5400                      |         | Pt I    | 823–55536          |

NOTES.—The comment column has the line character codes assigned at the comparator: (P) perturbed; (U) unresolved; (H) hazy; (W) wide; (G) guess (too weak to make a precise setting); (S) asymmetric tail to the short-wavelength side; (L) asymmetric tail to the long-wavelength side. Table 1 is also available in machine-readable form in the electronic edition of the *Astrophysical Journal Supplement*.

<sup>a</sup> Line seen in 10 mA exposure only.

<sup>b</sup> Wavelength taken from Persson (1971).

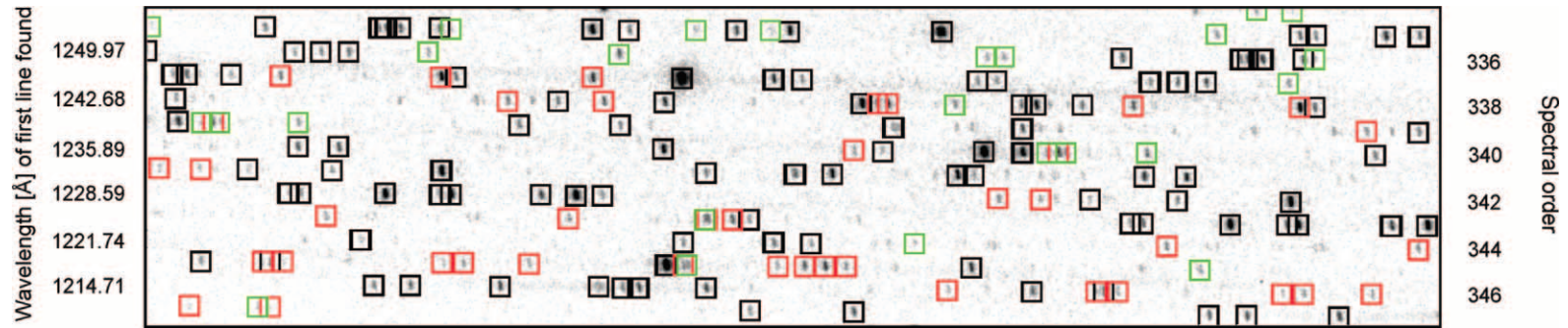


FIG. 2a

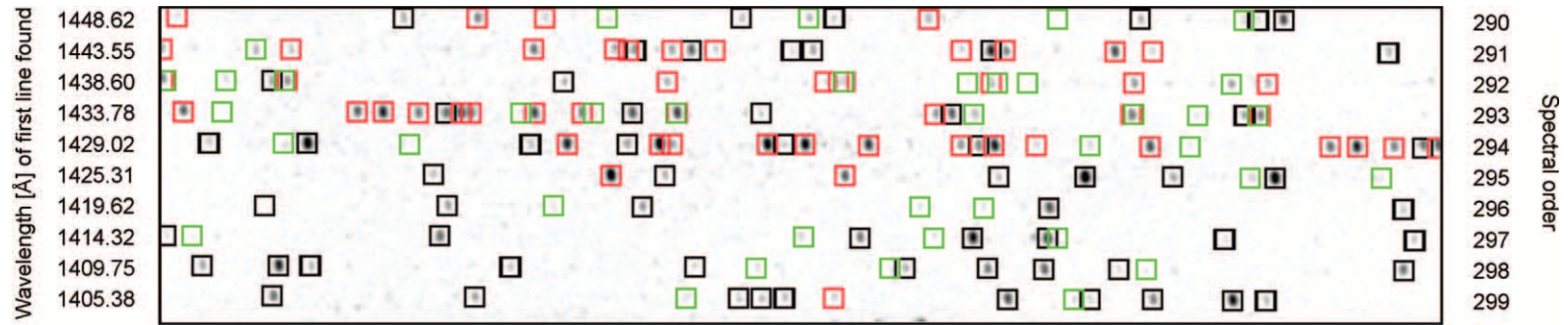


FIG. 2b

FIG. 2.—STIS Echelle spectra (mode G140H) with overlaid line identification. In both examples only a few orders are shown: the upper panel (a) is centered around 1230 Å, while the lower one (b) shows the region at 1430 Å. A physical model of STIS has been used to predict the location of the lines on the detector array. All identified lines are marked by a square, the different colors denote the source of the line: Black squares are used for lines present both in the new Pt/Cr-Ne line list and the 1990 Pt-Ne line list. Red squares mark previously unknown lines added by the measurements of the Pt/Cr-Ne lamp described in this article. Green squares indicate faint Pt lines that are known from the 1990 Pt-Ne line list but that have not been recovered in the shallower observations of the Pt/Cr-Ne lamp. The figures illustrate that (1) only few, and faint, lines remain unidentified on the STIS spectra, (2) the new measurements add a very significant number of Cr lines, including very prominent ones, and (3) the maximum number of lines can be identified and employed for deriving a dispersion solution by using both the 1990 Pt-Ne and the new Pt/Cr-Ne line lists.

