

C IV ABSORPTION IN A NEW SAMPLE OF 55 QSOs: EVOLUTION AND CLUSTERING OF THE HEAVY-ELEMENT ABSORPTION REDSHIFTS

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ABSTRACT

We have obtained spectra with a uniform signal-to-noise ratio of 20:1 and with a resolution of either 0.8 or 1.5 Å of 52 QSOs in the redshift range $1.8 \leq z_{\text{em}} \leq 3.56$. Most of the spectra cover the wavelength range from just longward of the C IV $\lambda 1549$ emission line down to the Lyman- α emission line. In some cases additional spectra of the Lyman- α forest region were also obtained. The QSOs were selected for observation using criteria which were independent of knowledge of the QSOs' absorption spectra. The spectra were supplemented with published spectra of three QSOs which had been obtained with the same observational parameters to produce a uniform sample of 55 QSOs.

Lists of absorption lines were generated for each QSO using identical methods and using criteria which ensure a high probability that the lines are real. Redshifts were determined by standard methods. A total of 229 absorption redshifts was found in which the C IV $\lambda\lambda 1548, 1550$ doublet was identified. Uniform samples were isolated consisting of redshifts for which the rest equivalent widths of both C IV lines exceed 0.15 Å. All of the redshifts in these samples could have been detected in any of the spectra. Some of these fall into clumps which are clearly not independent entities. Therefore, additional samples (called the "Poisson samples") were constructed in which clumps containing more than one system on a scale of less than 1000 km s^{-1} were treated as one system.

An additional sample of 40 redshifts based on the Mg II $\lambda\lambda 2796, 2803$ doublet was also generated; these redshifts will be discussed elsewhere.

The following principal results were obtained from a study of the C IV redshifts:

1. There is no significant tendency for the absorption redshifts to cluster around the emission redshift of the QSO, regardless of the radio properties of the QSO.
2. An application of the Bahcall-Peebles test shows that the large-scale distribution of redshifts along the line of sight is consistent with that expected based on the intervening hypothesis for the origin of the lines.
3. The distribution of the number of absorbers per QSO shows a marginally significant departure from the Poisson distribution expected for randomly distributed intervening absorbers. This is true at the 89% confidence level. It is proposed that the small range in redshift ($\Delta z \sim 0.6$) available in the spectrum of any given QSO causes the details of the large-scale distribution of galaxies along the line of sight to play an important role in the statistics.
4. The number density of absorption systems per unit redshift range $N(z)$ decreases with increasing redshift in the range $1.3 \leq z_{\text{abs}} \leq 3.4$ according to the relation $N(z) \propto (1+z)^{-1.2 \pm 0.7}$ if expressed as a power law. All of the redshift samples show the same qualitative behavior.
5. There is a systematic change in the mean C IV doublet ratio with redshift. Taken in conjunction with the preceding result this is most naturally interpreted as a decrease in the mean C IV abundance with redshift.
6. The two-point correlation function for the C IV redshifts is generally flat, as would be expected for absorbers randomly distributed along the line of sight. In addition, there is significant clustering of the redshifts on scales up to 600 km s^{-1} in the rest frame of the absorbers. Analysis shows that the observed clustering is unlikely to be due to relative motions of clouds in galaxies, but instead is a manifestation of galaxy-galaxy clustering. The amplitude of the clustering is compared with the predictions of published simulations of the evolution of clustering in "cold dark matter" cosmological models. The observed clustering amplitude is significantly larger than that predicted by any of these simulations. Thus, there is a need to invoke "biasing" in order to understand the galaxy clustering at $z \sim 2$, as well as at $z = 0$.

7. There is no significant correlation between the number of absorbers in the line of sight to a given QSO and its intrinsic luminosity. Such a correlation is to be expected if gravitational lensing significantly influences the luminosities of the apparently brightest QSOs.

8. Overall, both the clustering properties and the evolution in redshift of the absorbers responsible for the C IV lines are significantly different from those of the "Lyman- α clouds." Thus, a recent claim that the two kinds of absorbers are part of one population cannot be true.

Subject headings: cosmology — galaxies: clustering — galaxies: intergalactic medium
— line identifications — quasars

I. INTRODUCTION

Considerable progress has been made during the last few years in adding to our understanding of QSO absorption lines through large-scale systematic surveys (Weymann *et al.* 1978; Sargent *et al.* 1980, hereinafter SYBT; Young, Sargent, and Boksenberg 1982*a*, hereinafter YSB; Foltz *et al.* 1986; Tytler *et al.* 1987; Lanzetta, Turnshek, and Wolfe 1987). Work by many people over a number of years has led to the view that the heavy element absorbers are galaxies and that primordial intergalactic clouds produce the lines of the "Lyman- α forest." It is relatively easy to accumulate statistics on the Ly α forest lines because they are common. However, the heavy-element redshifts are much less common, and the existing surveys have only given tantalizing glimpses of their general properties—particularly their evolution in redshift and their clustering. For this reason, we embarked in late 1981 on a program to extend the survey of C IV doublets described in YSB. In the present paper, we report on the spectra of 52 QSOs with redshifts in the range $1.8 \leq z_{\text{em}} \leq 3.56$, which we have observed with a resolution of $1.5 \text{ \AA}$ or better and with a signal-to-noise ratio of ~ 20 . This survey has been carried out with the University College London image photon counting system at the Palomar 5.08 m telescope. Thus, it has been possible to observe more objects at a higher spectral resolution and with a better signal-to-noise ratio than in the survey reported in YSB, which was carried out with an intensified Reticon detector on the Las Campanas 2.5 m Du Pont telescope. Hence, we can hope to measure weaker lines and thereby obtain a much larger statistical sample of absorption redshifts than that described in YSB. Consequently, the present survey resulted in 229 C IV redshifts, as compared with the 49 found in 30 QSOs in YSB.

In § II, we describe the choice of objects, the observational parameters, and the reduction techniques. A description of the absorption spectra for each object is given in § III. Complete samples of redshifts which could have been found in any of the QSO spectra are defined in § IV. The samples are then used in § V for various tests of the intervening nature of the absorption redshifts. Section VI is devoted to an examination of the evolution in redshift of various statistical properties of the absorption systems. Clustering of the absorption systems is investigated in § VII. Here we also compare the observed two-point correlation function with theoretical simulations of its behavior at $z \sim 2$. In § VIII we examine the evidence for "line locking" and for the existence of special redshifts. Our conclusions are given in § IX.

II. OBSERVATIONS AND REDUCTIONS

a) Selection of Objects

The QSOs constituting our sample of 55 were selected solely on the basis of their emission redshifts ($z_{\text{em}} \geq 1.8$) and their estimated brightness ($m_V \leq 18.0$). None of the QSOs in the sample were selected because of *a priori* knowledge of their absorption spectra. Obvious broad-absorption-line (BAL) QSOs were excluded from the sample, although several were observed. The only other criterion for selection was the convenience of the position in the sky at the time the observations were made. We present new observations of 52 QSOs, and we include three QSOs whose spectra have been published previously (Q0119–046, Q0421+019, and Q1115+080) for which the data were obtained using the same instrumental setup and selection criteria as for the new observations. According to the catalog of Hewitt and Burbidge (1987), of the 55 QSOs in our sample, only 17 are known radio sources, while 12 are known X-ray sources. The great majority of the objects were discovered in objective prism surveys. Many of the QSOs are previously unpublished, and most have never been studied in detail.

b) Observations

All of the observations were made on the Palomar 5.08 m Hale Telescope with the double spectrograph (Oke 1982) at the Cassegrain focus. Almost all of the spectra were obtained using the IPCS detector attached to the blue side of the spectrograph; a few of the highest redshift objects were observed with both the IPCS and the red CCD camera (attached to the red side of the double spectrograph). The latter was used in order to achieve a high signal-to-noise ratio in the red end of the spectrum, where the sensitivity of the IPCS is greatly reduced. The majority of the spectra were obtained using a $1200 \text{ line mm}^{-1}$ grating blazed at $5000 \text{ \AA}$ (in first order); with a $1''$ slit, the resulting spectral resolution was $\sim 1.5 \text{ \AA}$. The wavelength coverage with this setup was $\sim 1250 \text{ \AA}$. The observed wavelength range generally covered the spectral region between Ly α and C IV $\lambda 1549$ emission, although complete coverage of this range was not achieved for all of the spectra, particularly those at somewhat higher redshifts. A few of the brightest objects were observed using $1200 \text{ line mm}^{-1}$ gratings (with first-order blaze at $7100 \text{ \AA}$ or at $9400 \text{ \AA}$) in second order, giving a spectral resolution of $\sim 0.7 \text{ \AA}$. When the gratings were used in second order, a liquid CuSO_4 filter was used to prevent contamination from

TABLE 1
OBSERVATIONS

Object	Date (UT)	FWHM (Å)	λ Range (Å)	Exposure (s)	Object	Date (UT)	FWHM (Å)	λ Range (Å)	Exposure (s)
Q0013-004	1983 Nov 7	1.5	3880-4950	1500	Q1017+280	1981 Nov 19	1.5	3600-4810	3000
	1983 Nov 8	1.5	3780-4850	4133		1981 Nov 20	1.5	3600-4810	3000
Q0014+813	1984 Oct 29	1.5	4760-5950	4000		1981 Nov 21	1.5	3600-4810	7500
	1984 Oct 31	1.5	5800-6950	18660		1983 Feb 16	0.8	3010-3743	4000
Q0058+019	1981 Nov 20	1.5	3595-4813	6000		1983 Feb 17	0.8	3851-4450	4000
	1981 Nov 22	0.8	3350-3953	6000	Q1054-034	1984 Mar 24	1.5	3750-4930	5000
Q0112+030	1984 Oct 25	1.5	4760-6000	9000	Q1138+040	1984 Mar 24	1.5	3750-4930	5000
	1984 Oct 28	1.5	4760-6000	3000	Q1148-001	1984 Mar 27	1.5	3750-4930	7000
Q0114-089	1984 Oct 26	1.5	4760-6000	5000	Q1159+124	1984 May 6	1.5	5550-6750	6000
Q0142-100	1981 Nov 17	0.8	3660-4248	6000		1984 May 6	1.5	4600-5800	6000
	1981 Nov 18	0.8	4180-4768	6000		1985 Apr 12	2.2 ^a	6550-7150	7200
	1981 Nov 25	1.5	4695-5900	9000		1985 Apr 12	0.8	4830-5400	7200
Q0150-203	1981 Nov 21	1.5	3815-5038	6000		1985 Apr 13	2.2 ^a	6050-6650	7200
Q0151+048	1981 Nov 20	1.5	3590-4812	6000		1985 Apr 13	0.8	4830-5400	7200
Q0207-003	1984 Oct 26	1.5	4760-6000	4000	Q1213+093	1985 Apr 14	1.5	4260-5500	7000
	1984 Oct 29	1.5	4760-6000	3000	Q1222+228	1984 Mar 23	1.5	3750-4930	2000
Q0216+080	1984 Oct 29	1.5	4760-6000	9000	Q1245+345	1984 Mar 23	1.5	3750-4930	6000
Q0226-038	1981 Nov 10	1.5	3760-4970	7000	Q1247+267	1983 Feb 13	0.8	3200-3750	2000
Q0229+131	1981 Nov 8	1.5	3755-4970	7335		1983 Feb 14	0.8	3200-3750	5000
Q0237-233	1981 Nov 22	0.8	3395-3952	9000		1983 Feb 19	0.8	3650-4200	4000
	1981 Nov 23	0.8	3850-4445	13500		1984 Mar 23	1.5	3750-4930	900
	1981 Nov 24	0.8	4430-5010	5320	Q1329+412	1984 Mar 24	1.5	3750-4930	6000
	1981 Nov 25	1.5	4700-5900	6000	Q1331+170	1984 Mar 23	1.5	3750-4930	2500
Q0329-255	1984 Oct 28	1.5	4760-6000	6000	Q1435+638	1984 Mar 23	1.5	3750-4930	2000
	1984 Oct 29	1.5	4760-6000	2000	Q1442+101	1984 May 6	1.5	5550-6750	6000
Q0348+061	1983 Nov 7	1.5	3880-5060	5000		1985 Apr 12	2.2 ^a	6550-7150	7800
Q0424-131	1981 Nov 20	1.5	3925-5150	6000		1985 Apr 13	2.2 ^a	6050-6650	4400
	1981 Nov 22	0.8	3340-3953	6000	Q1510+115	1984 May 2	1.5	4000-5200	5000
	1983 Feb 14	0.8	3150-3764	6000		1984 May 2	1.5	3500-4700	6000
	1983 Feb 16	0.8	3750-4354	6000	Q1511+091	1984 May 5	1.5	4200-5400	5000
Q0440-168	1984 Oct 27	1.5	4760-6000	4000		1984 May 5	1.5	5200-6400	8000
Q0449-135	1984 Oct 28	1.5	4760-6000	7000	Q1517+239	1984 Mar 27	1.5	3750-4930	6000
	1984 Oct 29	1.5	4760-6000	3760	Q1548+093	1985 Apr 15	1.5	4260-5500	3600
Q0450-132	1984 Nov 1	1.5	4040-5240	5000	Q1623+269	1981 Jun 25	0.8	3405-3965	8000
Q0528-250	1984 Oct 25	1.5	4760-6000	7000		1981 Jun 26	0.8	5005-5620	6000
Q0831+128	1984 Oct 27	1.5	4760-6000	9000		1981 Jun 27	0.8	5005-5620	8000
Q0837+109	1985 Apr 12	2.2 ^a	6500-7100	3600		1981 Jun 28	0.8	4485-5115	12324
	1985 Apr 12	2.2 ^a	6200-6800	3600		1981 Jun 29	0.8	3300-3860	10000
	1985 Apr 12	0.8	4850-5400	7200		1981 Jun 30	0.8	5005-5620	12000
	1985 Apr 13	2.2 ^a	5700-6300	3600	Q1715+535	1984 Mar 27	1.5	3750-4930	4000
	1985 Apr 13	0.8	4850-5400	3600	Q2126-158	1984 Oct 28	1.5	4760-6000	7000
	1985 Apr 14	2.2 ^a	5700-6300	3600		1984 Oct 30	1.5	5800-6950	4000
	1985 Apr 14	0.8	4850-5400	3600	Q2206-199	1981 Jul 1	1.5	3540-4850	8000
Q0848+163	1981 Nov 19	1.5	3590-4810	6000		1981 Jul 2	1.5	4530-5830	7000
	1981 Nov 23	0.8	3340-3952	7500	Q2342+089	1984 Oct 25	1.5	4760-6000	12000
Q0848+155	1983 Nov 8	1.5	3750-4930	1076		1984 Oct 28	1.5	4760-6000	4000
	1983 Nov 9	1.5	3750-4930	6800	Q2343+125	1984 Oct 26	1.5	4760-6000	5000
	1984 Mar 27	1.5	3750-4930	8000	Q2344+125	1984 Oct 27	1.5	4760-6000	7000
Q0852+197	1983 Nov 7	1.5	3880-5060	5700		1984 Oct 29	1.5	4760-6000	2000
Q0854+191	1983 Nov 10	1.5	3450-4600	4000					
Q0913+072	1983 Nov 7	1.5	3870-5090	4500					
Q0958+551	1983 Nov 10	1.5	3450-4600	1200					

^a Red CCD observations.

the first-order red. For the IPCS data, the exposures were broken into intervals of 1000 s at each of four positions along the slit; this procedure has been found to result in more accurate sky subtraction and superior signal-to-noise ratios because variations in the detector sensitivity along the slit are averaged out. A hollow-cathode Fe-Ar arc was exposed before and after each 1000 s interval in order to keep track of small

wavelength shifts. The red CCD spectra were obtained using the 1200 line mm⁻¹ (7100 Å blaze) grating and a slit width of 1''.5. While the spectral resolution achieved for these observations was only ~2.2 Å, the *velocity* resolution is comparable to that attained with the IPCS because of the differences in the wavelengths covered by the observations. A journal of the observations is presented in Table 1.

c) Reductions

The spectra were reduced in the usual fashion, using flat-field exposures to eliminate pixel-to-pixel variations in the sensitivity of the detectors. Observations of spectrophotometric standard stars were used to calibrate the spectra to an approximate relative flux scale; because of the narrow slit used, no attempt was made to achieve absolute spectrophotometry. Individual exposures of the same object (over the same wavelength range) were reduced separately, then rebinned to a linear wavelength scale and added together after being weighted approximately according to the number of raw counts in each spectrum. For the purposes of display, when more than one wavelength range was observed for the same object, the spectra were adjoined after forcing the separate spectra to be on the same relative flux scale. The spectra are plotted in Figure 1. It should be noted when examining these figures that they are limited by the resolution of the plotting device. Consequently, the figures do not quite do justice to the quality of the original spectra.

d) Emission Lines

The measured positions and equivalent widths of the prominent emission lines are presented in Table 2. In measuring the emission-line equivalent widths, no attempt was made to correct for absorption in the Ly α emission line. The adopted emission-line positions represent the peaks of the lines; since in many cases the C IV λ 1549 emission line is the only unblended line appearing in the spectrum, the peak is a better representation of the true emission redshift than any flux-weighted determination because of the well-known blue asymmetry of the line (YSB). When Ly α and C IV appeared in the spectrum, these lines were given twice the weighting of any of the other lines in determining the adopted emission redshift. The wavelength used for the Si IV/O IV blend was as determined by YSB (1399.7 Å). The errors on the line equivalent widths represent formal uncertainties and do not include errors due to the relatively large amount of subjectivity involved in defining the QSO continuum. The actual errors in the measurement of the stronger lines are probably of order 10%, while the errors for the weaker lines are of course substantially larger.

e) Absorption Lines

Absorption-line lists for all of the spectra were generated using procedures described in Young *et al.* (1979), YSB, and Young, Sargent, and Boksenberg (1982*b*). The line lists and the suggested line identifications are listed in Table 3. All of the wavelengths are heliocentric, vacuum values. When more than one wavelength range was observed for an object, the spectra were measured separately in order to provide a check on the consistency of the wavelength calibration and on the reality of weak features in the overlapping regions. The resulting line lists were then merged, with lines appearing in more than one list being weighted by the square of the signal-to-noise ratio to arrive at the tabulated value. A line was accepted for the line list if it exceeded $5\sigma(W)$ in strength.

Lines in complexes or blends were separated whenever it was deemed possible to do so. While the tabulated equivalent

widths for such features cannot be considered to be accurate, the *sum* of the equivalent widths should be accurate for the blends or complexes as a whole. In addition, the errors on the wavelengths for such partially blended lines are probably larger than the formal errors would suggest. In § III we discuss each of the spectra and the identified absorption redshifts individually.

III. DISCUSSION OF INDIVIDUAL OBJECTS

In our discussion of the individual objects in our sample, we will refer to previous work only when it involved absorption-line studies of the objects in question. Extensive references for each object can be found in Hewitt and Burbidge (1987).

a) Q0013-004

This QSO, also known as UM 224, has one of the most interesting and complex absorption spectra in the sample. Unfortunately, this object was observed under less than ideal conditions, so that the signal-to-noise ratio is only marginally acceptable. We have identified nine absorption redshifts in the spectrum, making this one of the richest in the sample:

$z_{\text{abs}} = 0.4470$.—While the redshift agreement is good between the two components of this Mg II doublet, the identification is not certain. The short-wavelength component may be blended with C II λ 1334 from another system.

$z_{\text{abs}} = 1.5617$.—This system is fairly uncertain; it is identified based solely on the presence of the C IV doublet, and at least one component of the doublet is badly blended with C II λ 1334 from another system. There is, however, very good redshift agreement between the two components.

$z_{\text{abs}} = 1.7137$.—This system is certain, as, in addition to the relatively strong C IV doublet, several low-ionization lines are identified.

$z_{\text{abs}} = 1.7536$.—While the C IV doublet is very near the threshold for inclusion in the line list, the redshift agreement is sufficiently good that we regard the system as real.

$z_{\text{abs}} = 1.9675, 1.9706, 1.9758$.—These three systems are involved in a complex. We regard them as certain, as corresponding lines of Si IV are found for all three and Si II λ 1526 lines are identified for the first two.

$z_{\text{abs}} = 1.9917$.—This system, based only on the comparatively weak C IV doublet, we regard as probable.

$z_{\text{abs}} = 2.0290$.—This certain system has several low-ionization lines in addition to the strong C IV and Si IV.

Several moderately strong lines remain unidentified in this spectrum. It would be important and interesting to obtain a higher quality spectrum of this object.

b) Q0014 + 813

This QSO is among the brightest known and has one of the highest emission redshifts in our sample. It was first identified as a radio source. Our spectrum is a composite of IPCS and red CCD spectra. The spectrum has been studied previously by Kuhr *et al.* (1983), but the resolution was only ~ 7 Å. In our data, which are of much higher resolution, we find the following absorption redshifts:

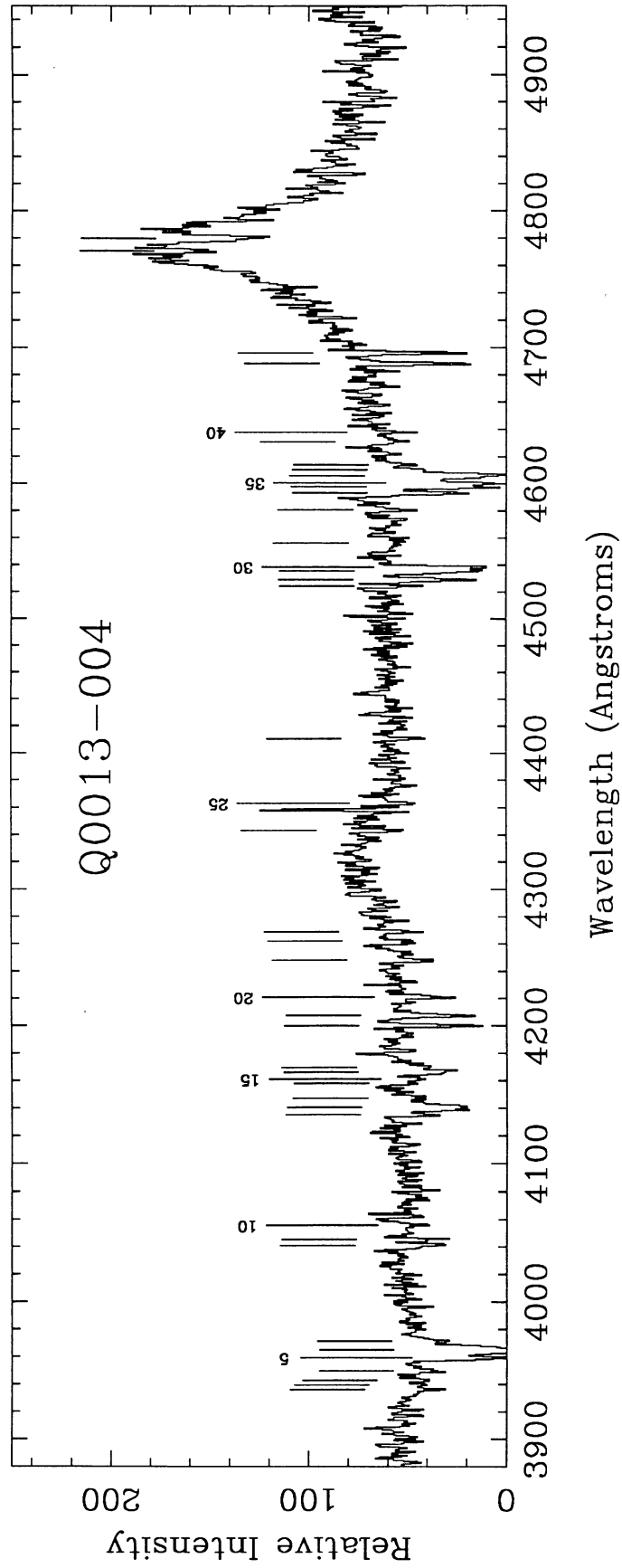


FIG. 1.—The spectra of the 52 newly observed QSOs. The spectra are of either 0.8 or 1.5 Å resolution and they are plotted without smoothing. Measured absorption lines (see Table 2) have been indicated. In general, the resolution of the plotter was not quite as good as the resolution of the spectra, so that some real features may not be clearly discernible from inspection of the plots. Also, note that the lettering of the plots in this figure does not correspond exactly to the lettering of the subsections in § III.

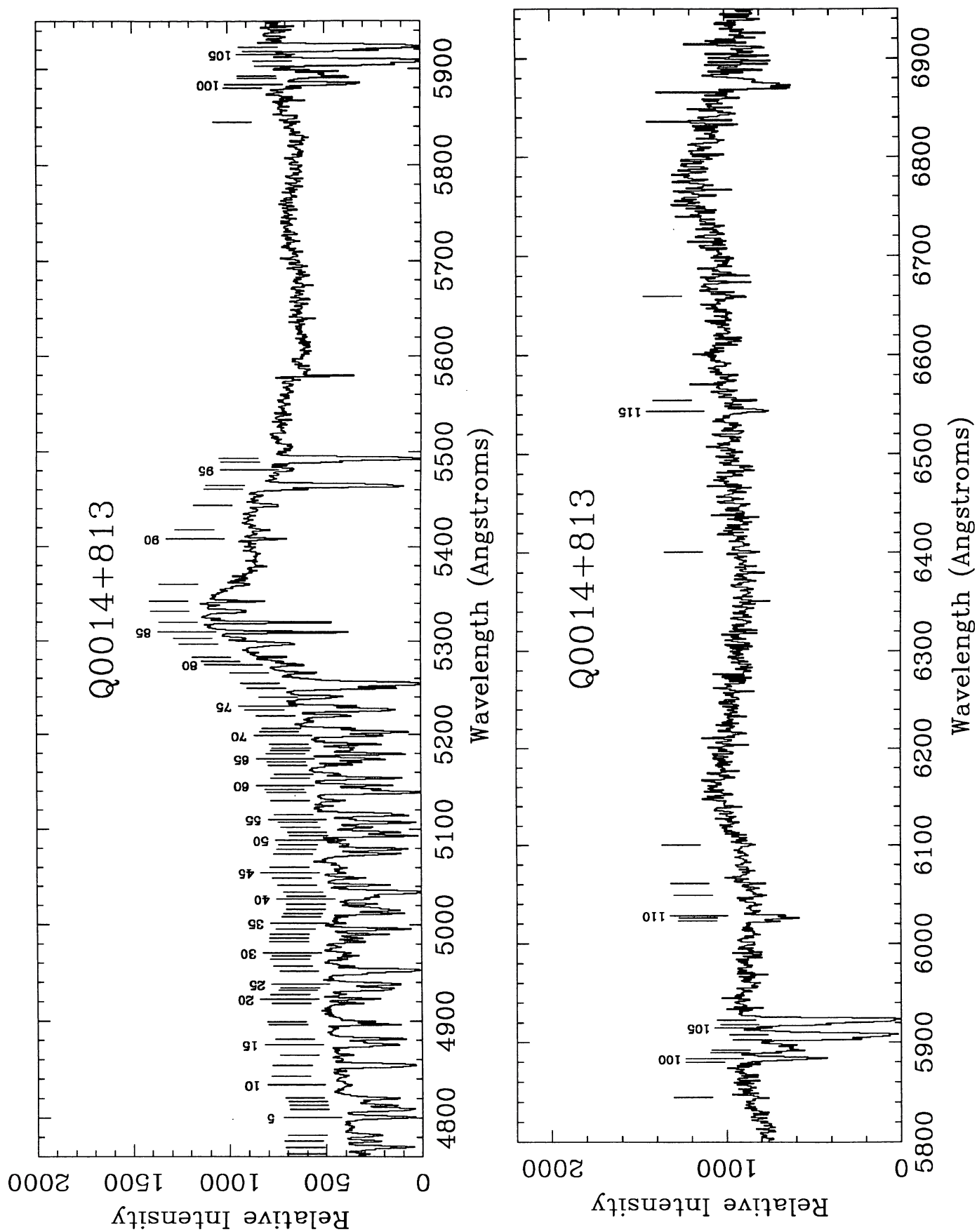


FIG. 1—Continued

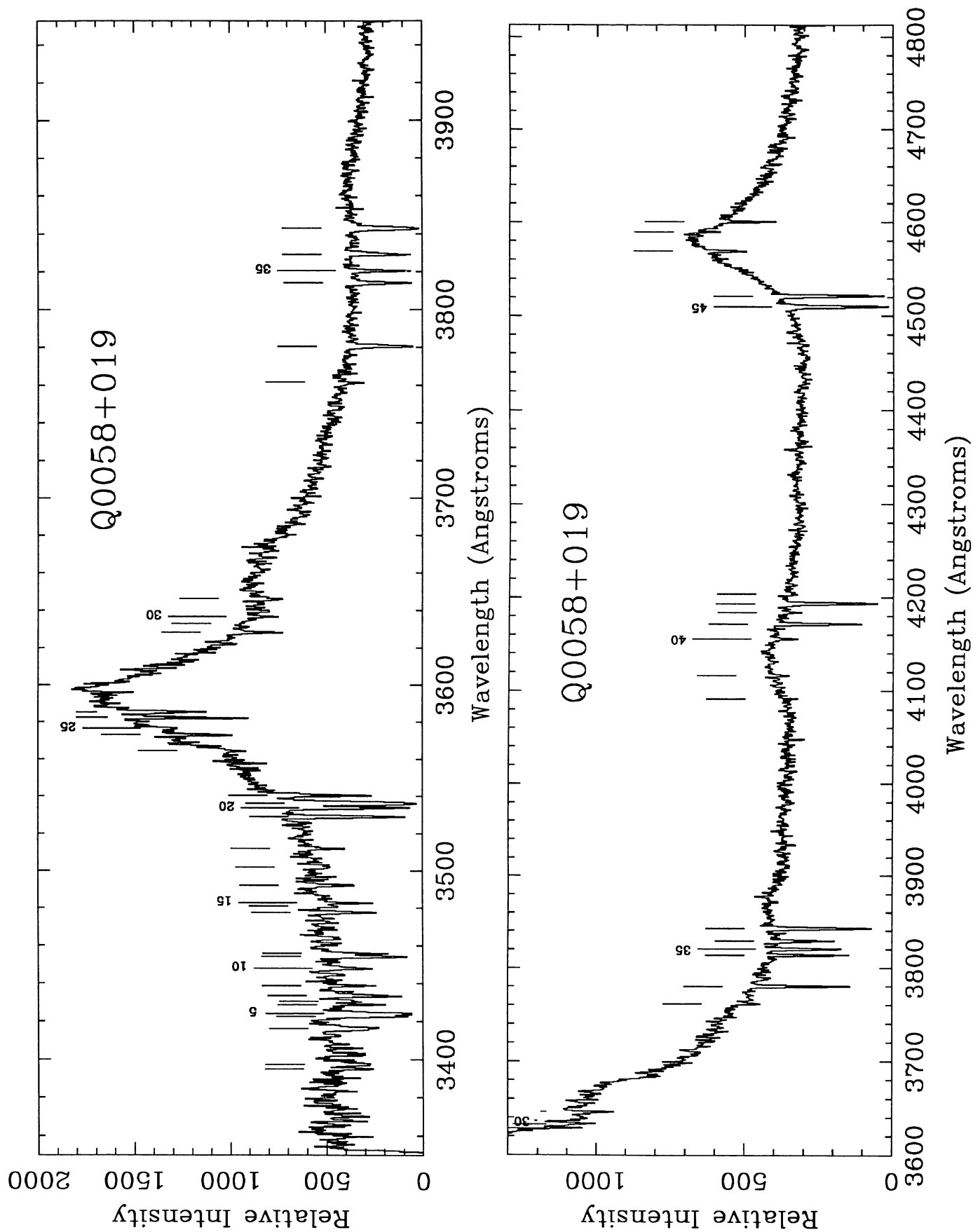


FIG. 1—Continued

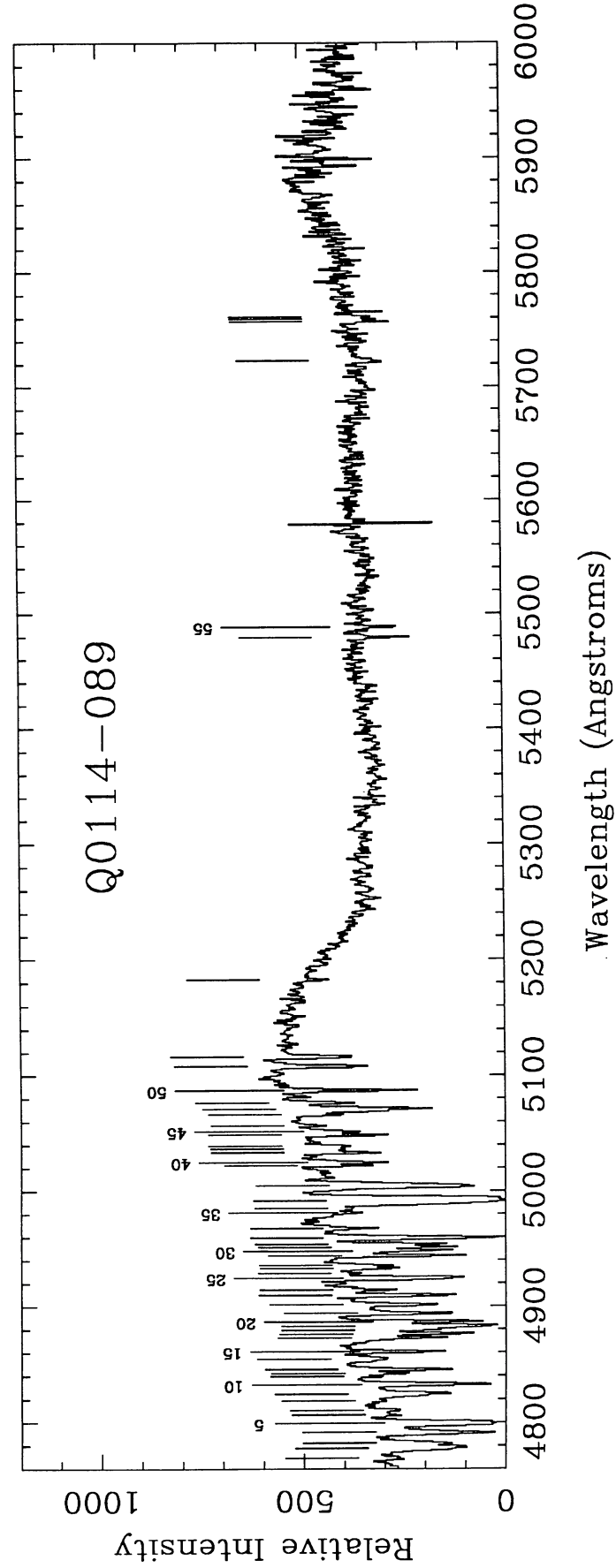
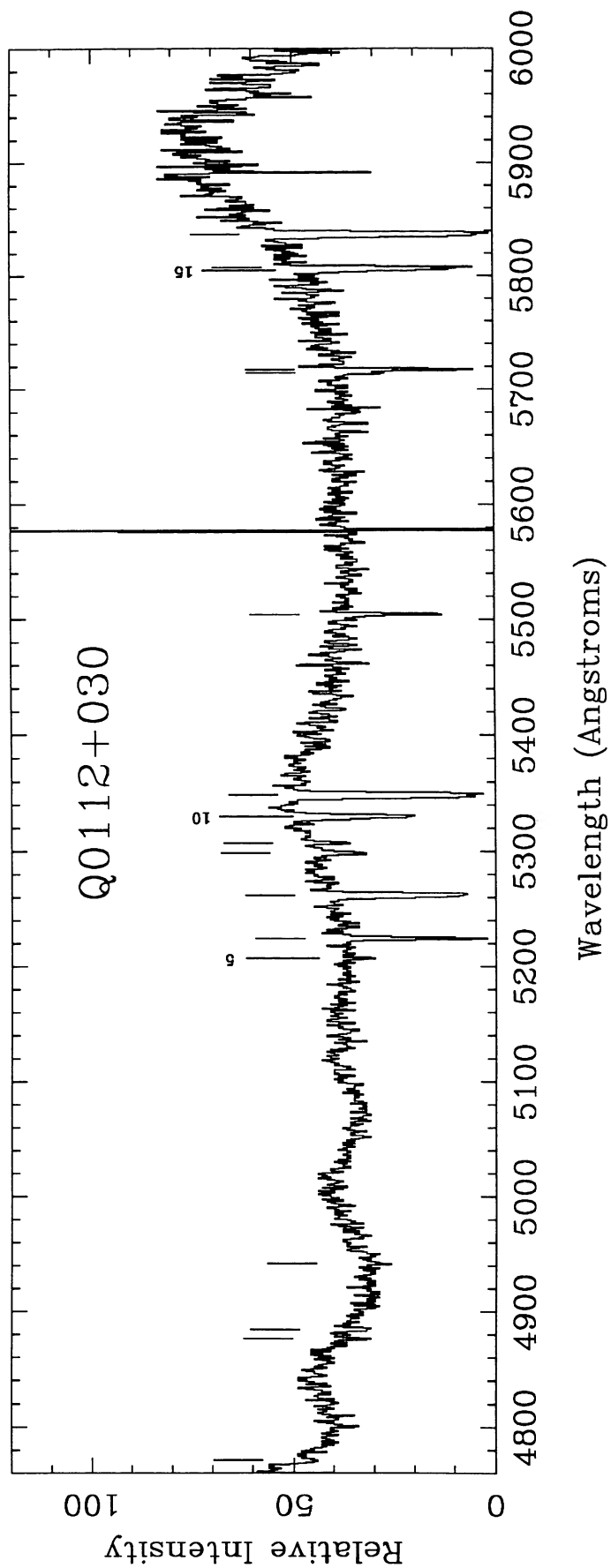


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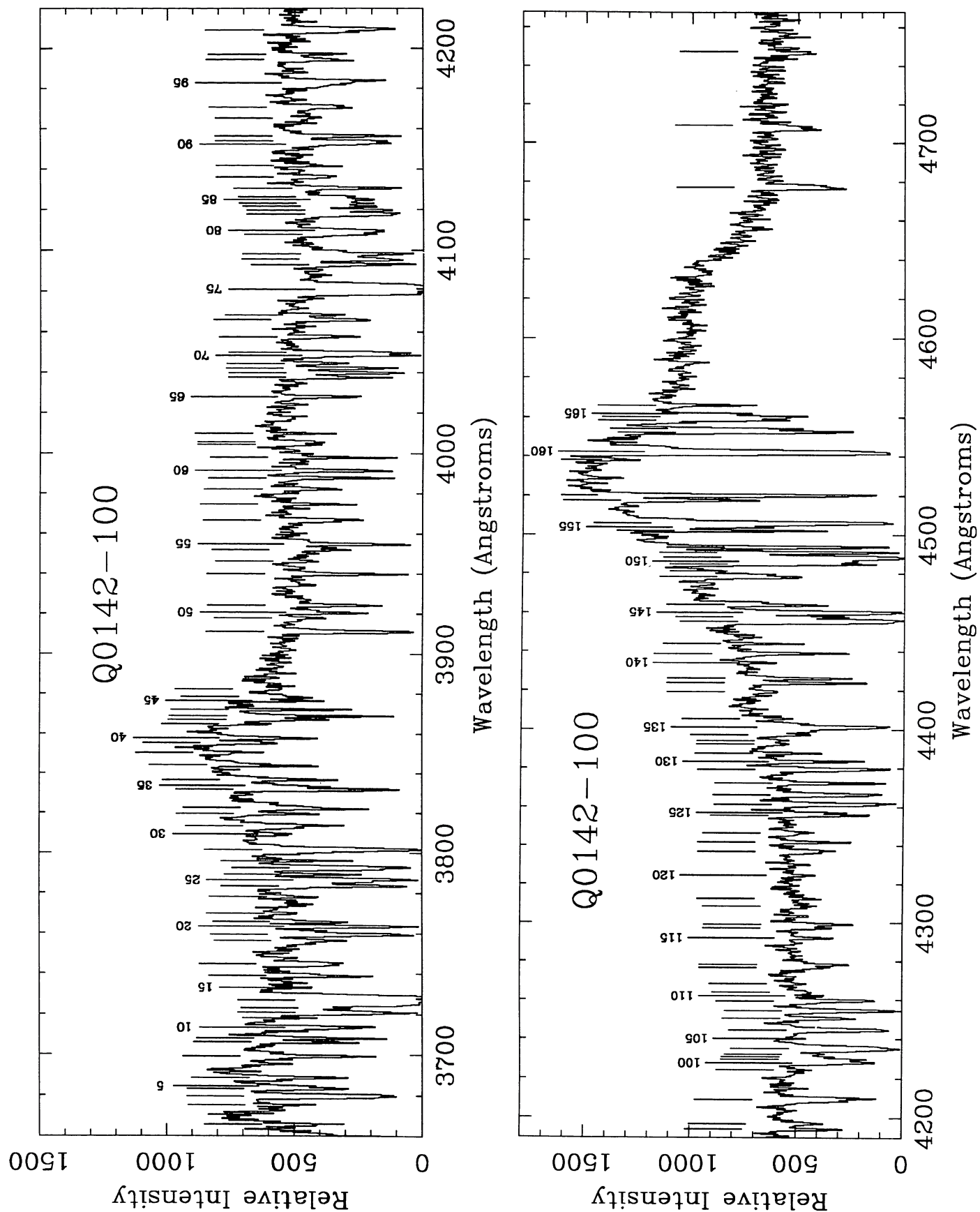


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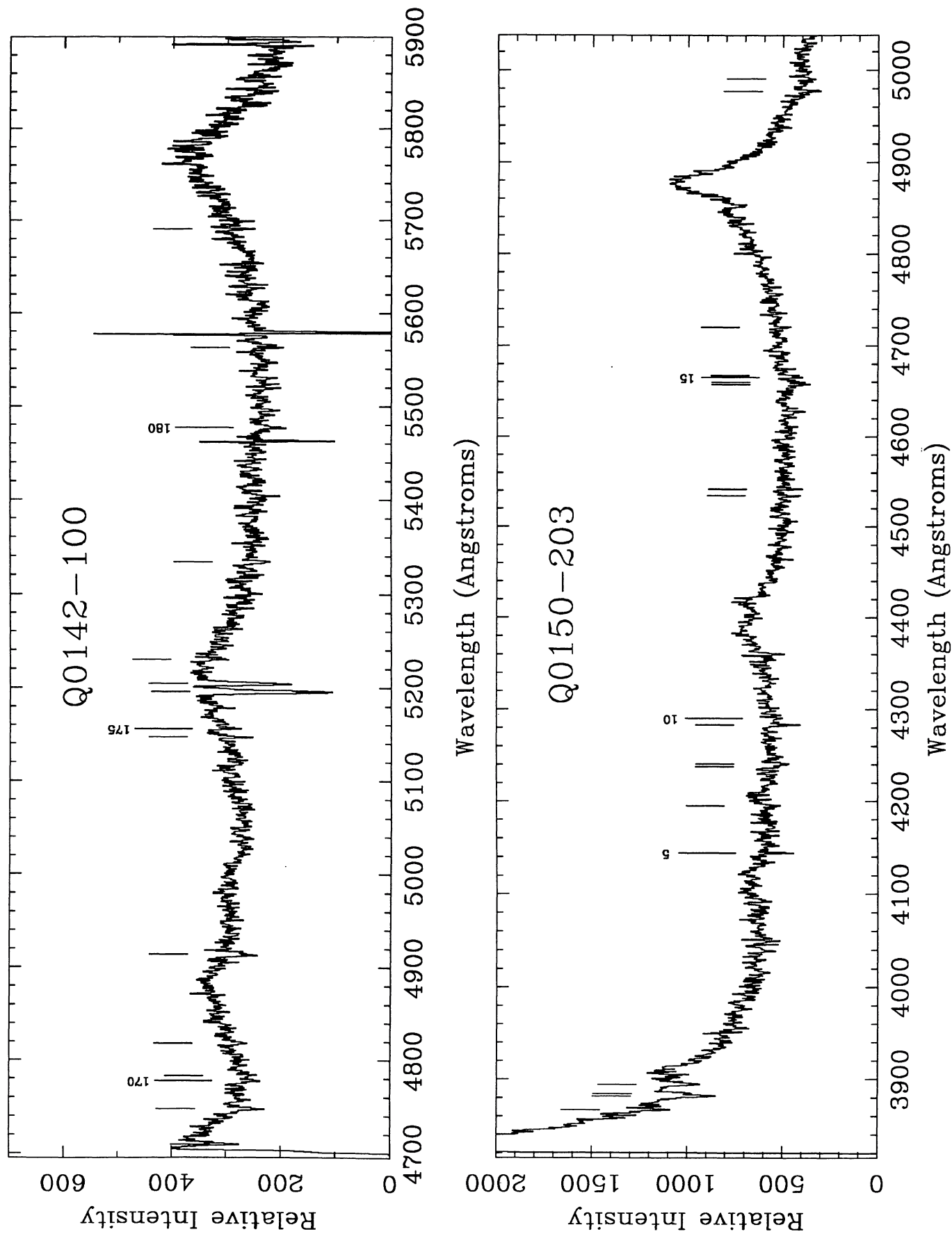
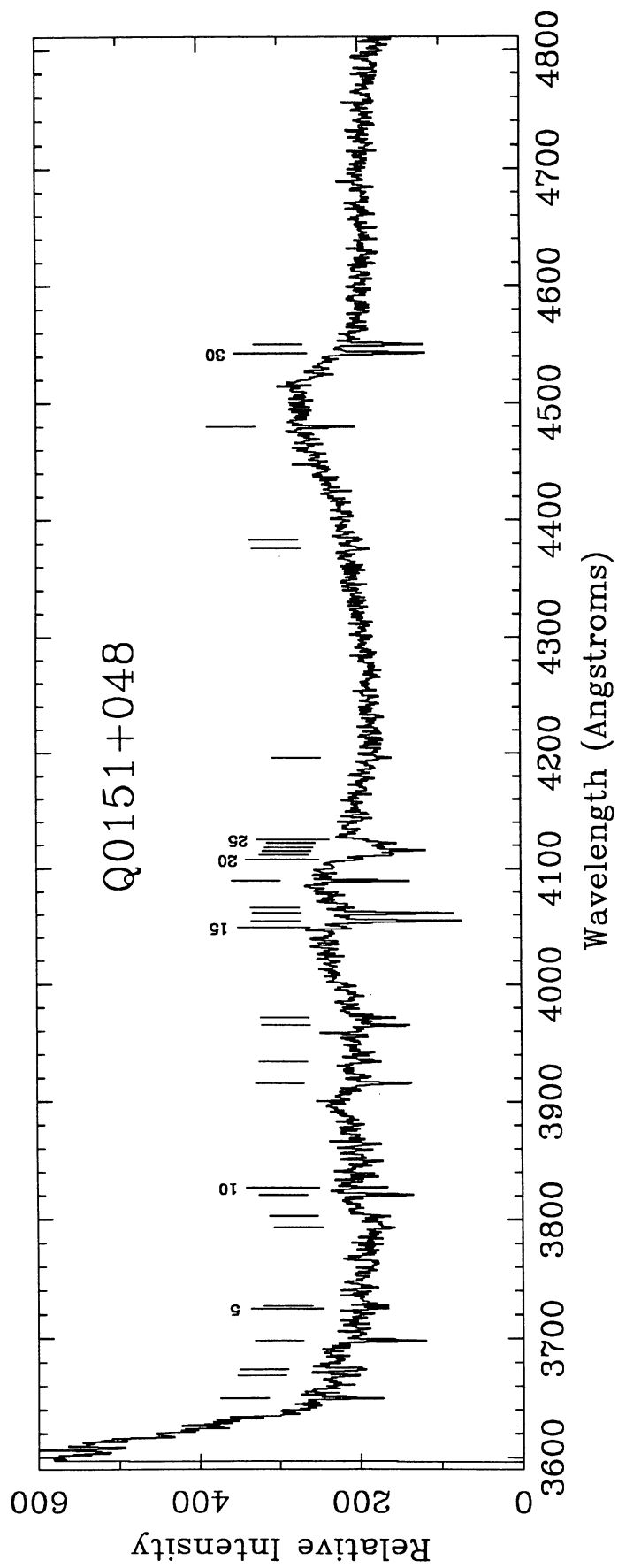


FIG. 1—Continued



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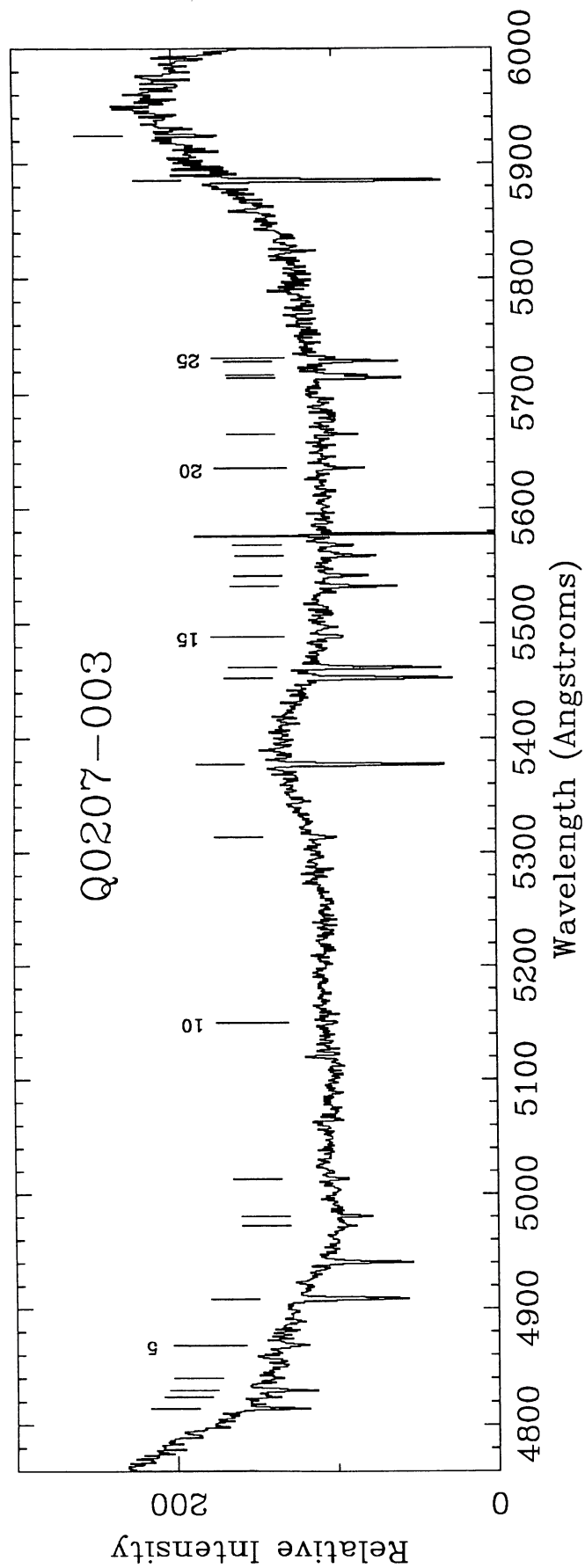


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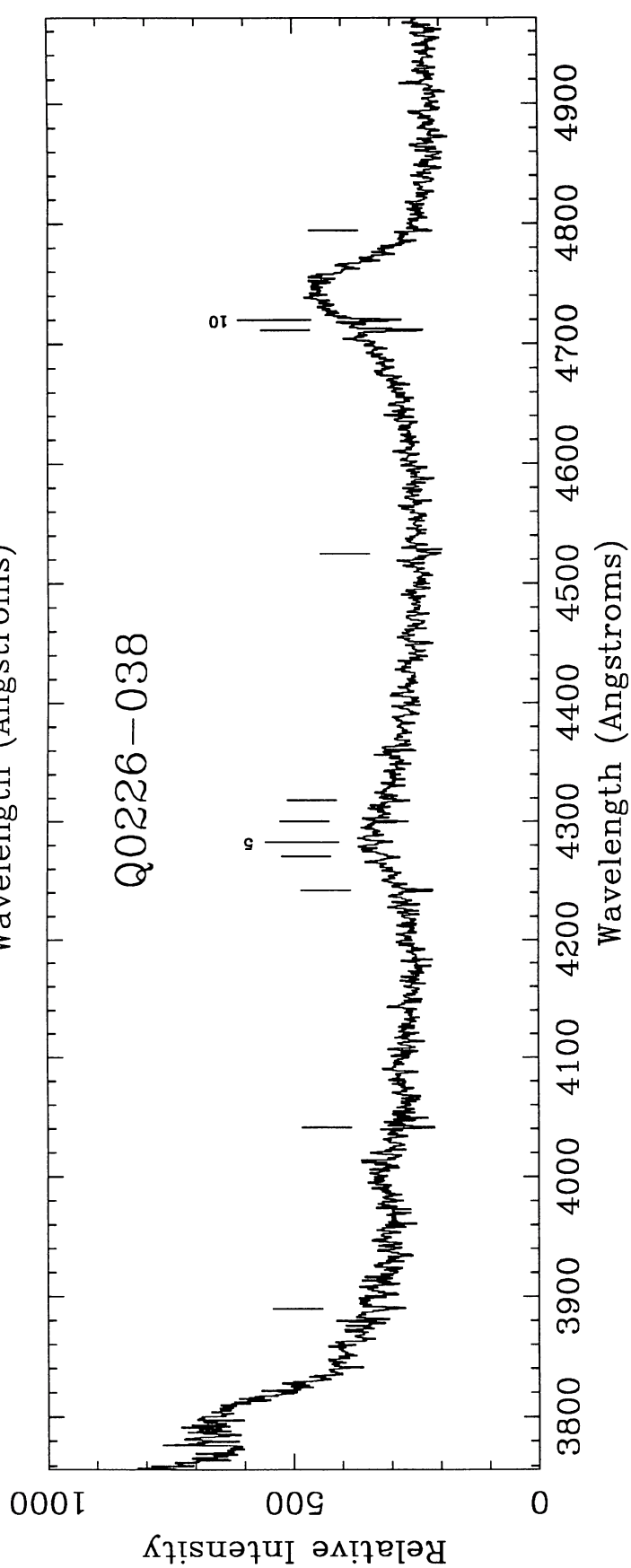
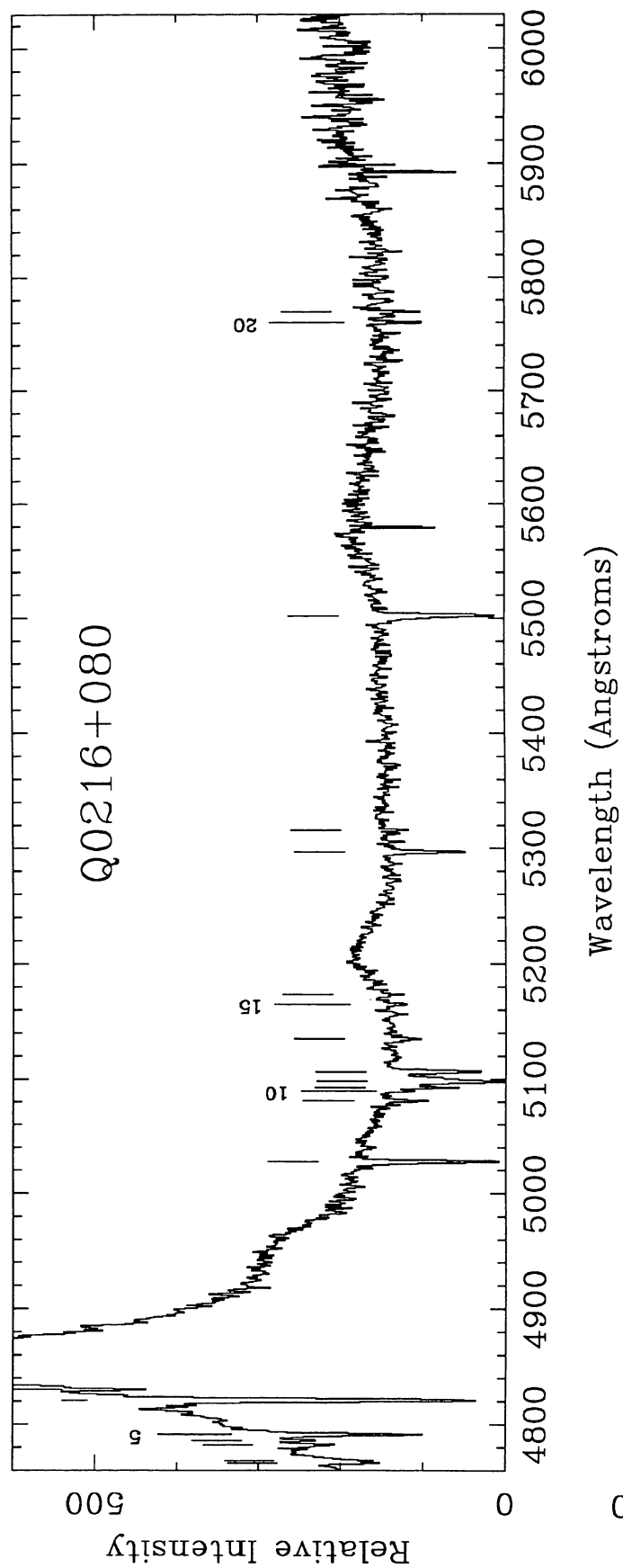