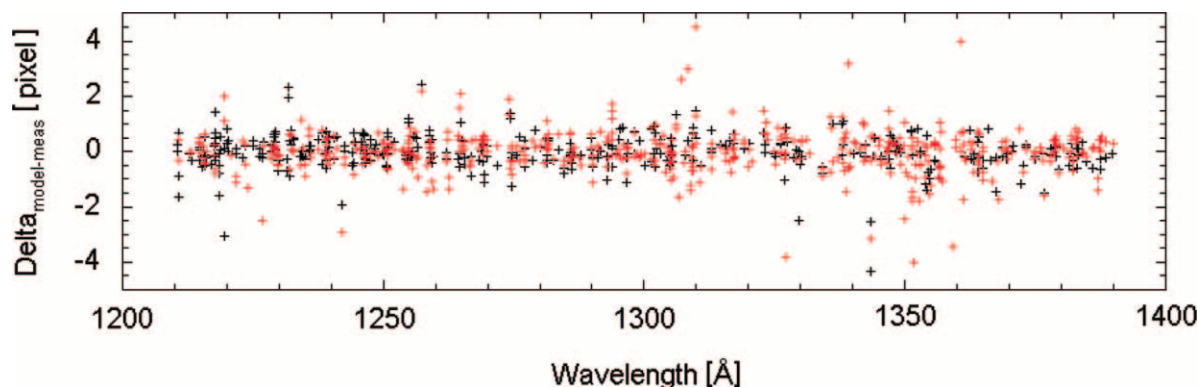


FIG. 3.—Differences in pixels between the fitted position of the line on the detector array and the location predicted by the STIS instrument model. One pixel is equivalent to 3 mÅ. Red crosses indicate the wavelength values from the 1990 Pt-Ne line list and black crosses the new values from the Pt/Cr-Ne list (Table 1). Only lines common to both lists are shown attesting to the excellent internal agreement of the wavelengths and the successful transfer of the Pt standard lines into the Cr spectrum.

comparable sensitivity are now made, they are the best recording material available. We tried to compensate for this loss in sensitivity by using longer exposure times and by developing for as long as 5 minutes instead of the recommended 2 minutes, but we did not quite reach the faintest lines seen previously. Fortunately, the internal accuracy and the quality of the transfer of the Pt standards into the Cr spectrum is very high, see Figure 3. Therefore, the new Pt/Cr-Ne list and the 1990 Pt-Ne list can be merged to form the input for the model-based wavelength calibration currently being derived by the ST-ECF's STIS-CE project.

Finally, we tested one Pt/Cr-Ne lamp to try to determine how such a lamp would age under the prolonged operating conditions needed for a space mission. On STIS there are three Pt/Cr-Ne lamps, with the LINE lamp being used for wavelength calibration exposures for the echelle modes, whereas the HITM (hole in the mirror) lamps are important for the target acquisition (Breyer 2002; Proffitt et al. 2002). During the 5.5 years of operation between installation in 1997 February and mid-2002, the LINE lamp had been used for a total of 117.5 hr, accumulated during more than 8600 exposures (J. Valenti 2002, private communication). On average this corresponds to about 3.5 minutes of lamp usage per day on orbit. Additionally, this lamp had been used for about 80 hr during prelaunch testing (Breyer 2002). Using these numbers the STIS LINE lamp would accumulate a total of about 370 hr in 13 years of operation until 2010, the nominal lifetime of the *HST*.

Most of the exposures taken are short; 91% lasted less than 60 s, with an average exposure time of  $\approx 31$  s. To simulate the working conditions of the STIS lamp we operated the lamp at 10 mA on an interval timer with 30 s on and 30 s off for several months, accumulating 1000 hr of operation. At several

times during this period, and at the end of the period, we photographed the spectrum of the lamp on the normal-incidence spectrograph and compared it with a spectrum taken at the beginning of the test. We found that the spectrum did not change noticeably. Only a small amount of sputtered cathode material was observed to be deposited on the inner walls of the lamp. The operating voltage, whose change would indicate a change in the rare gas pressure or in the cathode dimensions, changed only slightly. We thus conclude that these lamps should be able to operate reliably in space for a period of time substantially exceeding 10 years. In particular, the lifetime of the lamps will not be a limiting factor for the continued use of STIS—and proper wavelength calibration of the scientific observations—until the end of *HST* operations, currently planned for 2010. Both the effects of aging as well as the change of the spectral output as a function of operating current will be presented in more detail in a separate publication.

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