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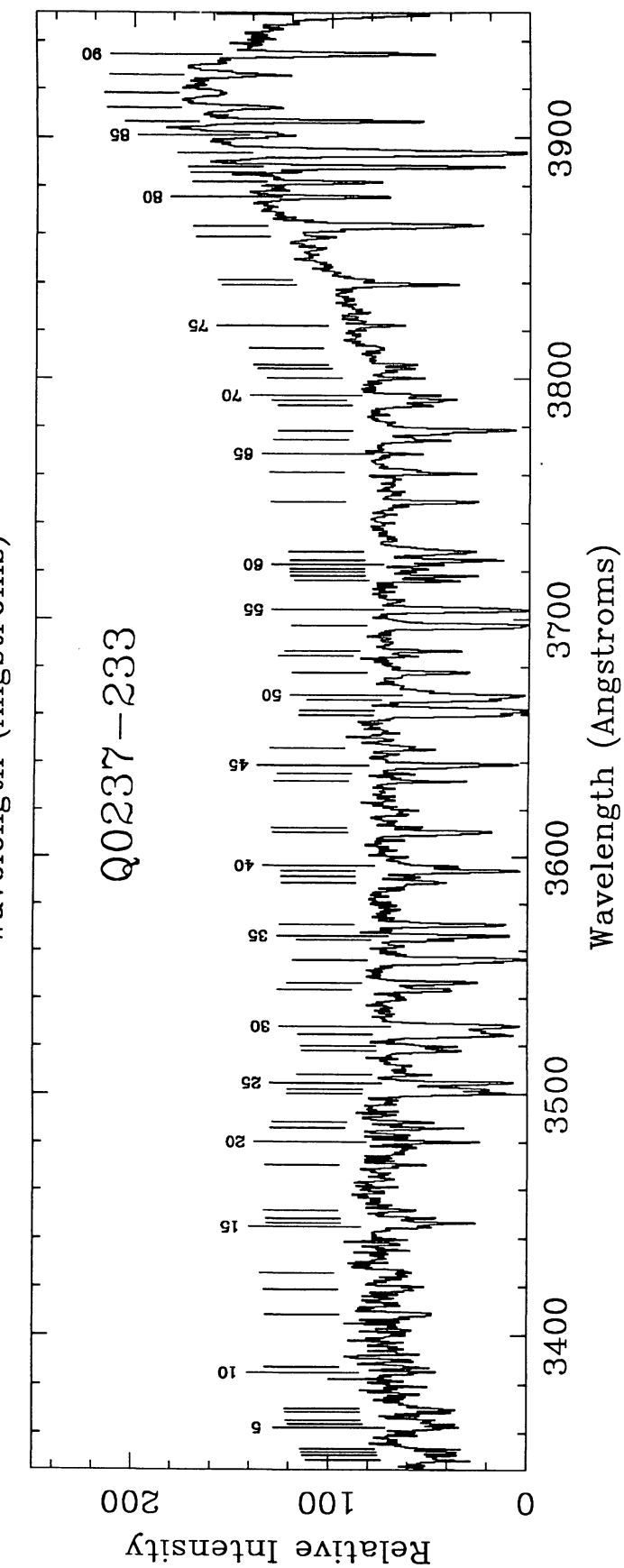
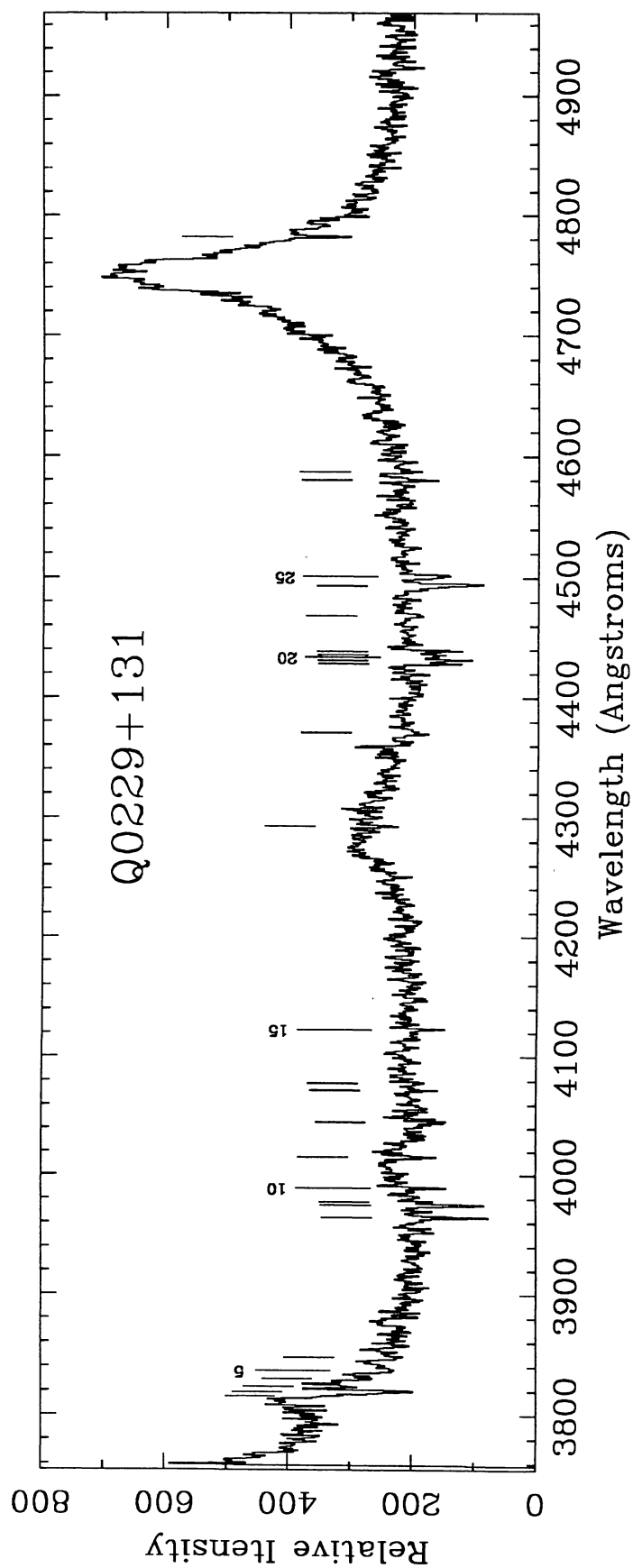


FIG. 1—Continued

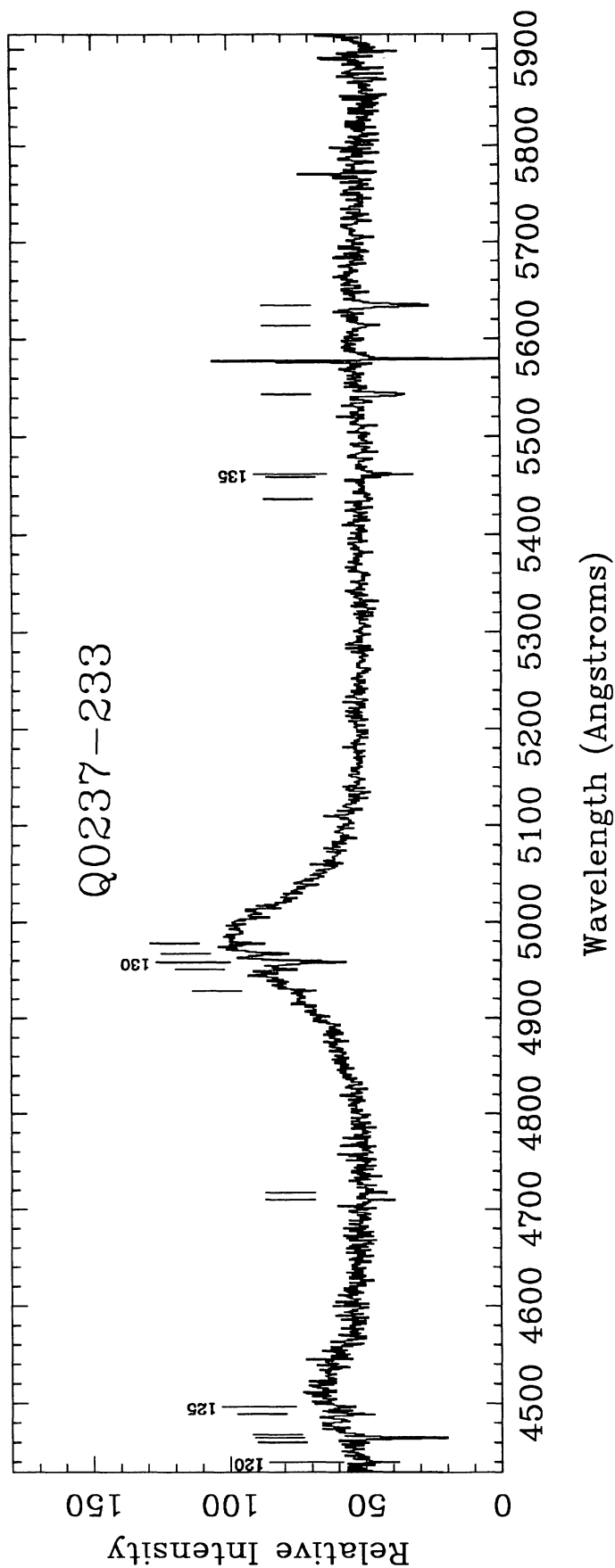
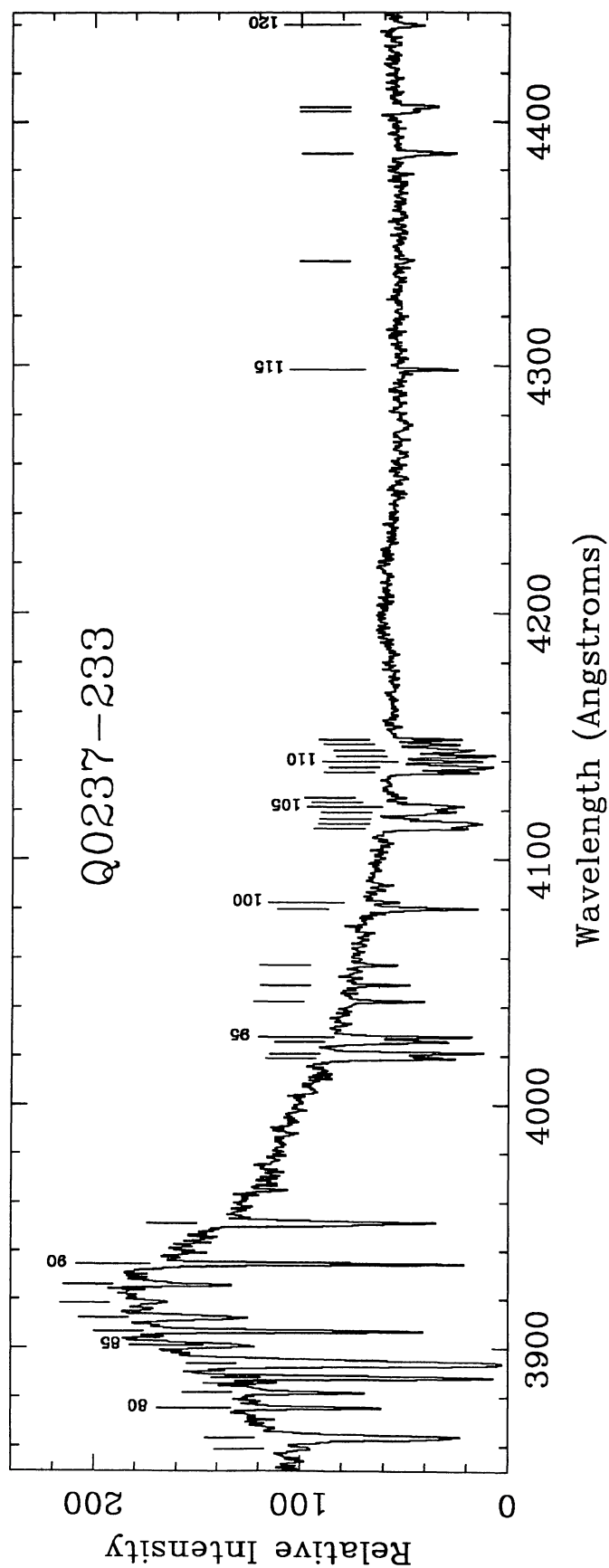
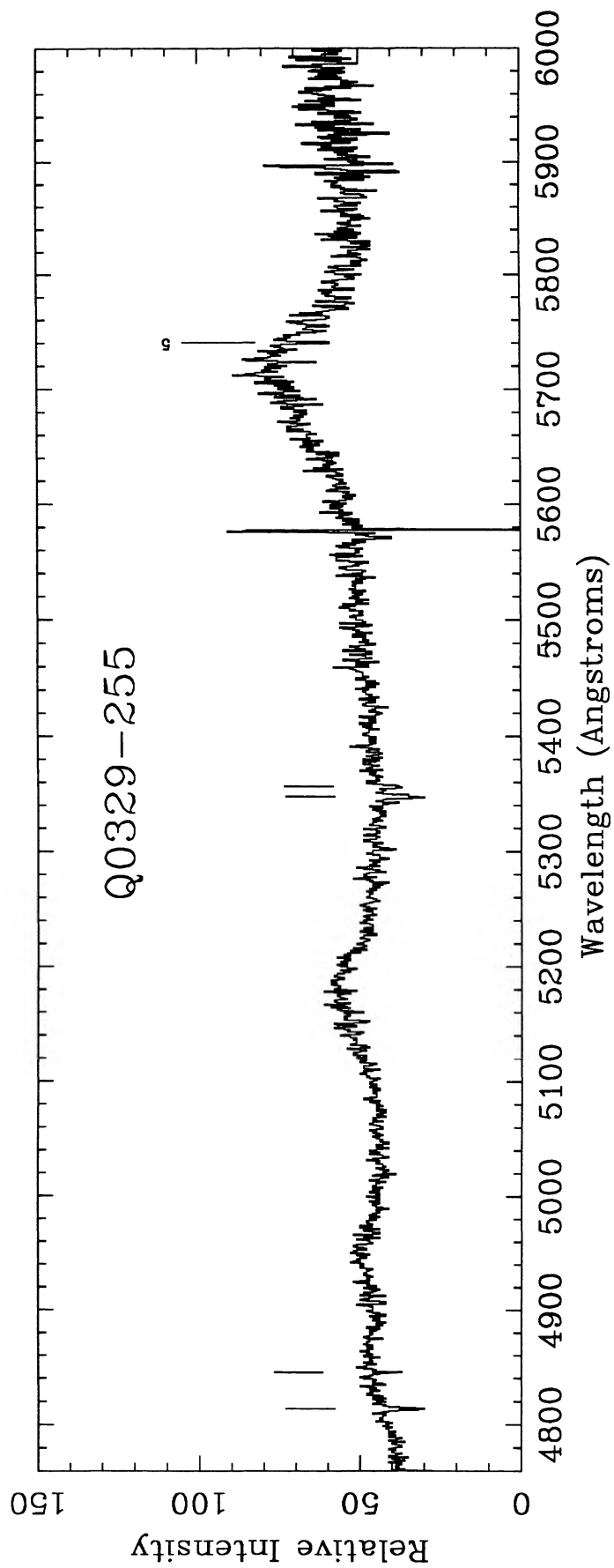


FIG. 1—Continued



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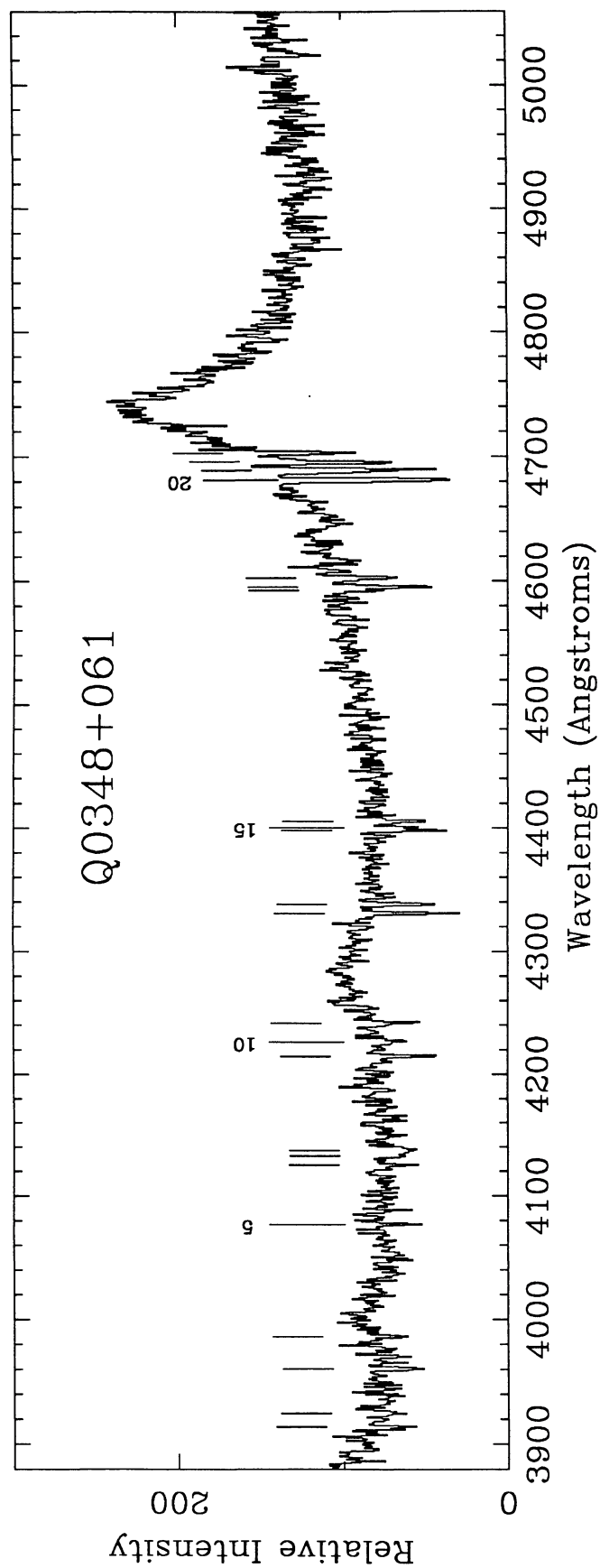


FIG. 1—Continued

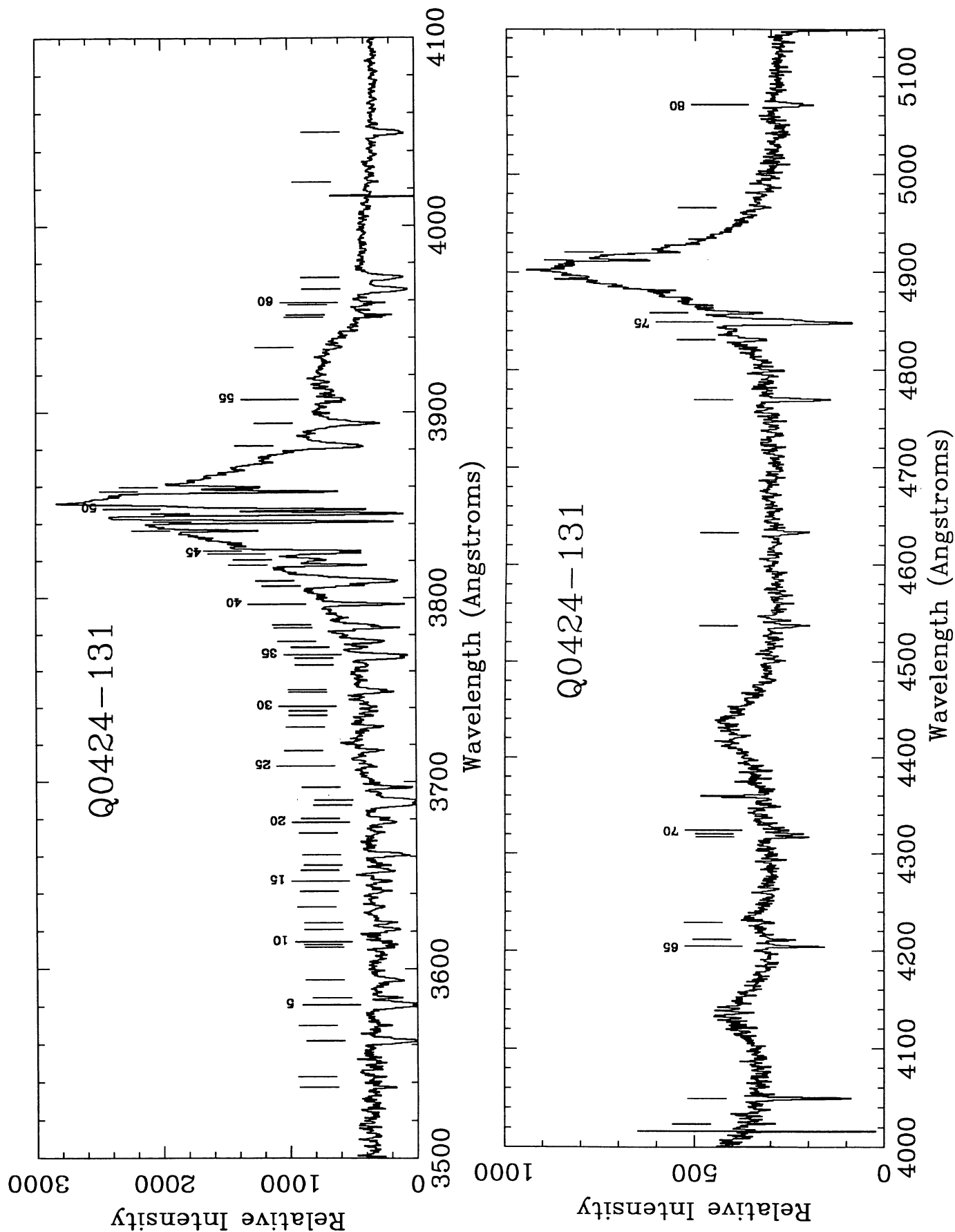


FIG. 1—Continued

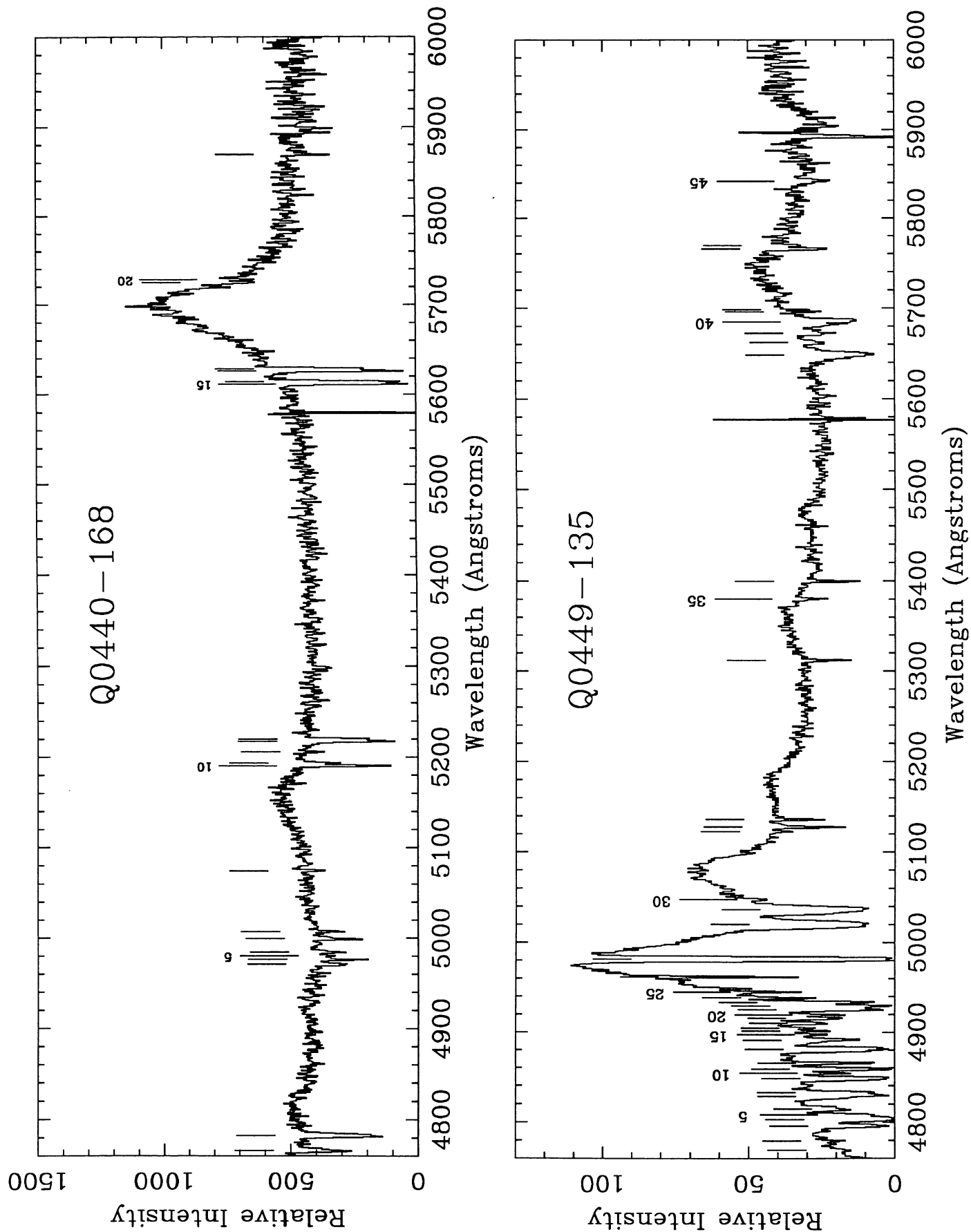


FIG. 1—Continued

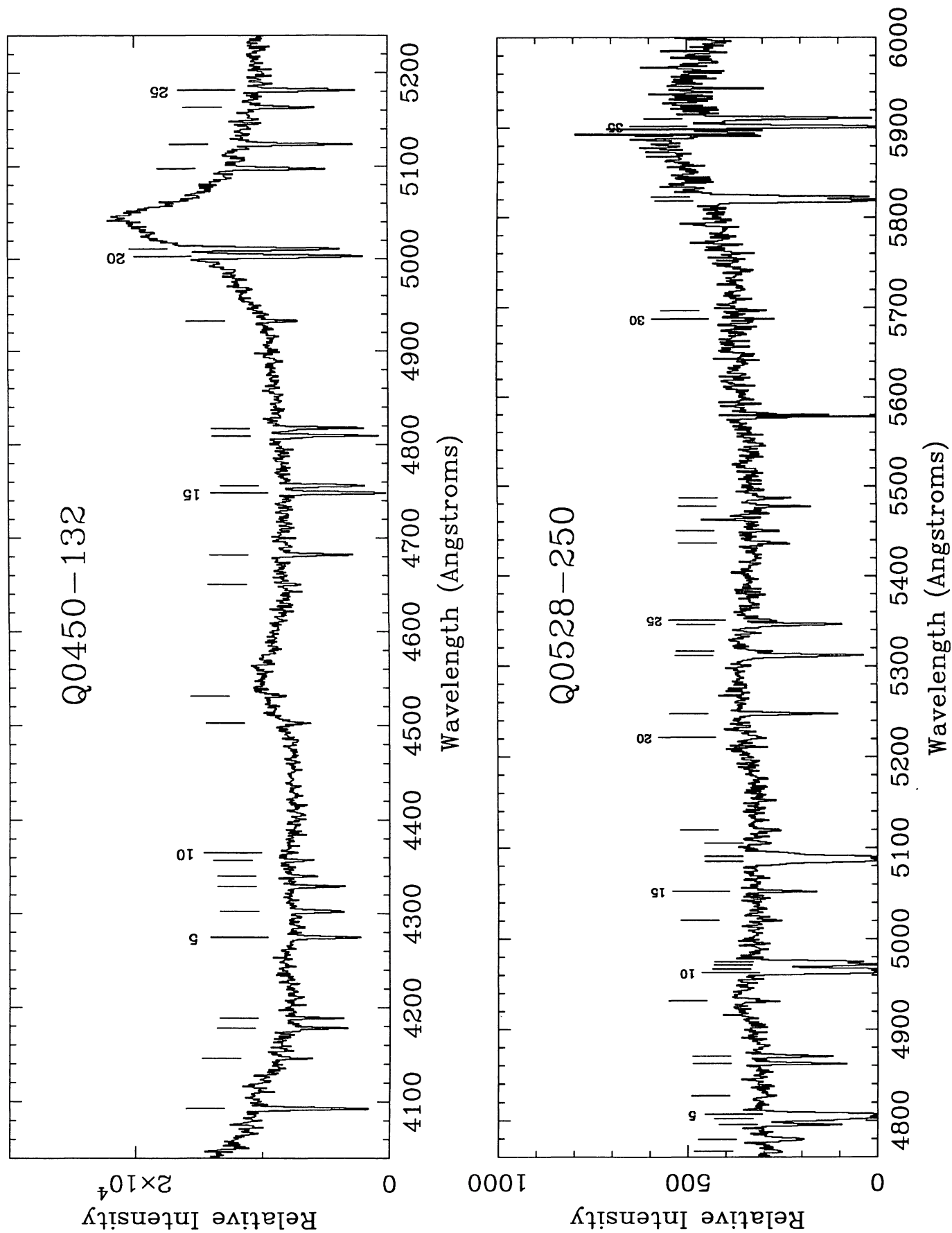


FIG. 1—Continued

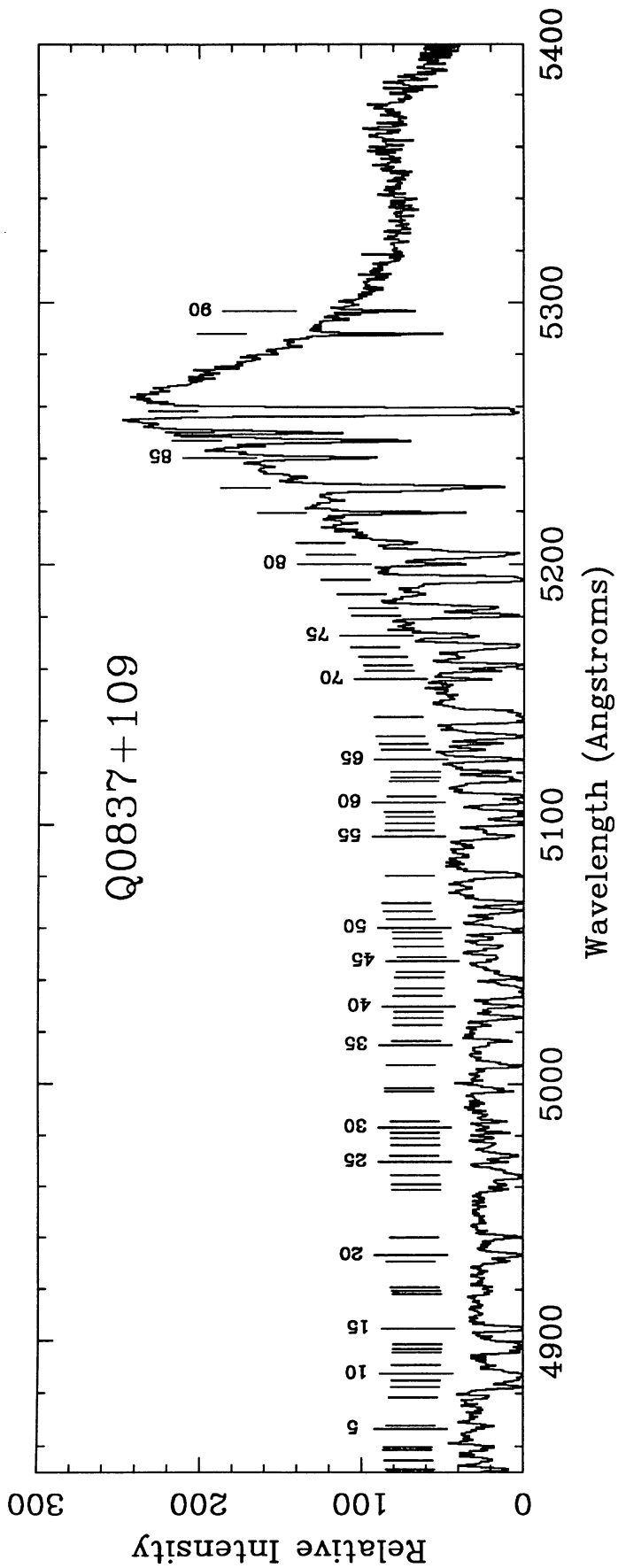
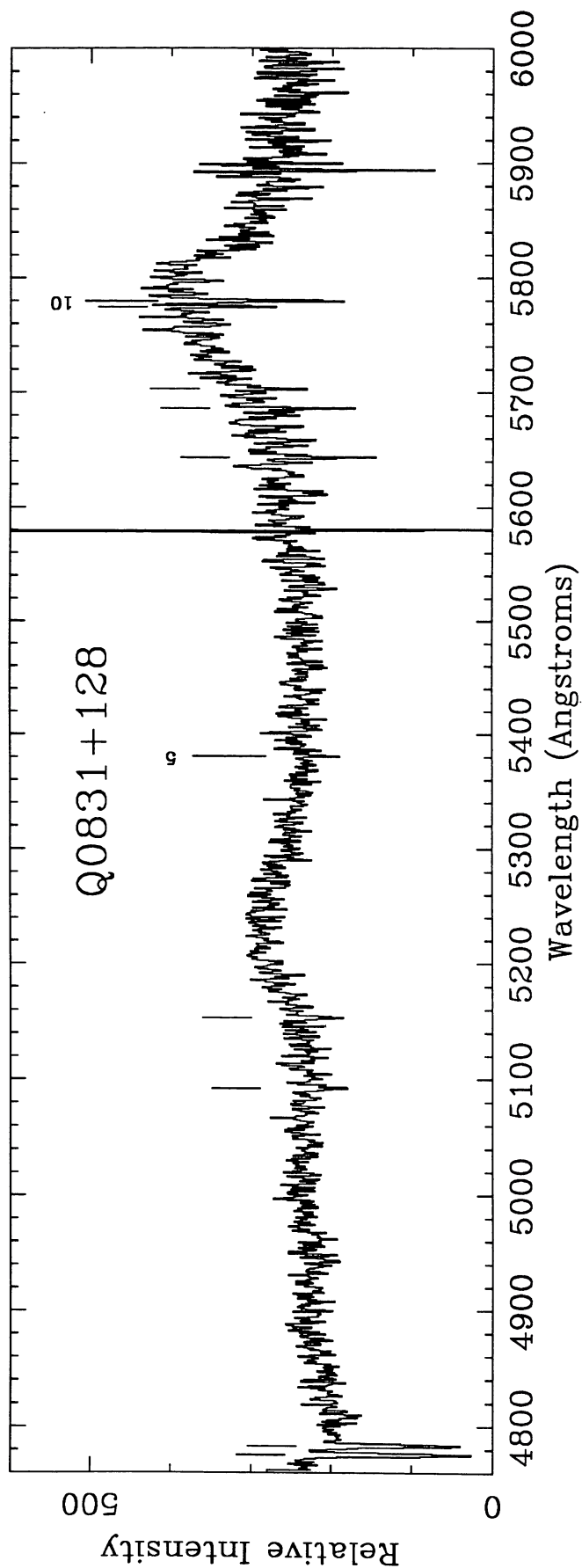


FIG. 1—Continued

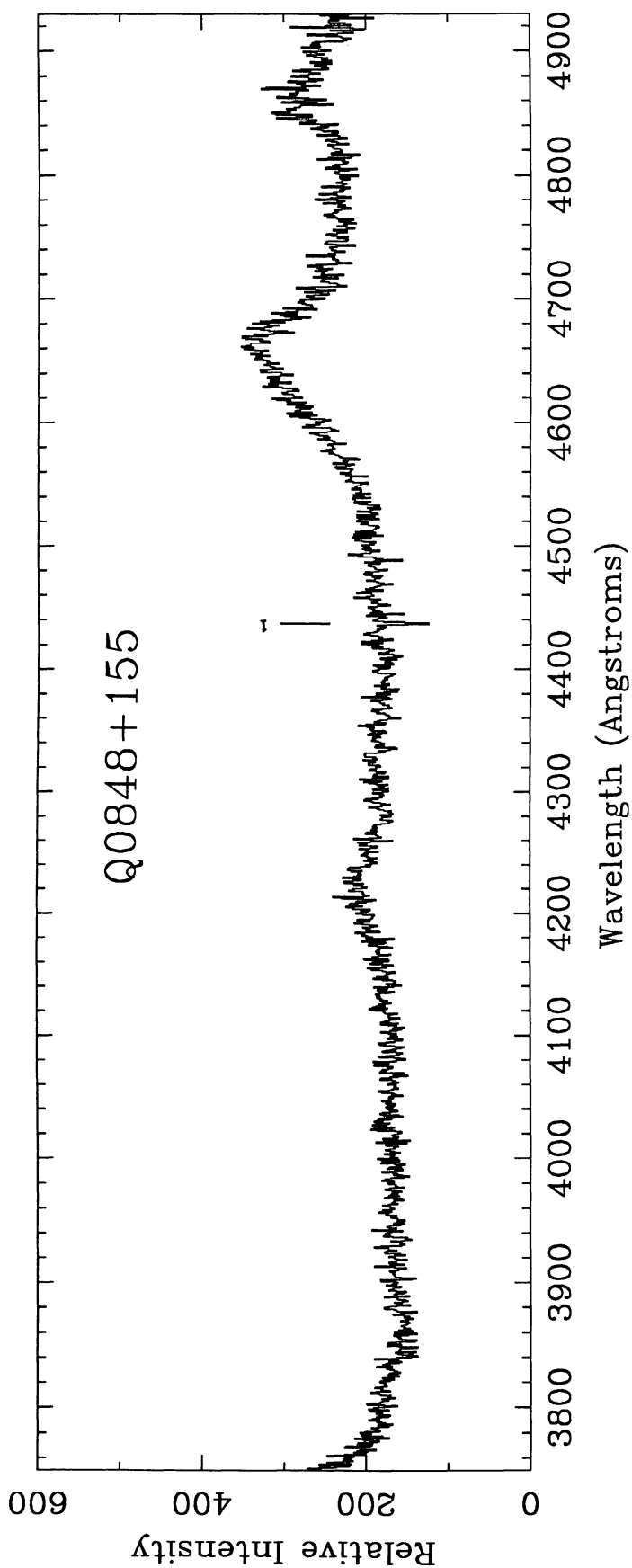
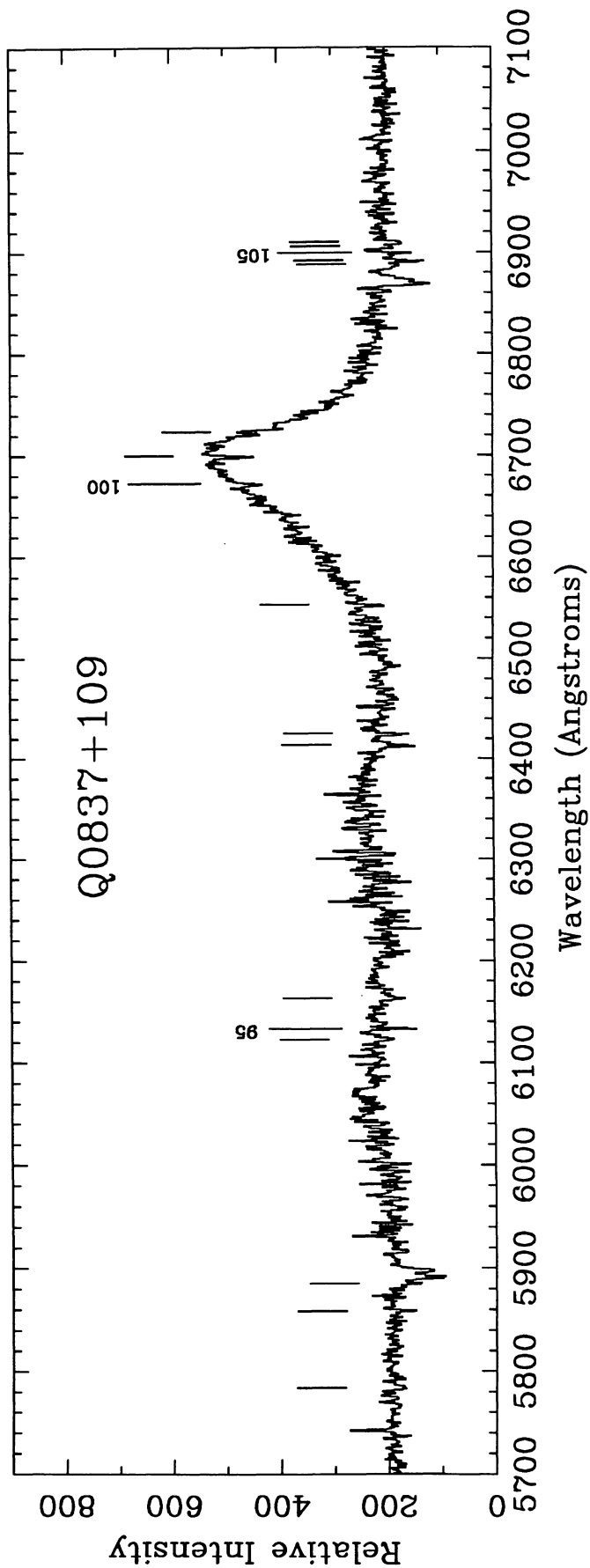


FIG. 1—Continued

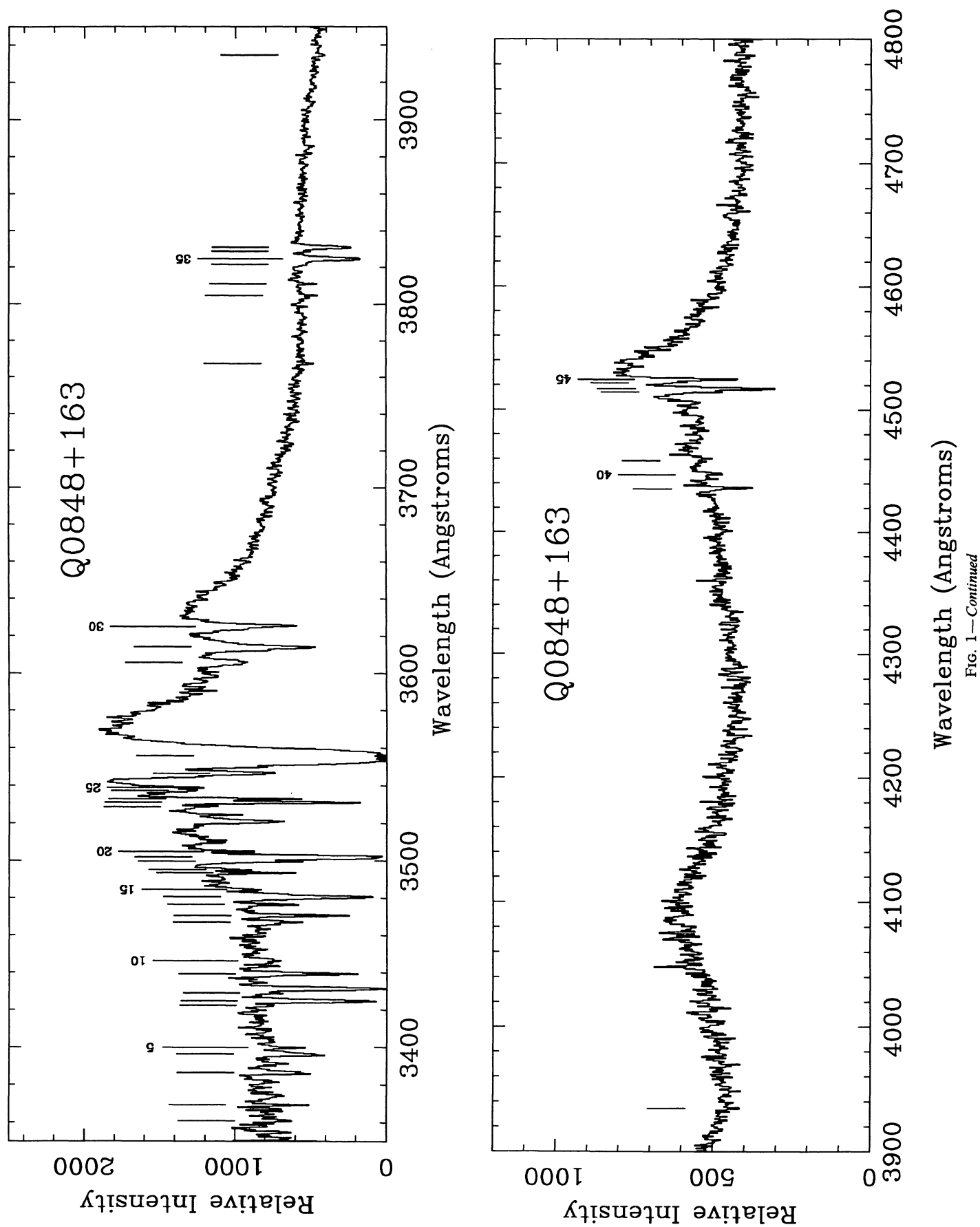


FIG. 1—Continued

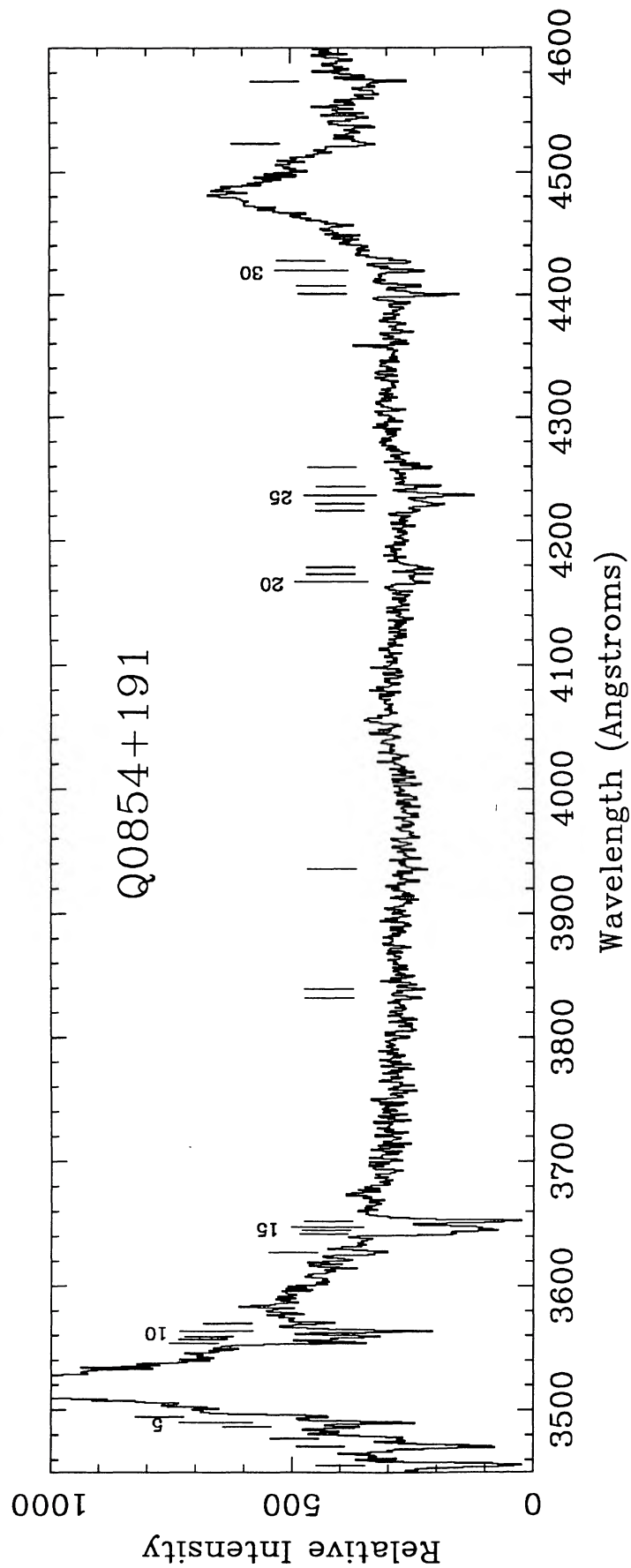
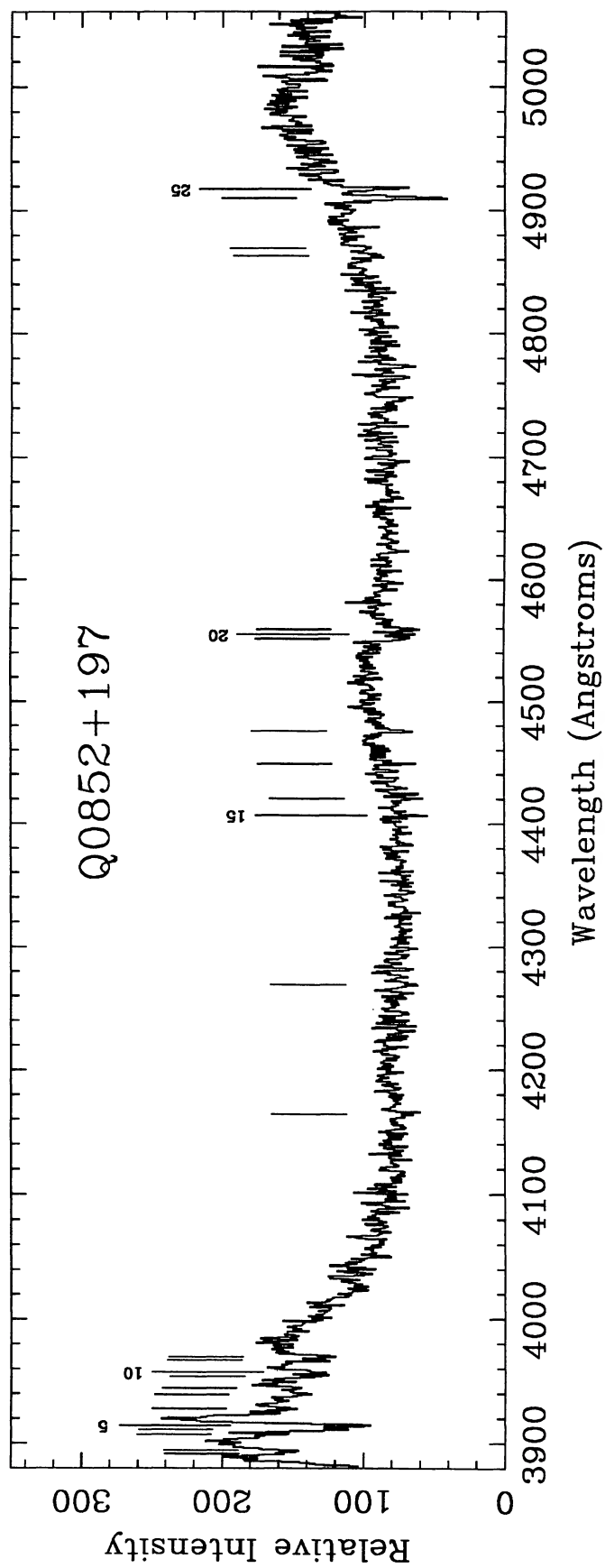


FIG. 1—Continued

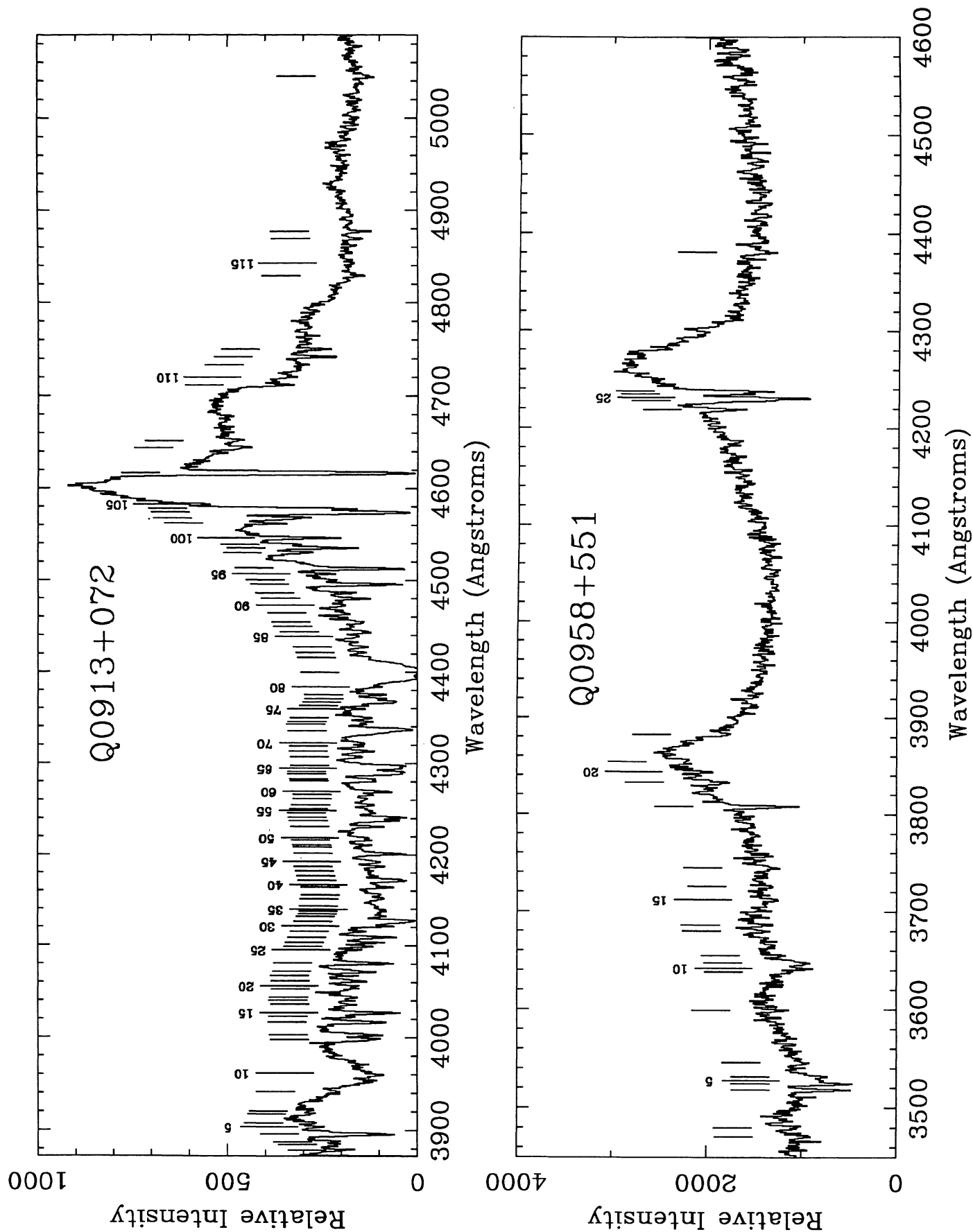


FIG. 1—Continued

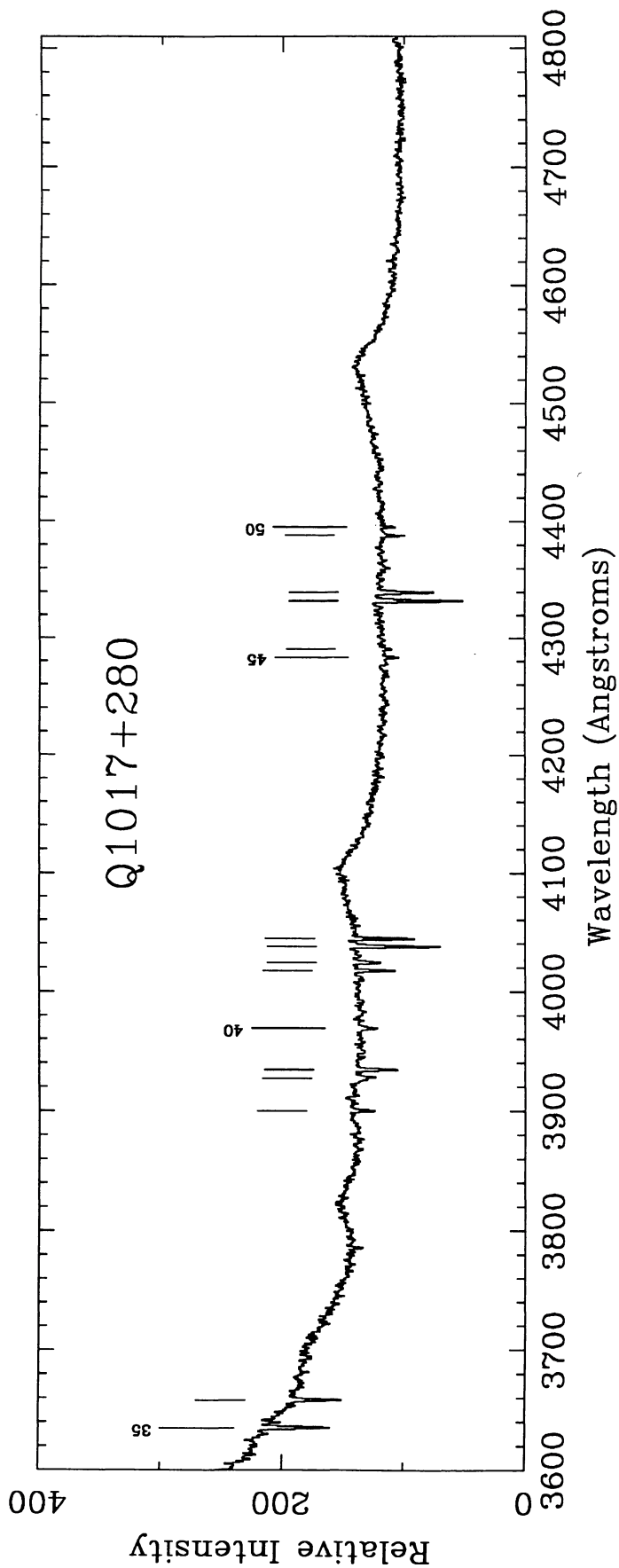
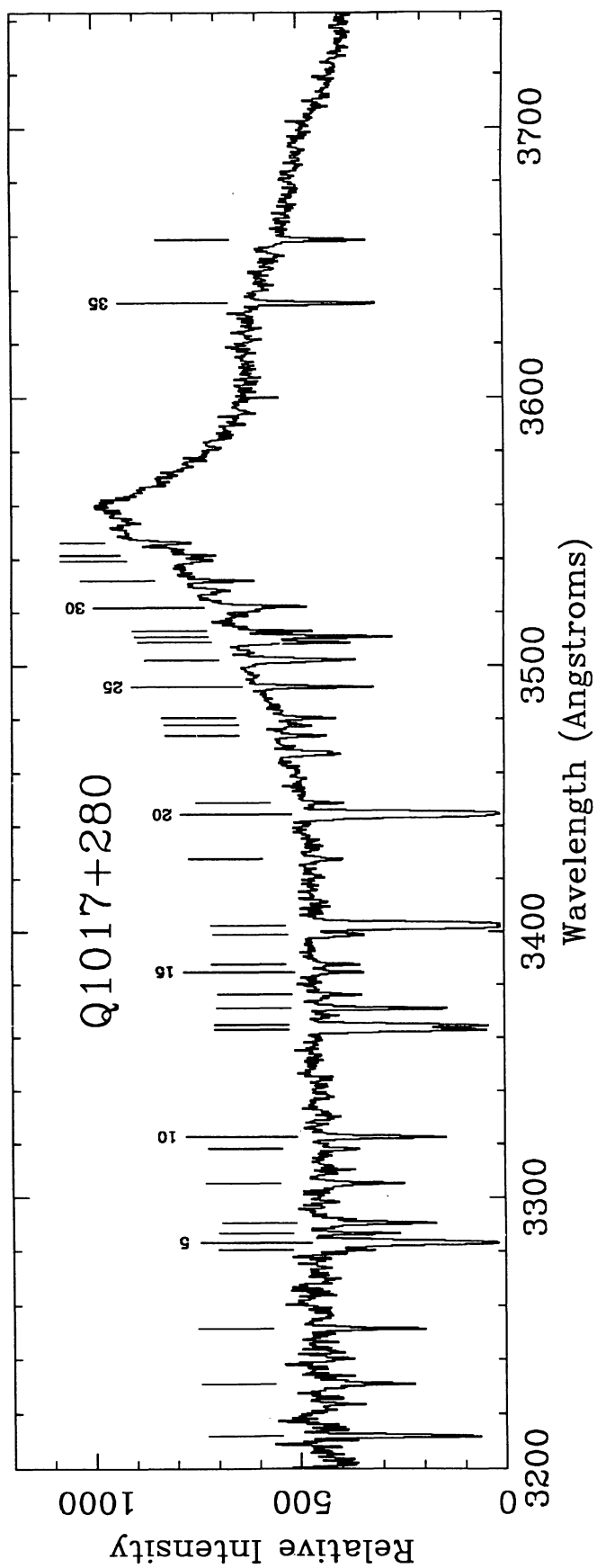


FIG. 1—Continued

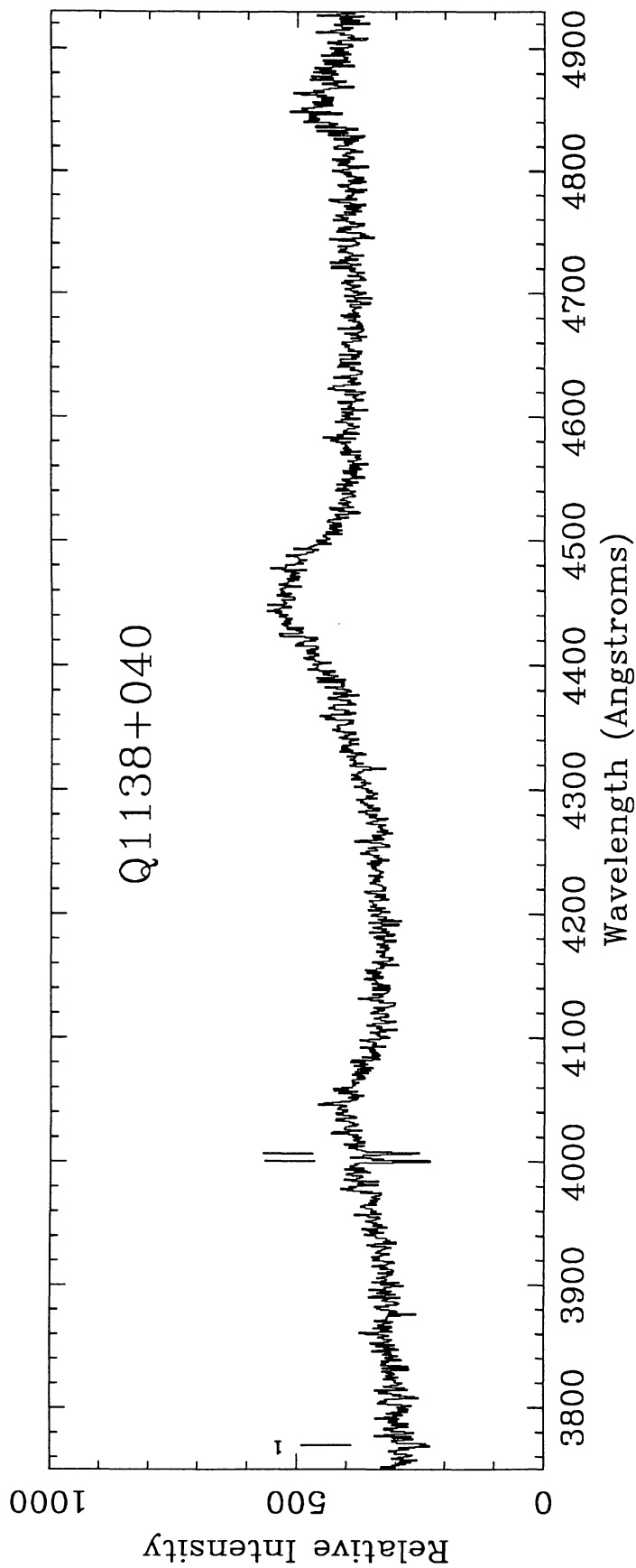
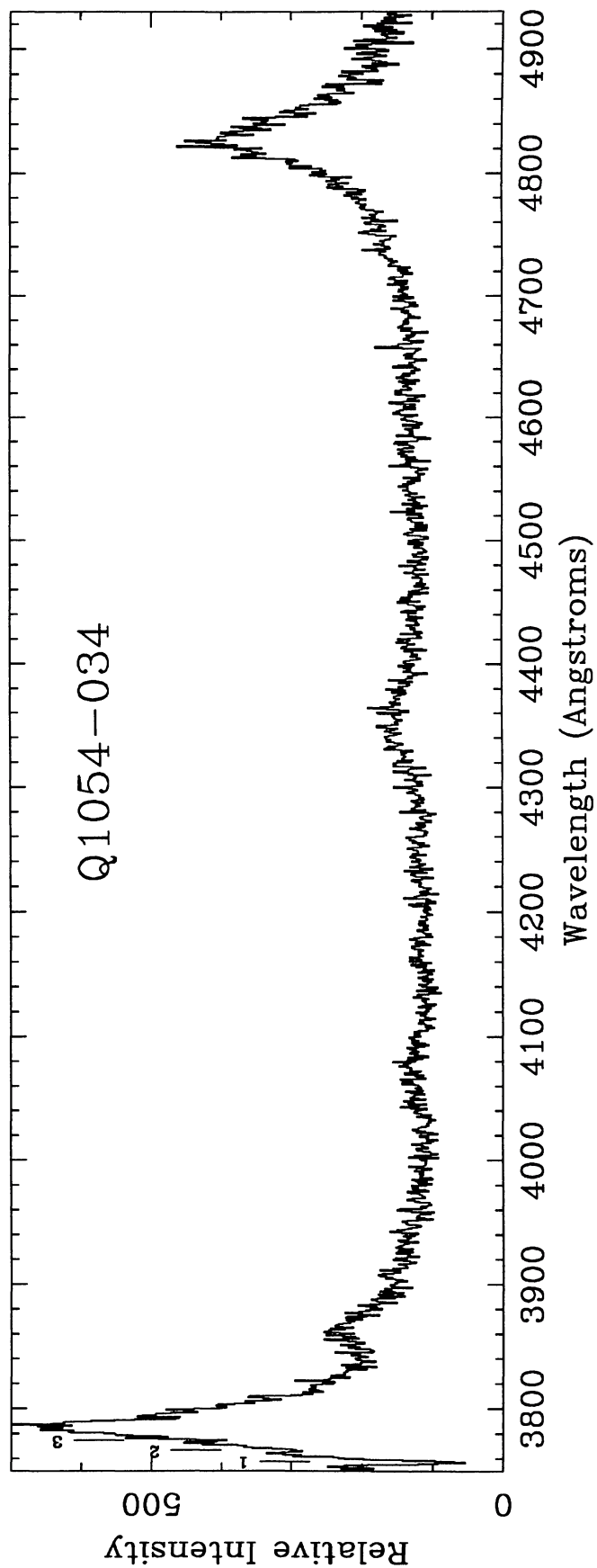


FIG. 1—Continued

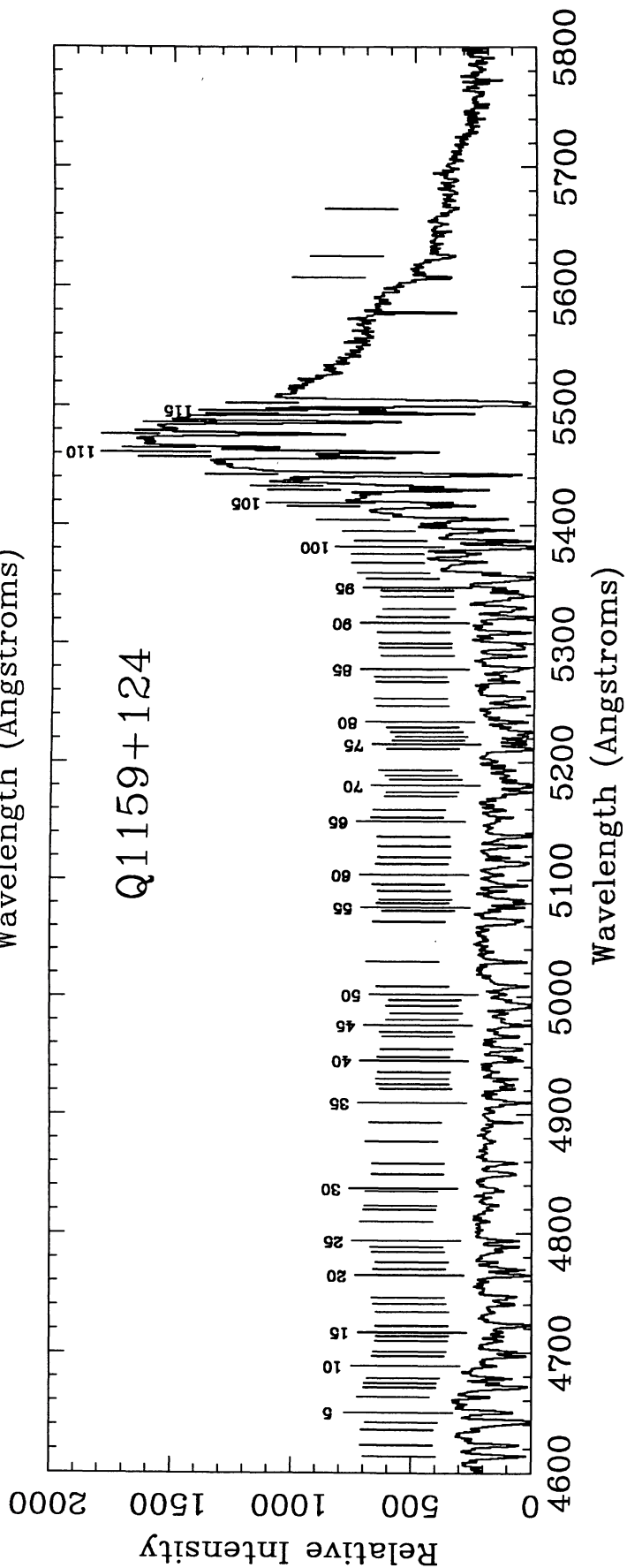
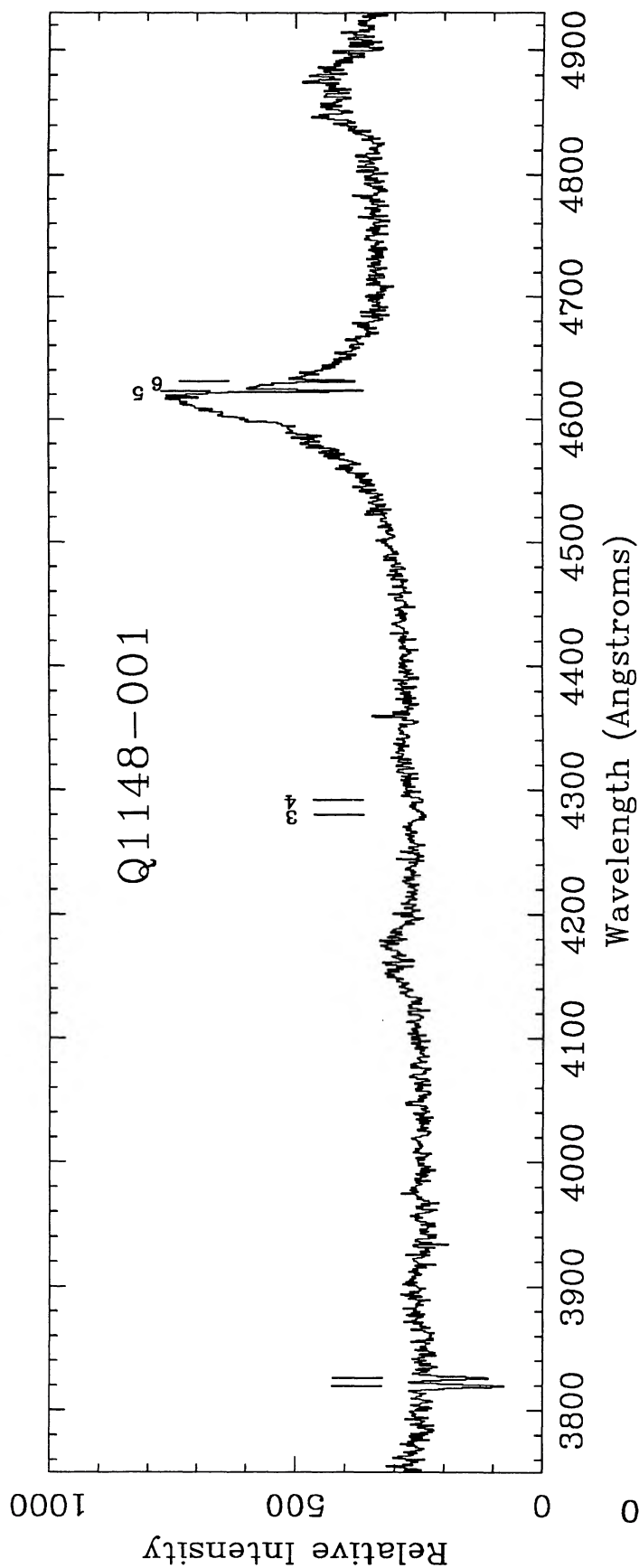


Fig. 1—Continued

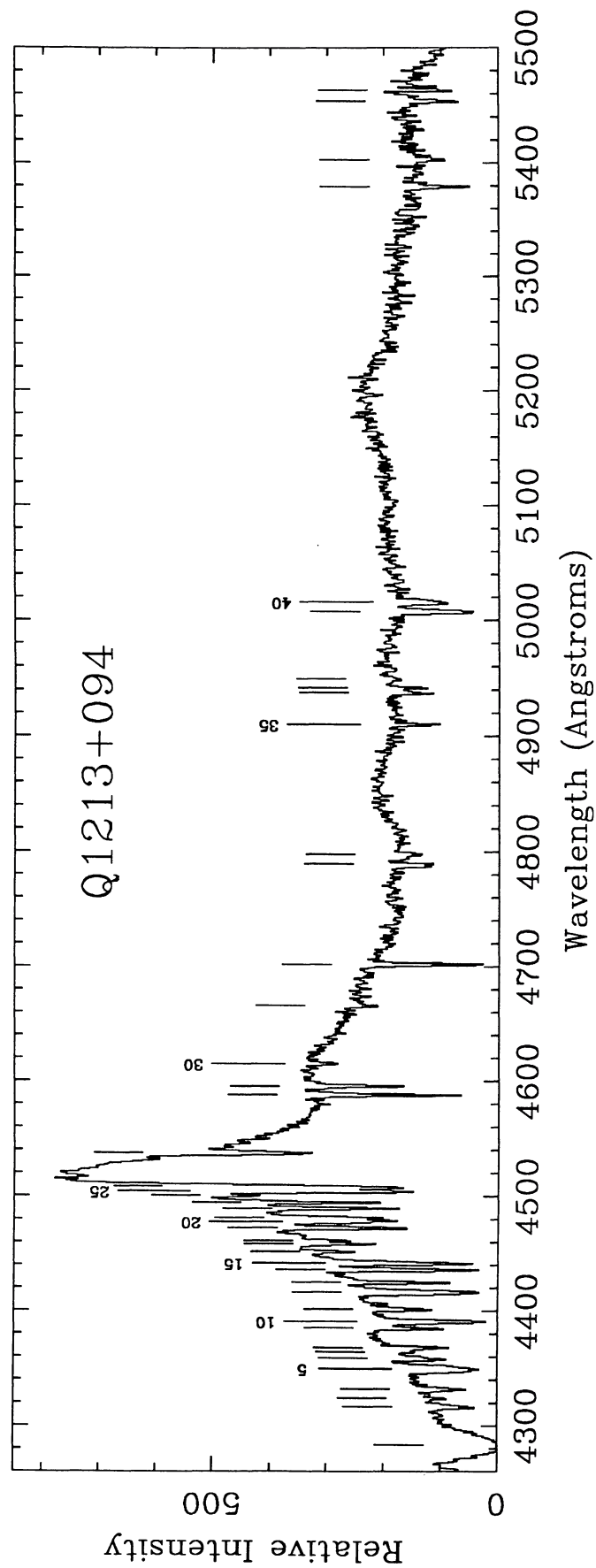
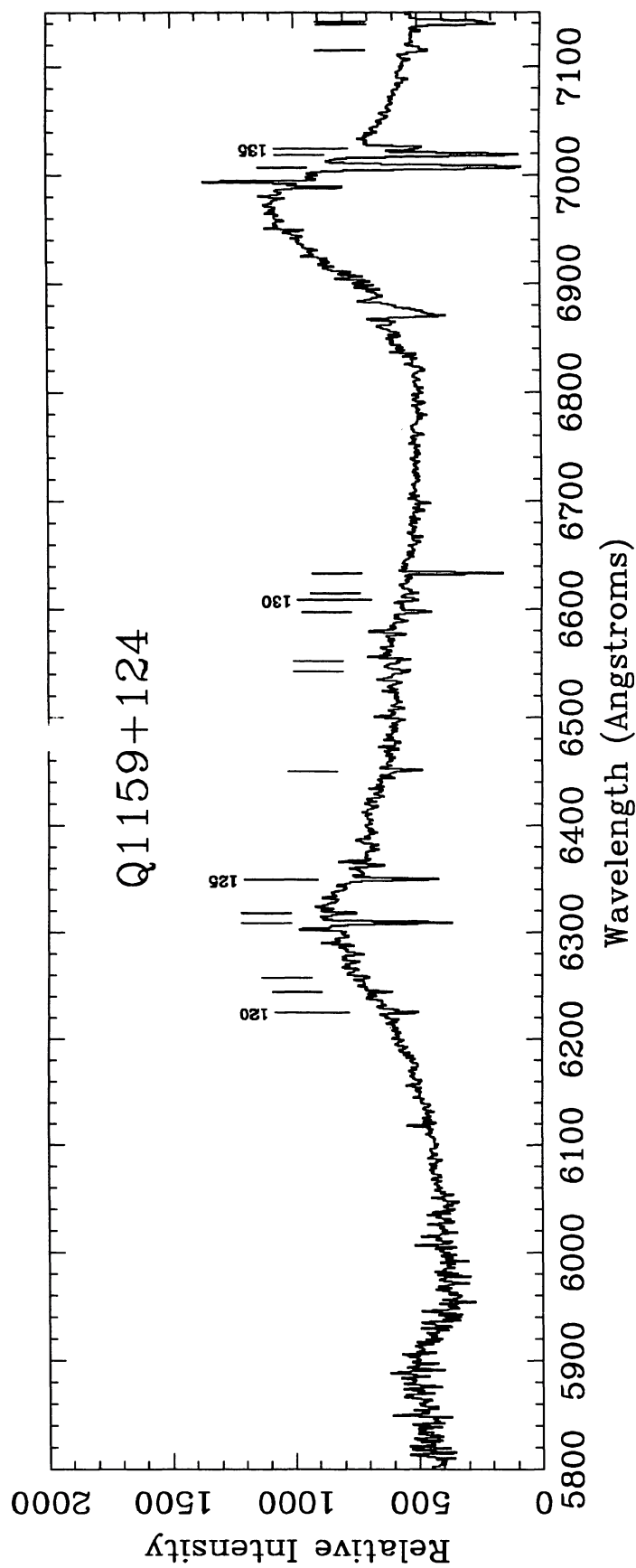


FIG. 1—Continued

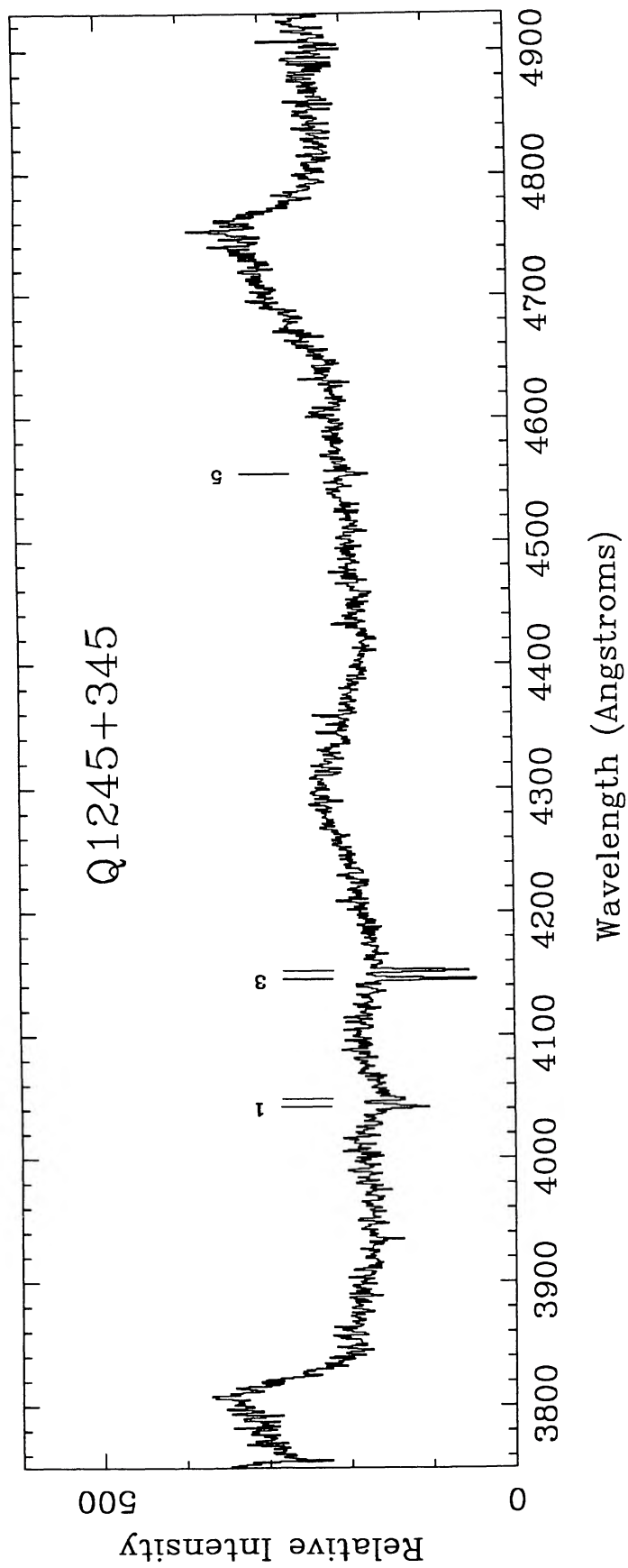
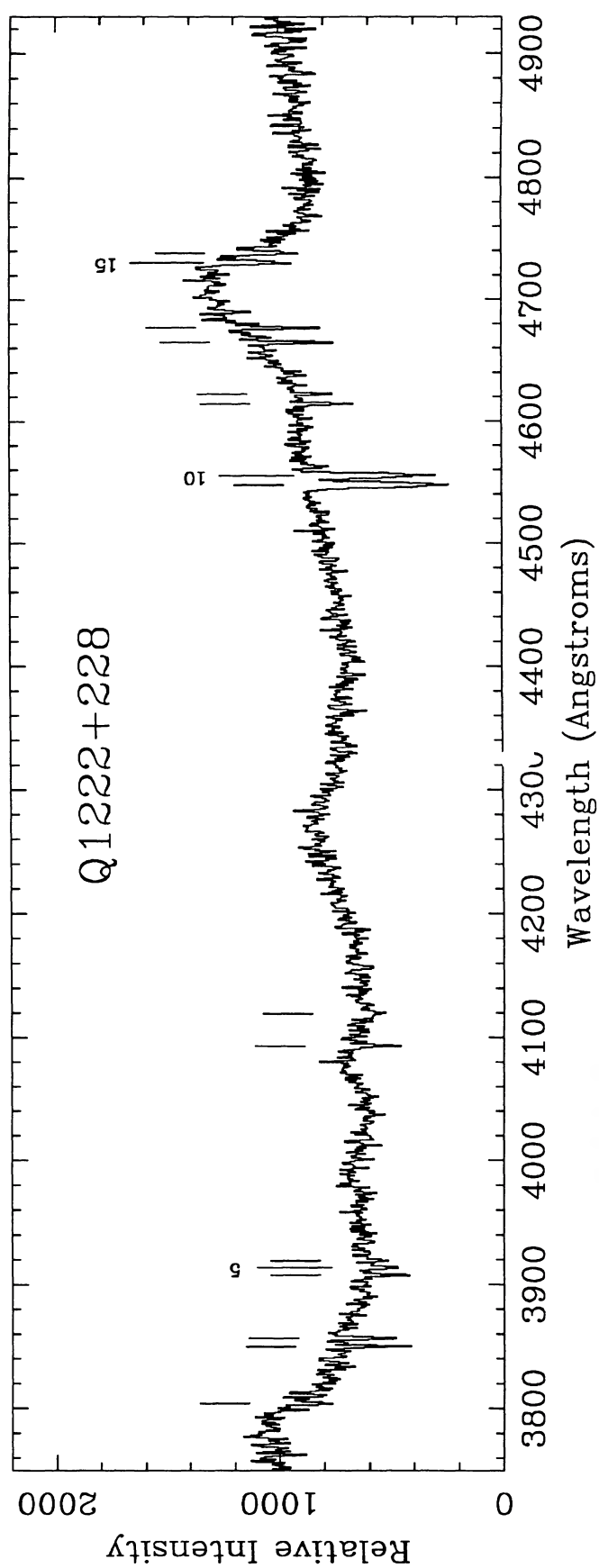


FIG. 1—Continued

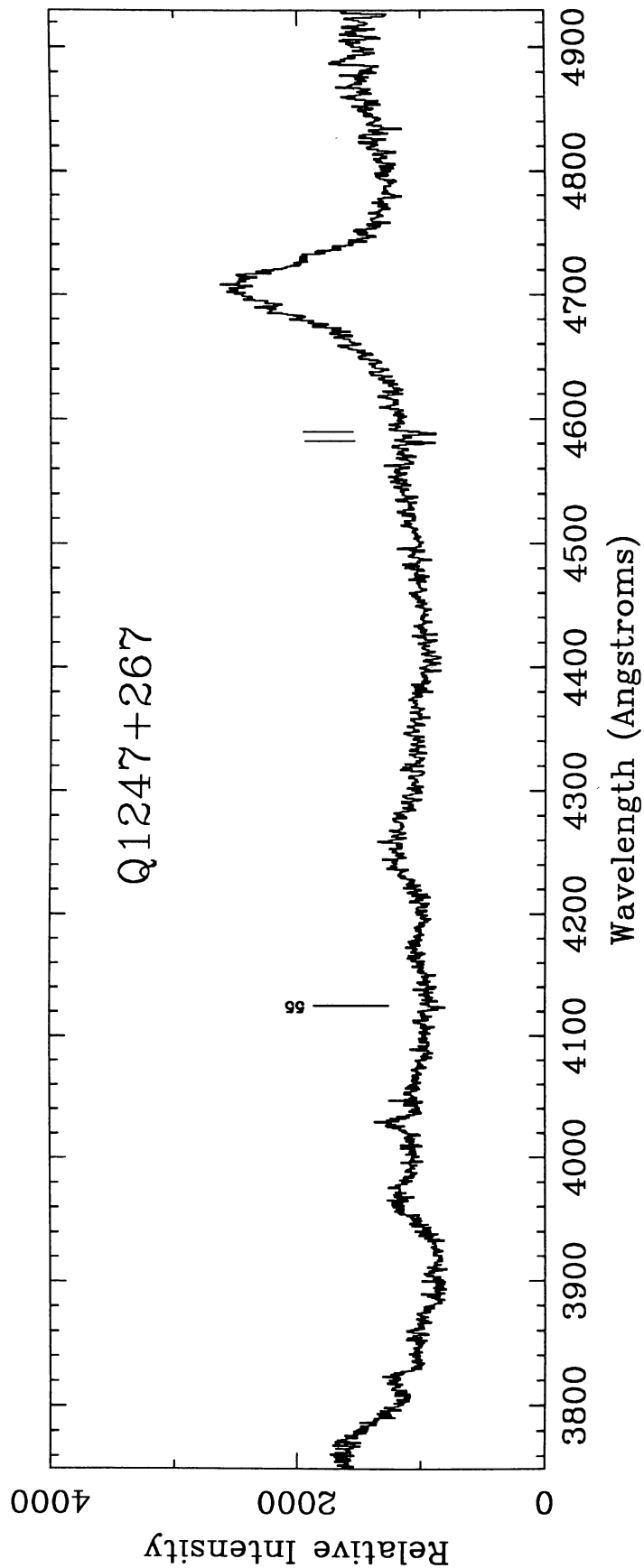
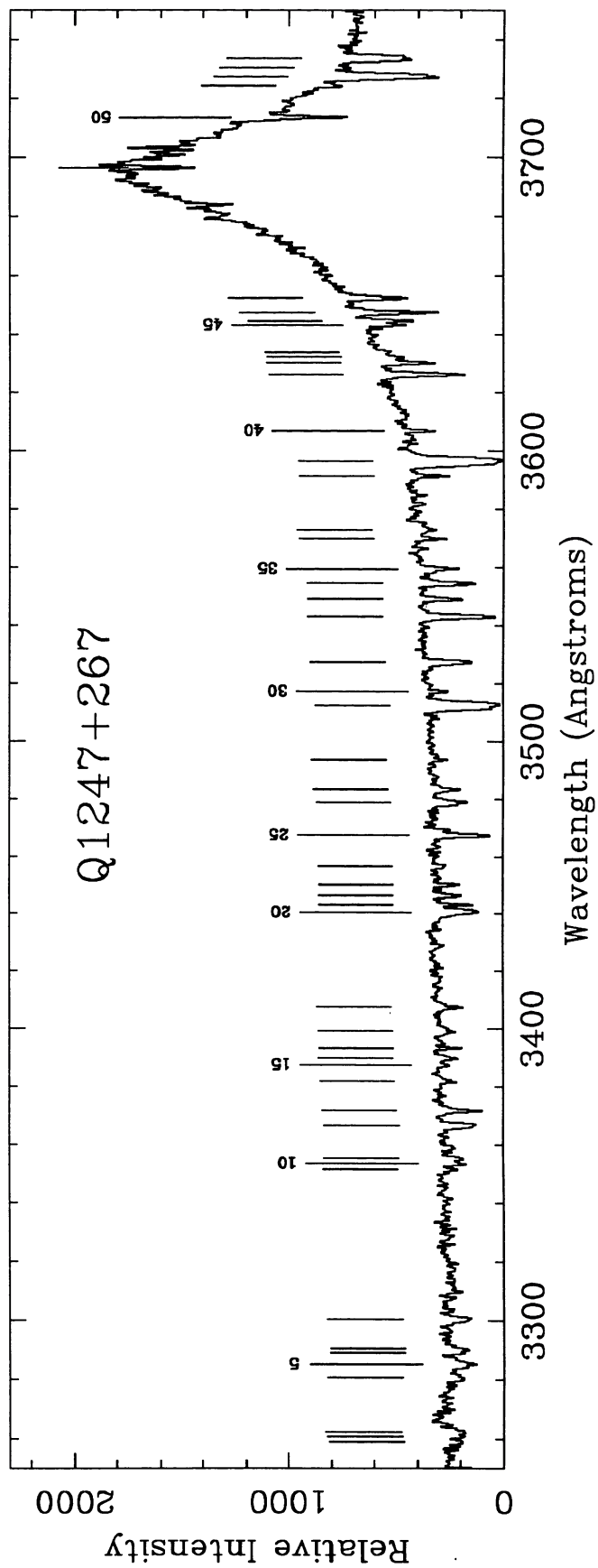


FIG. 1—Continued

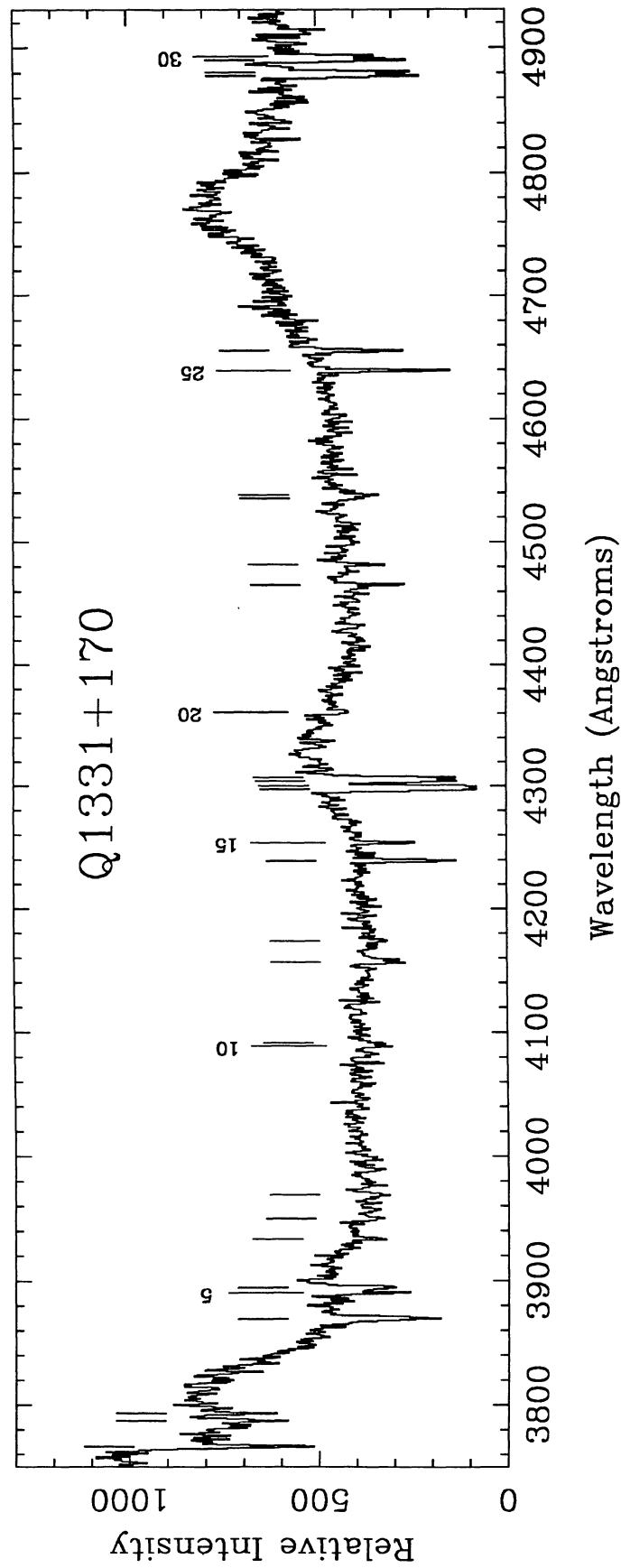
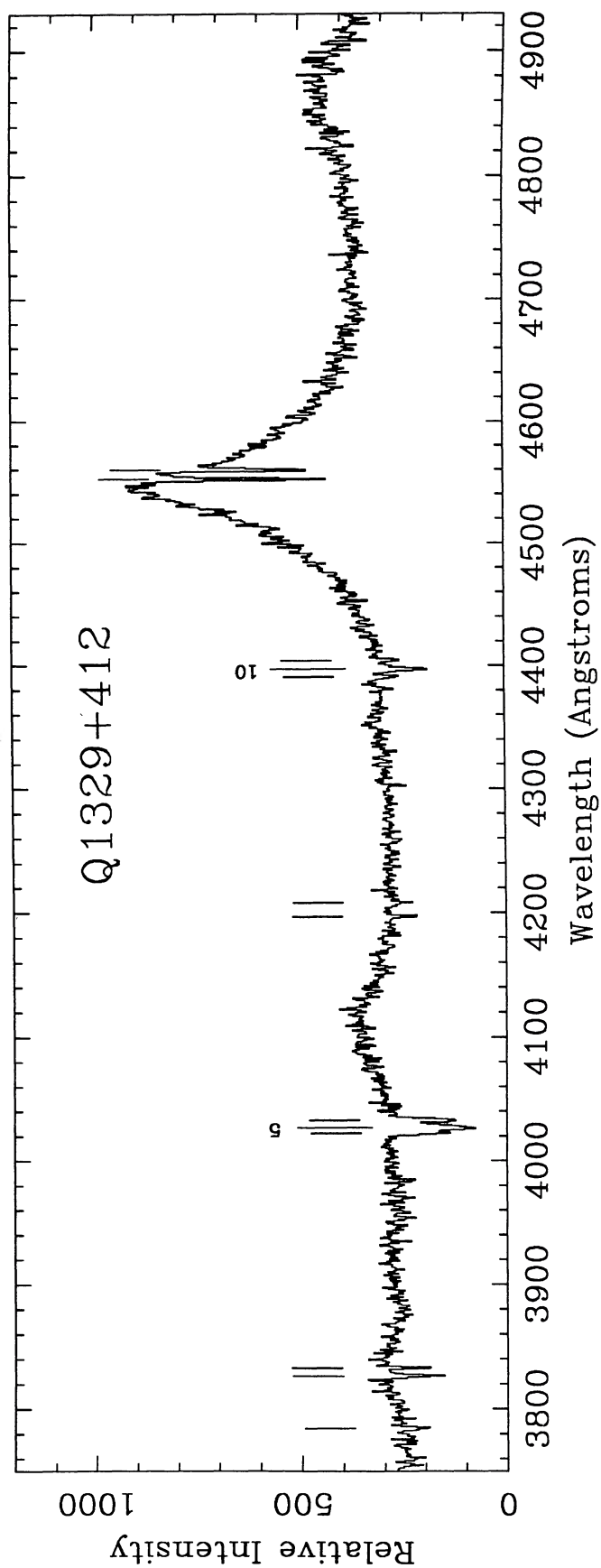


FIG. 1—Continued

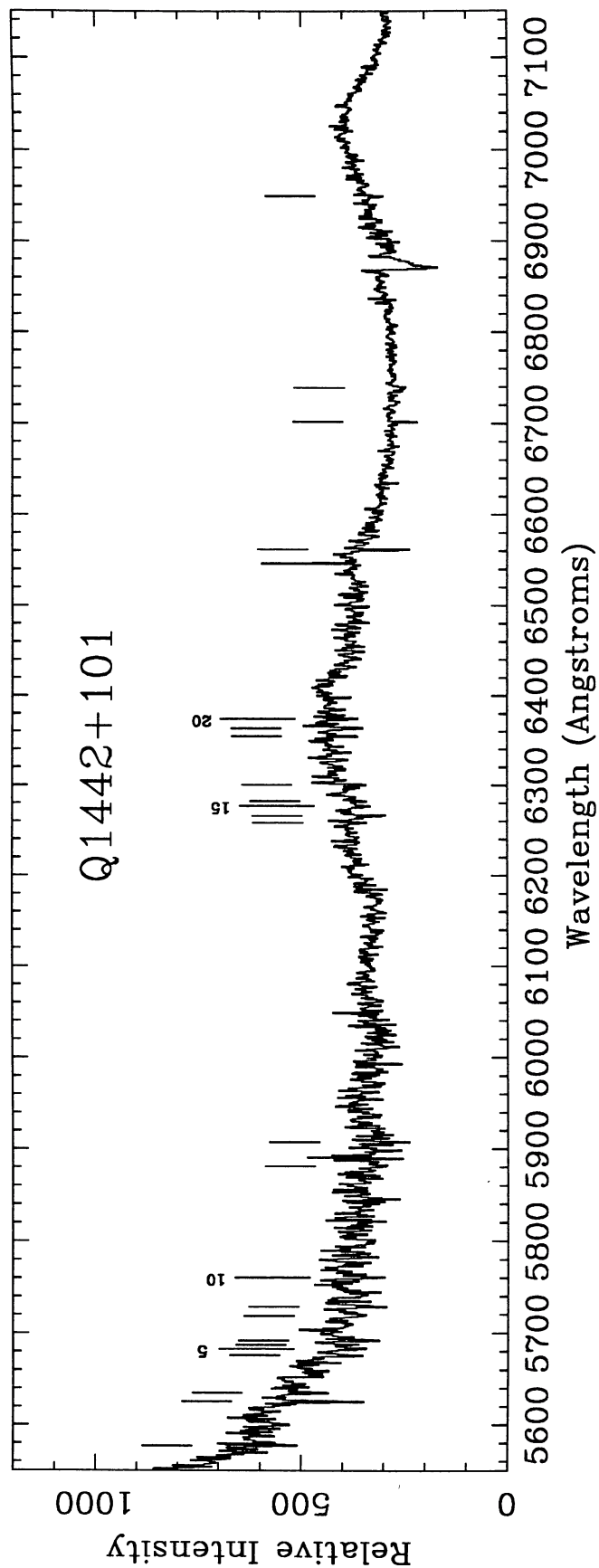
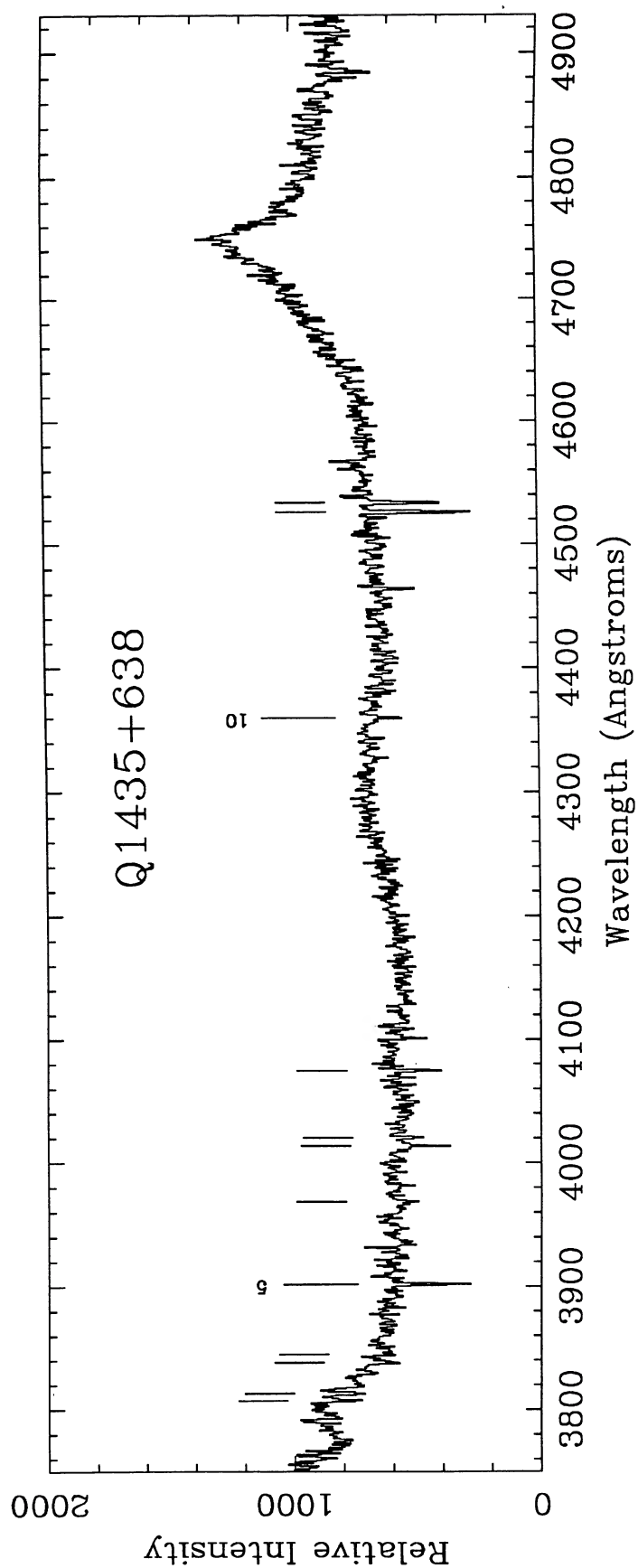


FIG. 1—Continued

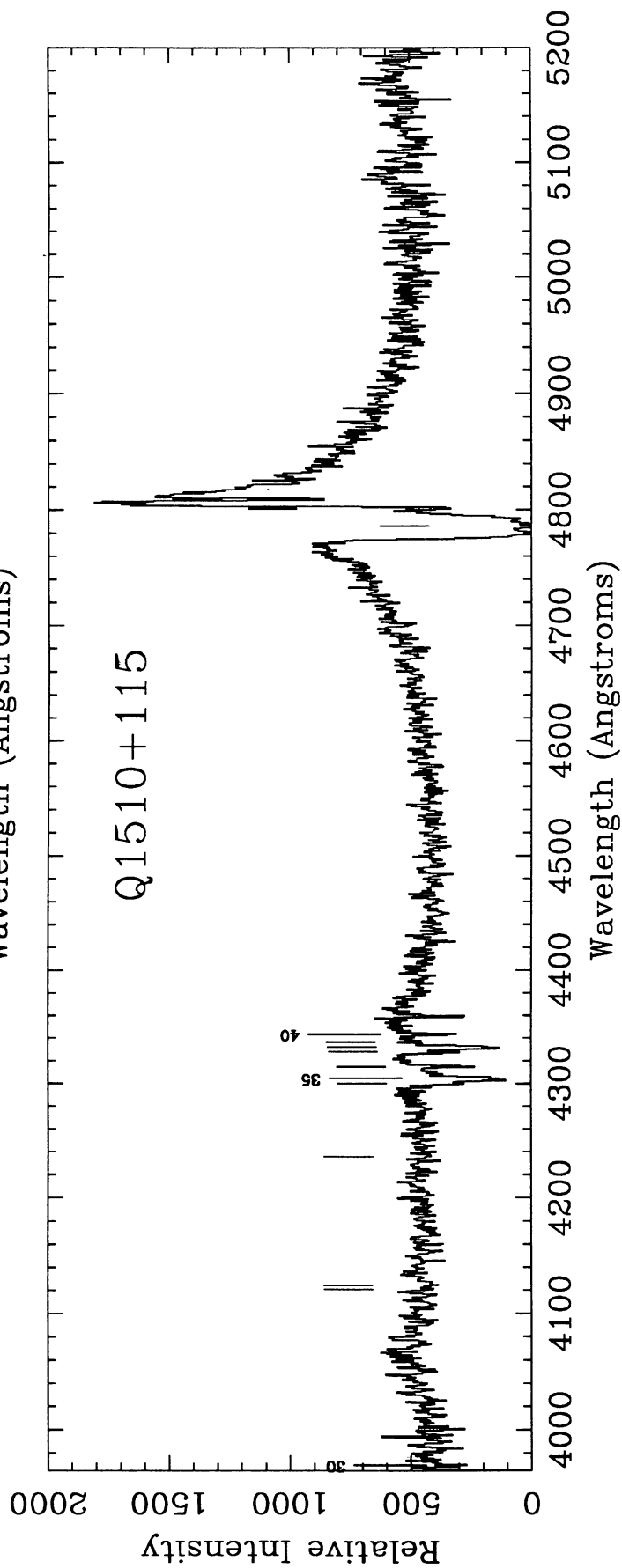
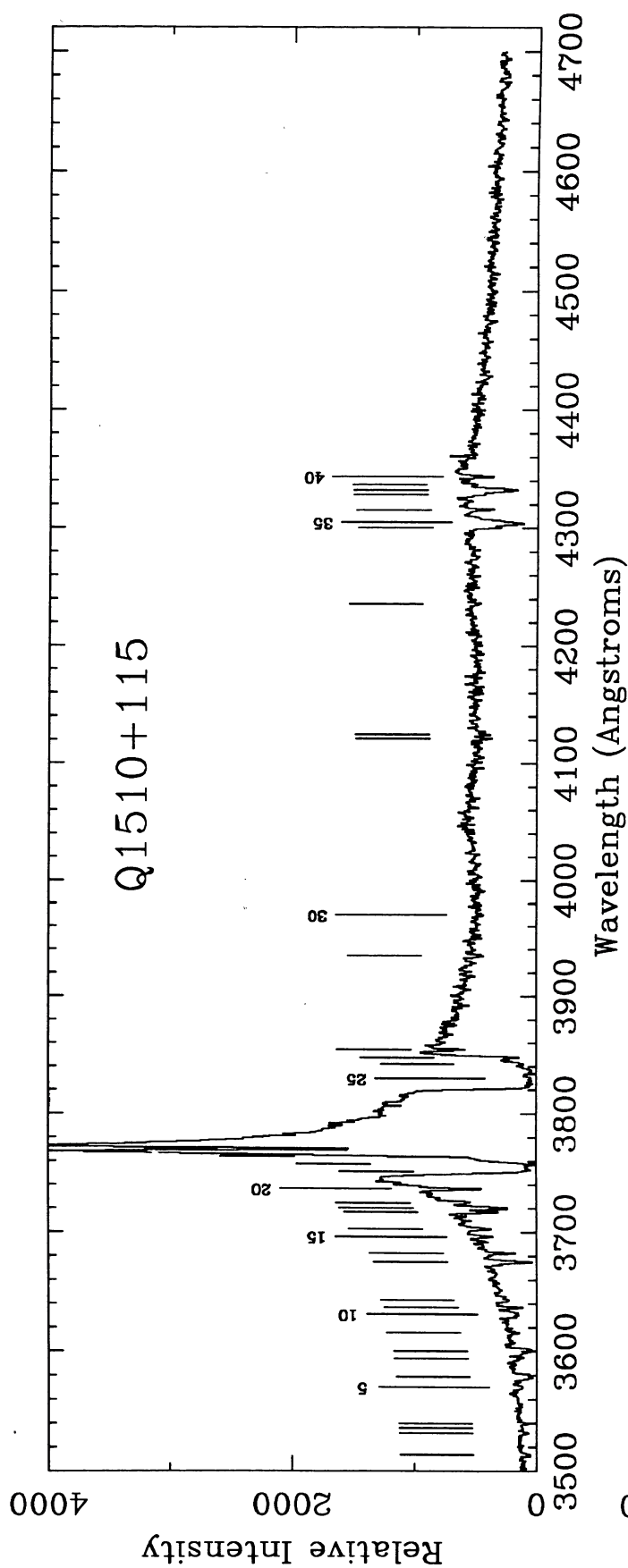


FIG. 1—Continued

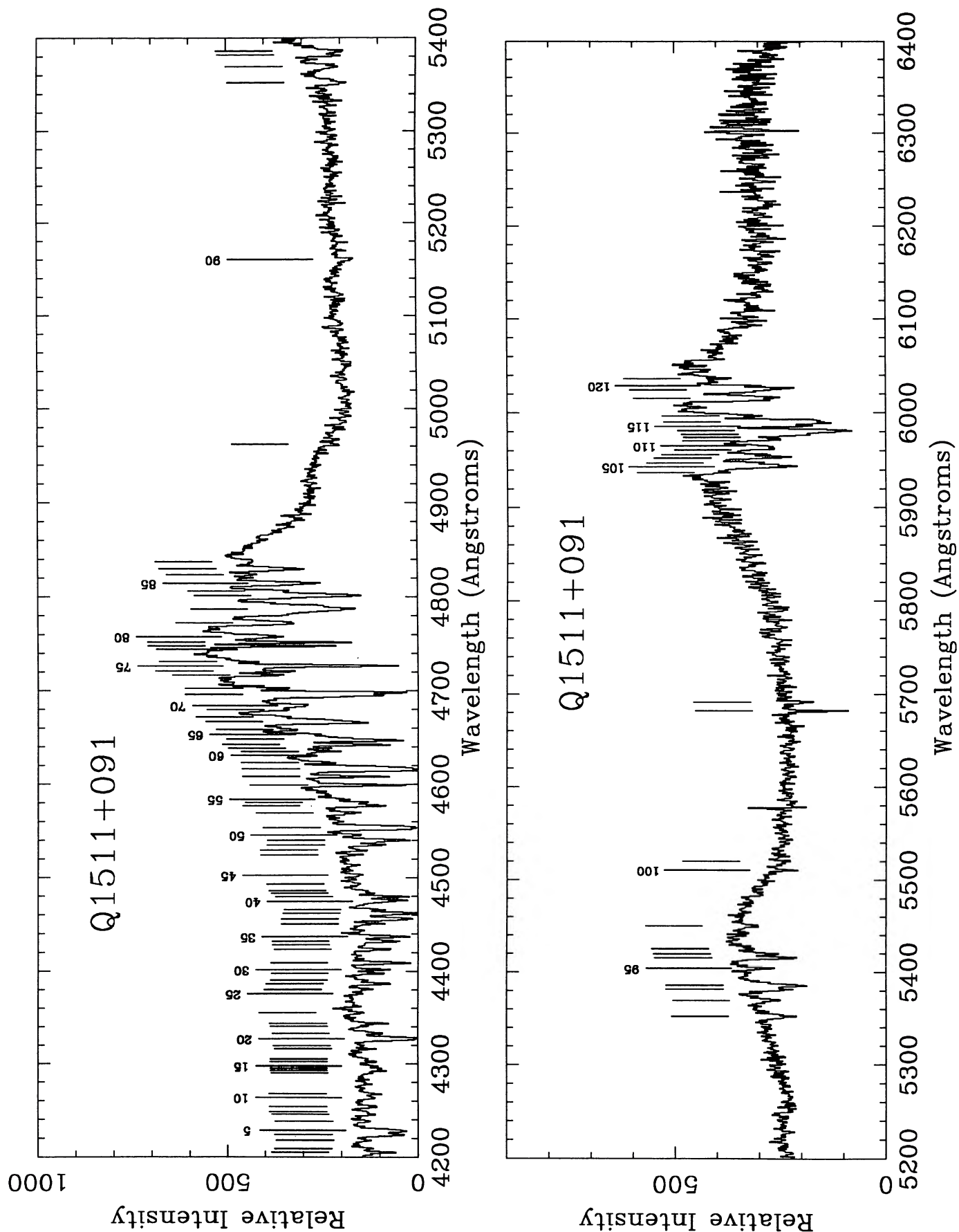


FIG. 1—Continued

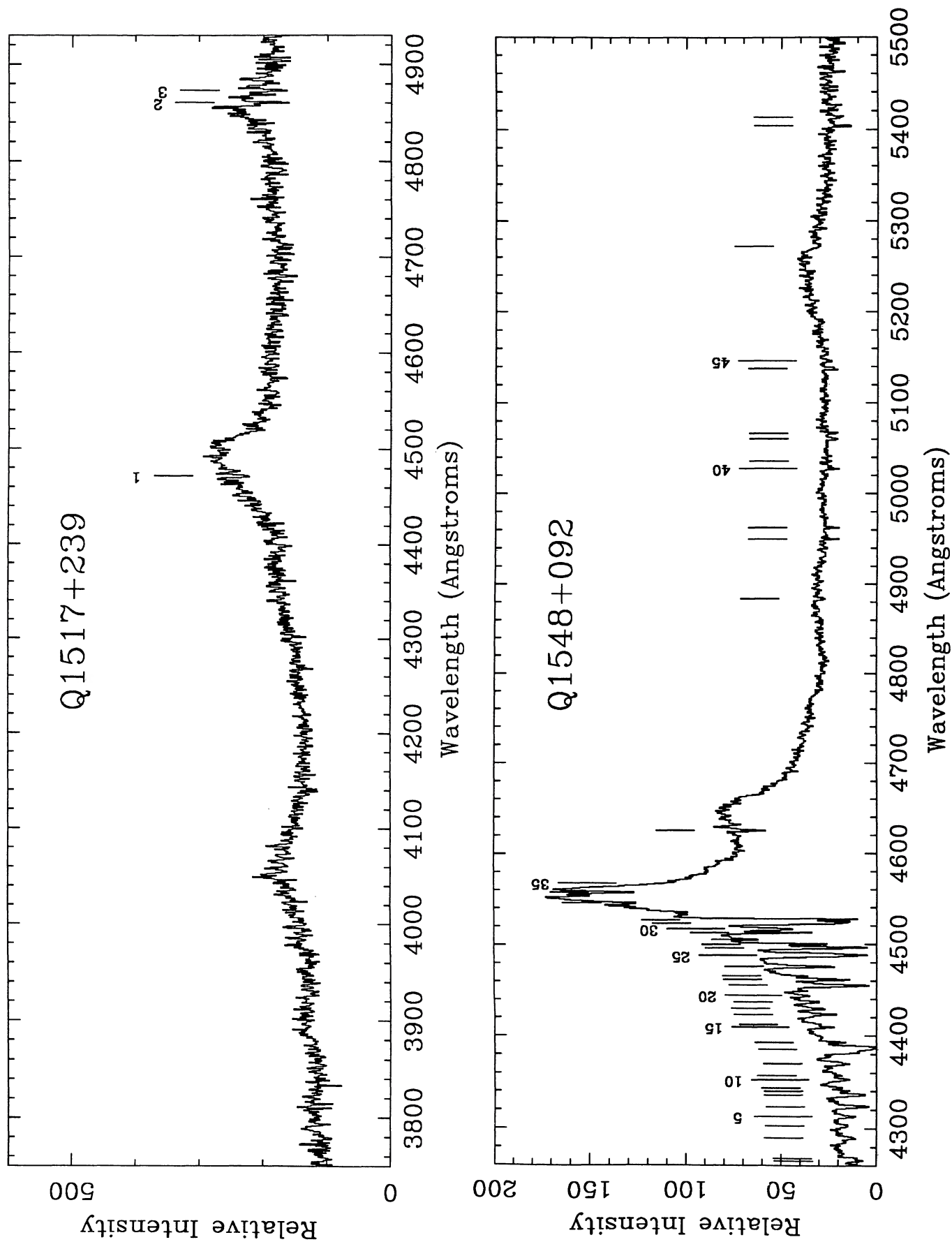


FIG. 1—Continued

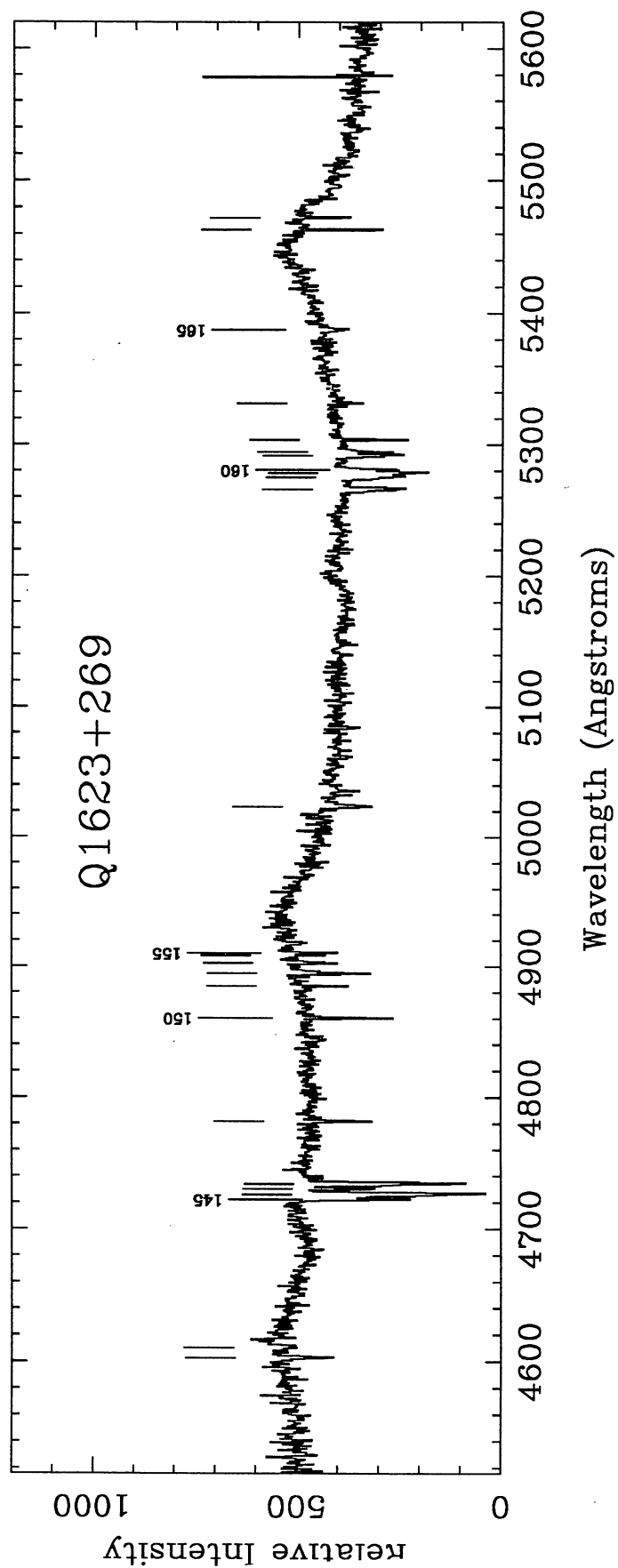
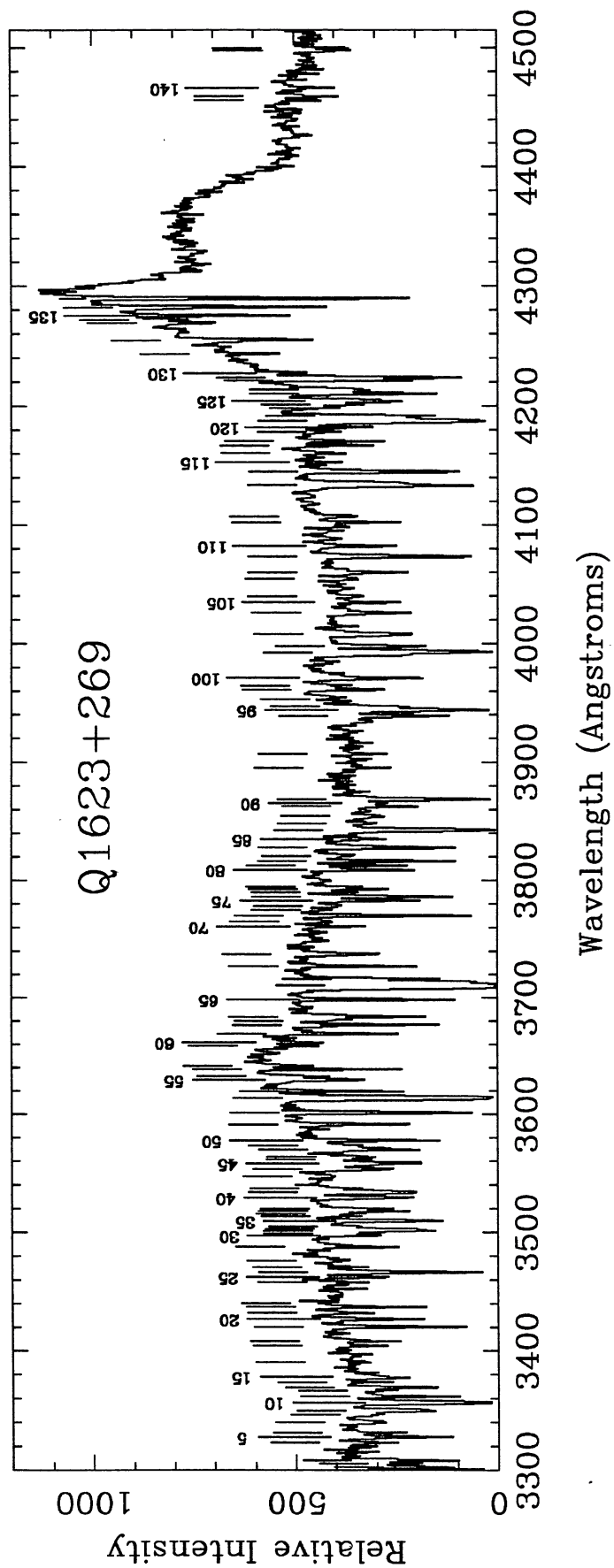


FIG. 1—Continued

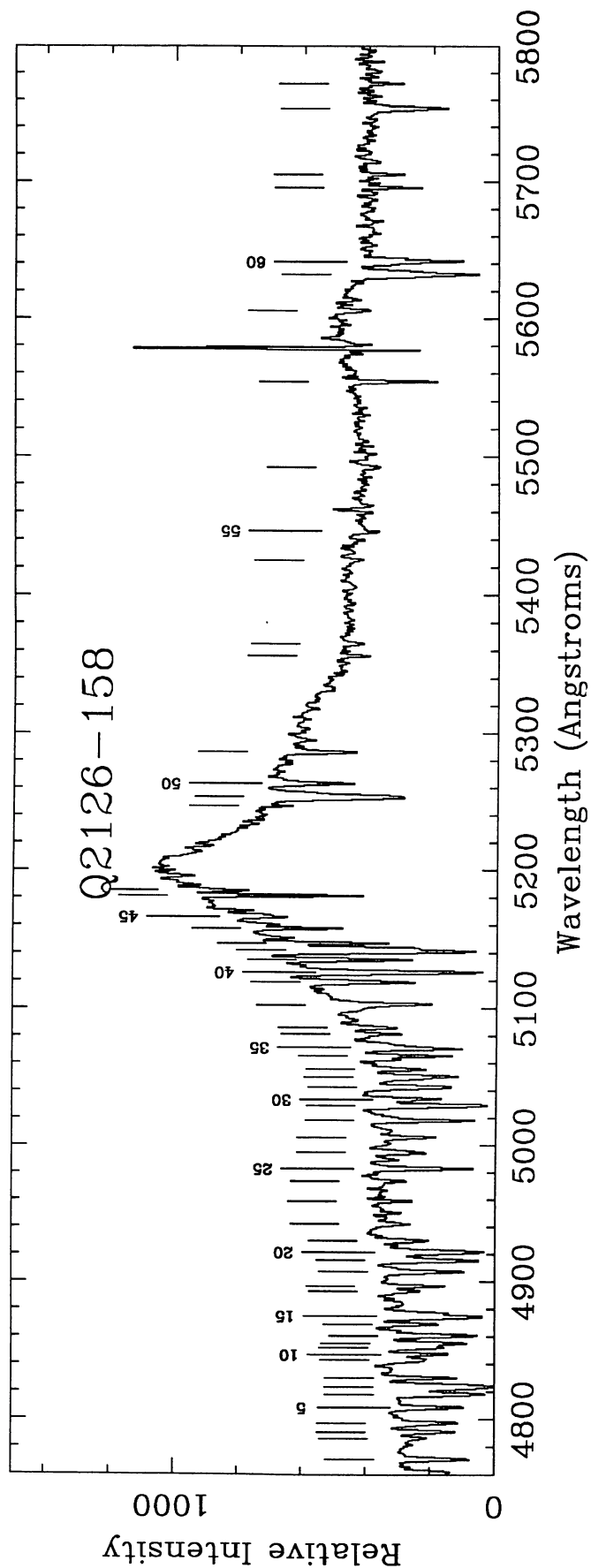
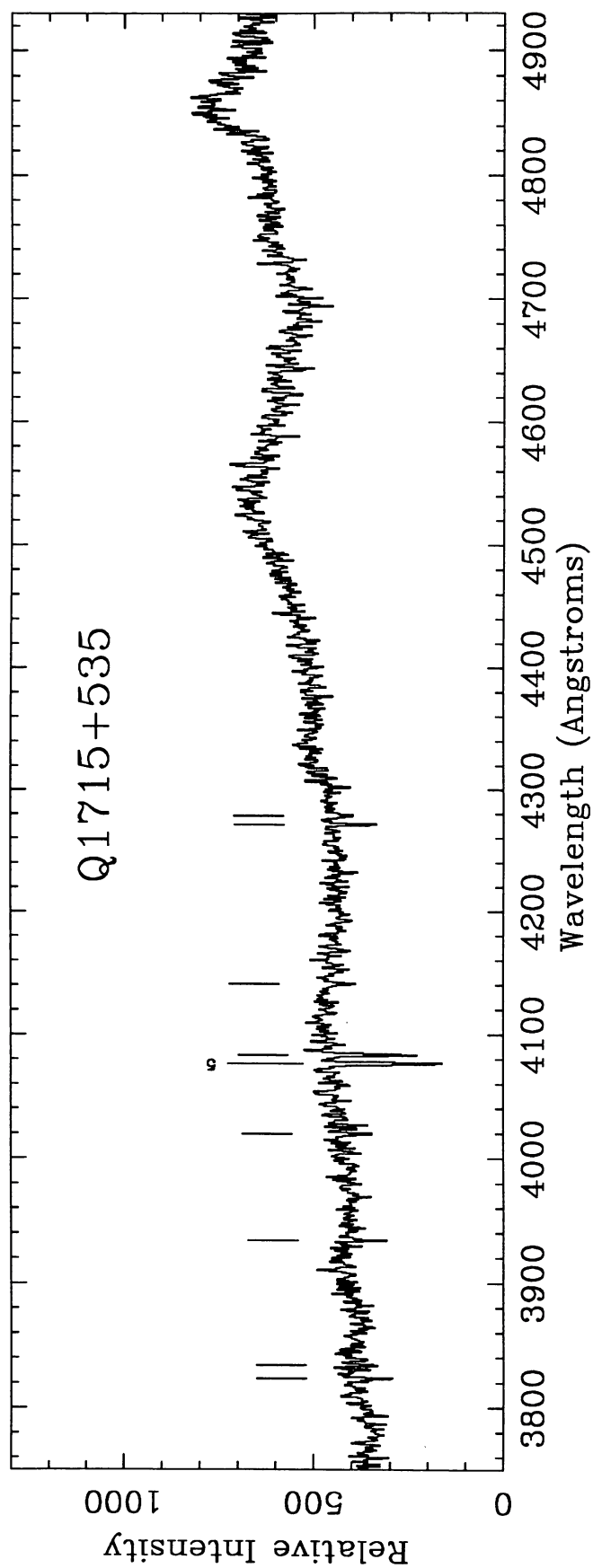


FIG. 1—Continued

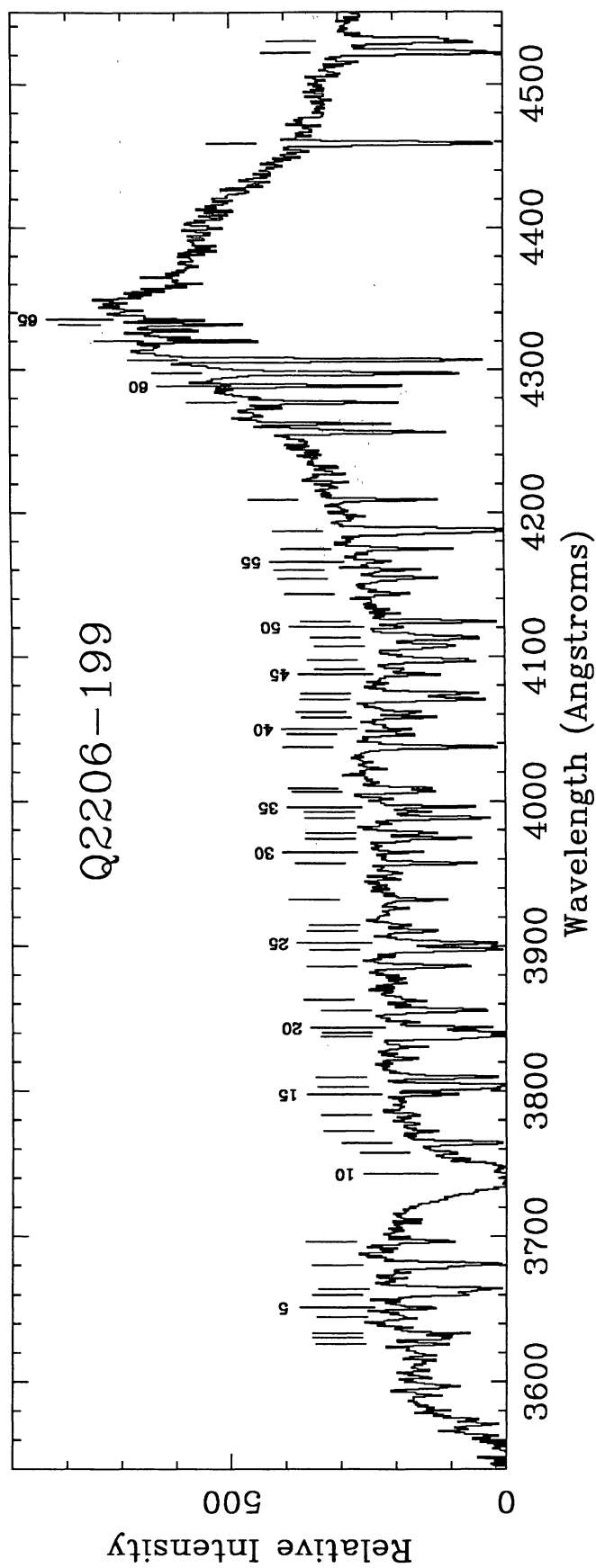
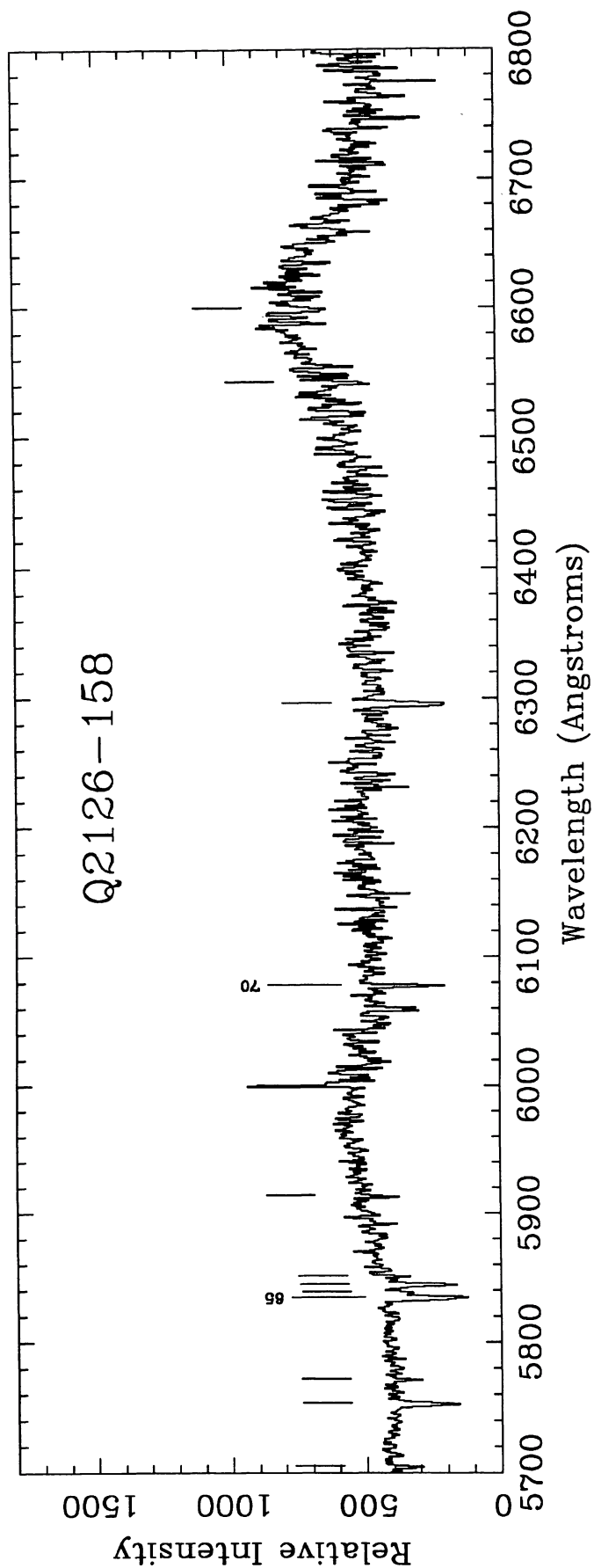


FIG. 1—Continued

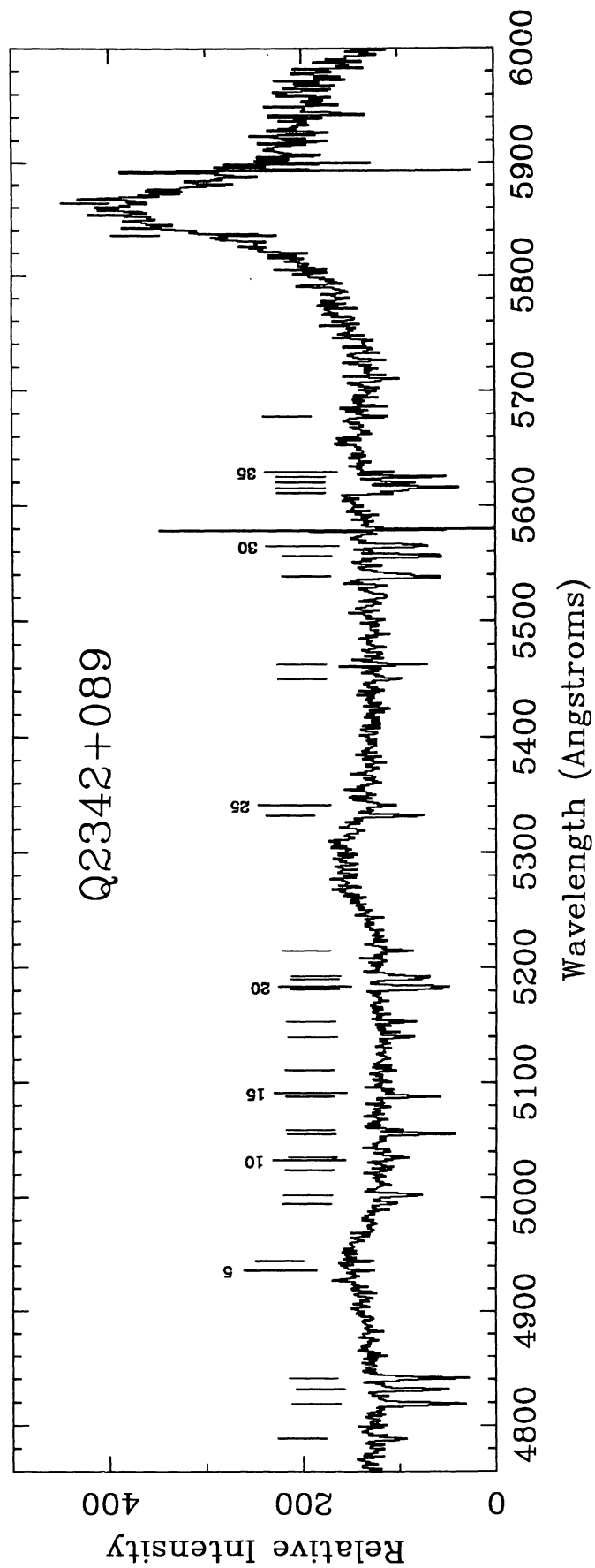
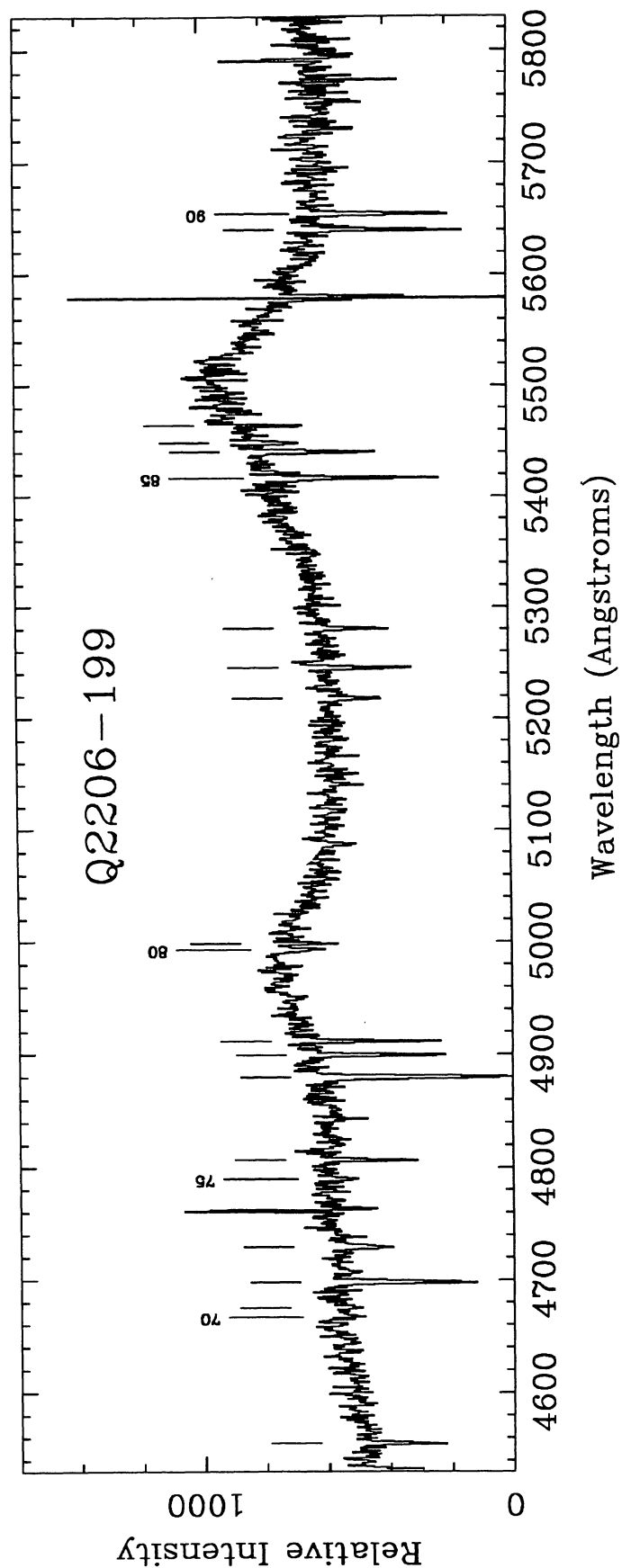


FIG. 1—Continued

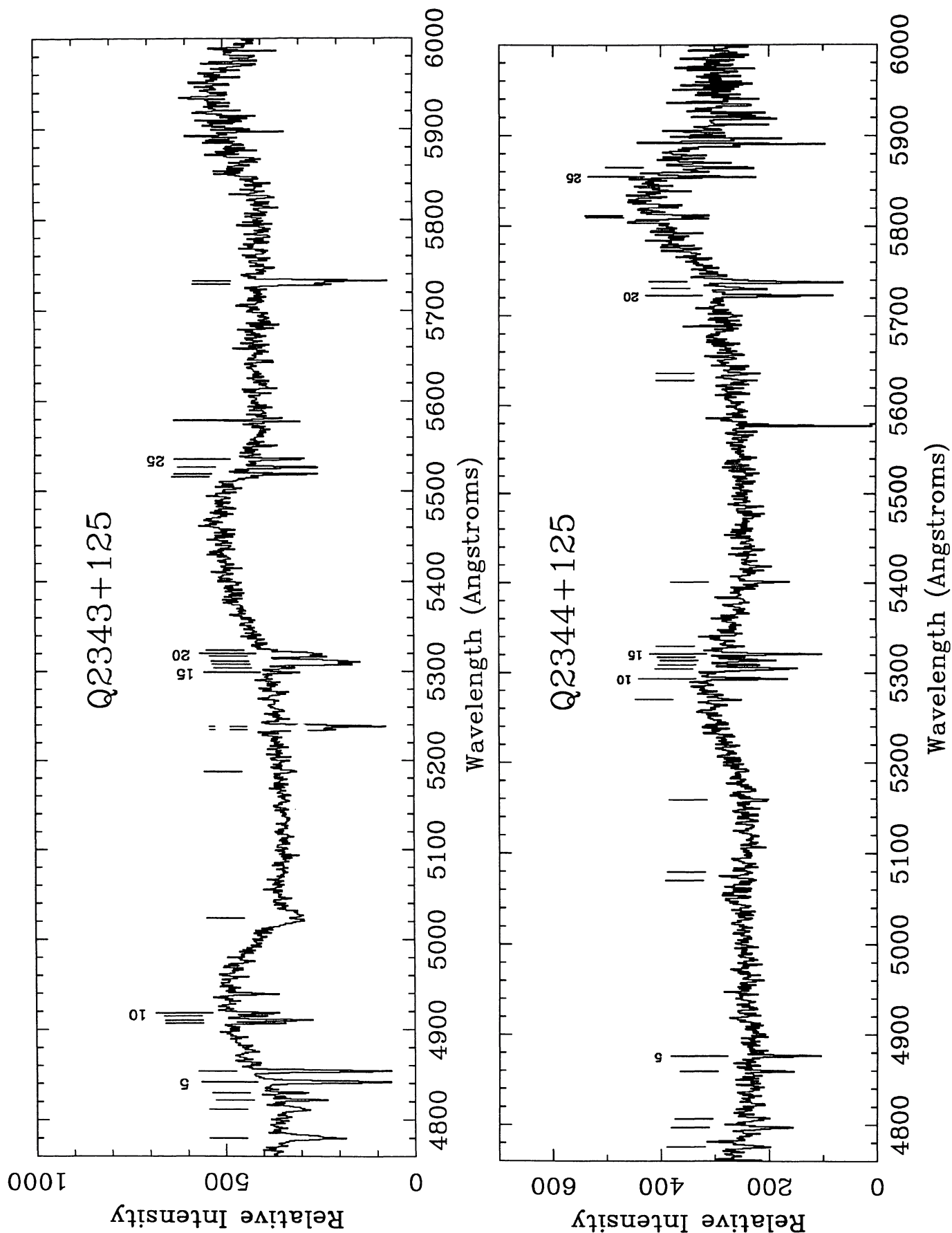


FIG. 1—Continued

TABLE 2
EMISSION LINES

Ion	λ_{Lab}	λ_{Obs}	z_{em}	W_{Obs}	Ion	λ_{Lab}	λ_{Obs}	z_{em}	W_{Obs}	Ion	λ_{Lab}	λ_{Obs}	z_{em}	W_{Obs}
Q0013-004					Q0150-203					Q0329-255				
SiIV+OIV]	1399.7	4325.4	[2.091]	40	NV	1240.1	3905.9	[2.150]	...	SiIV+OIV]	1399.7	5166.4	[2.691]	39
CIV	1549.1	4776.5	2.083	241	OI+SiII	...	4108.6	...	8	CIV	1549.1	5712.2	2.687	76
					SiIV+OIV]	1399.7	4398.7	[2.143]	30					
					CIV	1549.1	4877.2	2.149	151					
Q0014+813					$\langle z_{em} \rangle = 2.086$					$\langle z_{em} \rangle = 2.689$				
HI	1215.7	5324.4	3.380	103										
NV	1240.1	5423.5	[3.373]	...	Q0151+048					Q0348+061				
OI+SiII	...	5534.5	...	13	SiIV+OIV]	1399.7	4055.5	[1.898]	41	OI+SiII	...	4002.2	...	10
SiIV+OIV]	1399.7	6153.6	[3.396]	29	CIV	1549.1	4504.5	1.908	64	SiIV+OIV]	1399.7	4279.4	[2.058]	32
CIV	1549.1	6762.7	3.366	53						CIV	1549.1	4741.6	2.061	92
Q0058+019					$\langle z_{em} \rangle = 1.904$					Q0424-131				
HI	1215.7	3597.5	1.959	196						HI	1215.7	3850.4	2.167	360
OI+SiII	...	3869.3	...	3	Q0207-003					OI+SiII	...	4135.5	...	21
SiIV+OIV]	1399.7	4142.1	[1.960]	17	SiIV+OIV]	1399.7	5388.6	[2.850]	39	SiIV+OIV]	1399.7	4434.7	[2.169]	45
CIV	1549.1	4582.4	1.958	125	CIV	1549.1	5960.4	2.848	[146]	CIV	1549.1	4902.0	2.164	121
Q0112+030					$\langle z_{em} \rangle = 2.849$					$\langle z_{em} \rangle = 2.166$				
OI+SiII	...	5008.8	...	20	Q0216+080					Q0440-168				
SiIV+OIV]	1399.7	5337.6	[2.814]	35	HI	1215.7	4853.74	2.993	470	SiIV+OIV]	1399.7	5154.3	[2.682]	28
CIV	1549.1	5899.0	2.808	136	OI+SiII	...	5202.0	...	18	CIV	1549.1	5697.2	2.678	99
					SiIV+OIV]	1399.7	5575.2	[2.983]	14					
Q0114-089					$\langle z_{em} \rangle = 2.990$					Q0449-135				
HI	1215.7	5098.7	3.194	89						HI	1215.7	4973.5	3.091	[170]
SiIV+OIV]	1399.7	5881.6	[3.202]	30	Q0226-038					NV	1240.1	5082.7	[3.099]	[120]
					OI+SiII	...	4001.8	...	21	SiII	...	5179.7	...	80
					SiIV+OIV]	1399.7	4283.1	[2.060]	47	OI+SiII	...	5362.0	...	53
					CIV	1549.1	4747.5	2.065	88	SiIV+OIV]	1399.7	5750.1	[3.108]	60
Q0142-100					$\langle z_{em} \rangle = 2.063$					$\langle z_{em} \rangle = 3.097$				
HI	1215.7	4531.5	2.727	137	Q0229+131					Q0450-132				
OI+SiII	...	4886.0	...	19	OI+SiII	...	4008.7	...	19	SiIV+OIV]	1399.7	4547.1	[2.249]	26
SiIV+OIV]	1399.7	5216.3	[2.727]	41	SiIV+OIV]	1399.7	4290.2	[2.065]	30	CIV	1549.1	5041.8	2.255	98
CIV	1549.1	5773.3	2.727	98	CIV	1549.1	4751.9	2.068	143					
$\langle z_{em} \rangle = 2.727$					$\langle z_{em} \rangle = 2.067$					$\langle z_{em} \rangle = 2.253$				
					Q0237-233					Q0831+128				
					HI	1215.7	3919.6	2.224	[240]	SiIV+OIV]	1399.7	5240.5	[2.744]	41
					SiIV+OIV]	1399.7	4511.8	[2.224]	62	CIV	1549.1	5775.5	2.728	87
					CIV	1549.1	4986.9	2.219	...					
					$\langle z_{em} \rangle = 2.222$					$\langle z_{em} \rangle = 2.734$				

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TABLE 2—Continued

Ion	λ_{Lab}	λ_{Obs}	z_{em}	W_{Obs}	Ion	λ_{Lab}	λ_{Obs}	z_{em}	W_{Obs}
Q1510+115					Q2126–158				
SiIV+OIV]	1399.7	4359.1	[2.114]	30	HI	1215.7	5203.7	[3.280]	212
CIV	1549.1	4805.3	2.102	[127]	SiII+OI	...	5592.1	...	19
					SiIV+OIV]	1399.7	5974.7	[3.269]	18
			$\langle z_{em} \rangle = 2.106$		CIV	1549.1	6594.1	3.257	60
Q1511+091								$\langle z_{em} \rangle = 3.266$	
SiIV+OIV]	1399.7	5430.3	[2.880]	80	Q2206–199				
CIV	1549.1	6005.9	2.877	[183]	HI	1215.7	4345.9	[2.575]	256
HeII+OIII]	...	6299.9	...	69	SiIV+OIV]	1399.7	5301.0	[2.556]	27
			$\langle z_{em} \rangle = 2.878$		CIV	1549.1	5503.2	2.553	100
Q1517+239								$\langle z_{em} \rangle = 2.559$	
SiIV+OIV]	1399.7	4045.1	[1.890]	48	Q2342+089				
CIV	1549.1	4496.0	1.902	92	OI+SiII	...	4936.2	...	30
HeII+OIII]	...	4854.2	...	17	SiIV+OIV]	1399.7	5301.0	[2.787]	35
			$\langle z_{em} \rangle = 1.898$		CIV	1549.1	5859.3	2.782	167
Q1548+092								$\langle z_{em} \rangle = 2.784$	
HI	1215.7	4558.6	2.750	561	Q2343+125				
NV	1240.1	4643.3	[2.744]	...	SiIV+OIV]	1399.7	4929.4	[2.522]	50
SiIV+OIV]	1399.7	5250.7	[2.751]	42	CIV	1549.1	5439.4	2.511	52
			$\langle z_{em} \rangle = 2.749$		HeII+OIII]	...	5932.0	...	29
Q1623+269								$\langle z_{em} \rangle = 2.515$	
OVI	...	3452.6	...	7	Q2344+125				
HI	1215.7	4294.5	2.533	114	SiIV+OIV]	1399.7	5275.0	[2.769]	42
SiIV+OIV]	1399.7	4938.3	[2.528]	10	CIV	1549.1	5825.0	2.760	66
CIV	1549.1	5448.1	2.517	27				$\langle z_{em} \rangle = 2.763$	
			$\langle z_{em} \rangle = 2.526$						
Q1715+535									
SiIV+OIV]	1399.7	4091.7	[1.923]	16					
CIV	1549.1	4542.3	1.932	57					
HeII+OIII]	...	4854.2	...	35					
			$\langle z_{em} \rangle = 1.929$						

TABLE 3
ABSORPTION LINES

No.	λ_{obs}	$\sigma(\lambda)$	W_{obs}	$\sigma(W)$	S/N	ID	Z_{abs}	Q0013-004						
								No.	λ_{obs}	$\sigma(\lambda)$	W_{obs}	$\sigma(W)$	S/N	ID
1	3937.06	0.18	0.92	0.10	17.3			1	4762.73	0.18	0.52	0.07	22.2	
2	3940.53	0.17	0.44	0.07	17.0			2	4769.47	0.14	2.99	0.08	25.7	
3	3944.05	0.19	0.54	0.08	16.9	OI(1302)	2.0288	3	4776.06	0.14	1.03	0.06	25.1	
4	3950.95	0.18	1.12	0.11	16.9	SiII(1304)	2.0290	4	4782.09	0.15	1.57	0.08	24.9	
5	3960.36	0.13	3.35	0.10	16.9	SiII(1334)	1.9676	5	4800.54	0.14	3.40	0.09	26.3	SiII(1260)
6	3966.10	0.13	7.11	0.13	16.9	CIV(1548)	1.5617	6	4808.61	0.14	3.68	0.08	26.1	
7	3972.58	0.18	1.64	0.12	17.2	+CII(1334)	1.9719	7	4813.14	0.14	1.95	0.07	24.5	
8	4041.96	0.18	1.36	0.12	14.6	+CII(1334)	1.5617	8	4817.04	0.14	1.01	0.06	24.2	
9	4046.46	0.15	0.99	0.10	14.7	CII(1334)	1.9768	9	4820.72	0.15	2.27	0.08	25.1	
10	4056.83	0.19	0.62	0.10	14.4	MgII(2796)	2.0287	10	4834.14	0.29	0.69	0.09	22.9	
11	4136.39	0.15	1.01	0.10	14.3	MgII(2803)	0.4470	11	4842.80	0.28	0.41	0.07	24.3	
12	4141.67	0.15	3.60	0.15	14.4	SiIV(1393)	1.9678	12	4854.03	0.14	4.12	0.09	24.8	
13	4148.35	0.19	1.10	0.12	14.7	+SiIV(1393)	1.9716	13	4854.03	0.14	4.12	0.09	24.8	
14	4159.24	0.20	0.44	0.09	14.7	SiIV(1402)	1.9672	14	4865.04	0.24	0.53	0.08	22.9	
15	4162.32	0.17	0.80	0.10	15.1	SiIV(1402)	1.9709	15	4875.58	0.14	3.29	0.10	23.5	
16	4167.45	0.14	1.78	0.11	14.7	SiIV(1402)	1.9716	16	4881.56	0.14	2.53	0.09	24.1	
17	4170.93	0.16	0.95	0.10	14.9	CIV(1548)	1.7136	17	4896.43	0.14	1.73	0.06	23.8	SiIV(1393)
18	4201.18	0.14	1.56	0.11	15.3	CIV(1548)	1.7136	18	4899.54	0.14	1.18	0.07	23.2	
19	4208.71	0.16	1.96	0.12	15.3	CIV(1550)	1.7139	19	4918.52	0.15	0.67	0.06	21.4	
20	4222.24	0.15	1.32	0.11	15.7	SiIV(1393)	2.0294	20	4922.92	0.15	1.23	0.08	21.4	
21	4249.39	0.20	1.01	0.11	15.8	SiIV(1402)	2.0293	21	4927.83	0.21	0.46	0.07	20.6	
22	4263.17	0.16	0.42	0.07	16.3	CIV(1548)	1.7536	22	4927.86	0.26	0.54	0.09	20.5	
23	4270.17	0.15	0.64	0.08	17.1	CIV(1550)	1.7536	23	4932.43	0.14	1.67	0.08	20.5	
24	4344.38	0.16	0.66	0.09	15.1	FeII(1608)	1.7133	24	4934.52	0.14	1.80	0.07	20.8	
25	4364.26	0.18	0.57	0.10	14.6	FeII(1608)	1.7133	25	4938.50	0.14	3.00	0.10	20.4	
26	4411.76	0.18	0.59	0.10	14.2	SiII(1526)	1.9674	26	4951.91	0.14	4.73	0.12	19.8	FeII(2344)
27	4525.47	0.20	0.57	0.11	13.3	SiII(1526)	1.9716	27	4957.26	0.21	0.78	0.09	19.3	SiII(1304)
28	4530.31	0.15	2.18	0.14	13.2	SiII(1526)	1.9716	28	4964.51	0.17	0.34	0.06	18.8	
29	4536.86	0.14	3.38	0.16	12.9	SiII(1526)	1.9716	29	4967.78	0.18	0.81	0.09	19.1	SiII(1304)
30	4539.80	0.13	2.03	0.11	13.2	SiII(1526)	1.9716	30	4970.93	0.18	0.49	0.07	19.2	
31	4557.38	0.45	1.60	0.22	12.8	SiII(1526)	1.9716	31	4982.49	0.16	1.05	0.09	19.3	
32	4582.03	0.32	0.68	0.14	14.2	SiII(1526)	1.9716	32	4986.36	0.17	0.96	0.09	19.2	
33	4594.41	0.15	2.07	0.13	14.9	CIV(1548)	1.9676	33	4990.18	0.16	1.54	0.09	19.5	
34	4598.85	0.13	2.46	0.11	15.4	CIV(1548)	1.9674	34	4995.71	0.14	2.63	0.10	20.2	FeII(2367)
35	4601.80	0.13	2.28	0.10	15.4	CIV(1550)	1.9674	35	5001.86	0.20	0.37	0.07	19.9	FeII(2367)
36	4607.04	0.14	5.14	0.15	15.0	CIV(1550)	1.9708	36	5008.45	0.22	0.45	0.08	20.0	
37	4611.38	0.14	1.05	0.10	14.8	+CIV(1548)	1.9757	37	5011.90	0.14	1.89	0.08	20.1	FeII(2374)
38	4615.11	0.20	0.98	0.12	14.7	CIV(1550)	1.9760	38	5016.26	0.14	2.98	0.10	20.0	
39	4631.94	0.21	0.71	0.12	14.3	SiII(1808)	1.5619	39	5021.66	0.16	1.41	0.10	19.5	
40	4639.15	0.16	0.54	0.09	14.4	+CIV(1548)	1.9918	40	5027.13	0.14	1.43	0.07	19.3	
41	4689.58	0.15	1.92	0.12	16.3	CIV(1548)	1.9915	41	5029.81	0.14	1.43	0.07	19.0	FeII(2382)
42	4697.20	0.15	1.71	0.11	16.2	CIV(1548)	2.0290	42	5034.12	0.14	4.72	0.12	18.6	FeII(2382)
43	4772.00	0.21	0.60	0.09	18.4	FeII(1608)	1.9668	43	5041.44	0.16	1.53	0.10	18.5	
44	4781.19	0.21	1.84	0.14	18.7	FeII(1608)	1.9668	44	5048.86	0.22	1.03	0.11	17.5	
								45	5054.45	0.20	0.44	0.08	17.4	
								46	5060.34	0.20	0.59	0.09	17.8	
								47	5074.00	0.16	2.79	0.12	18.0	
								48	5079.19	0.14	2.72	0.10	17.8	
								49	5083.66	0.21	0.96	0.11	17.4	CII(1334)
								50	5088.56	0.29	0.56	0.10	18.5	
								51	5093.40	0.14	2.97	0.09	19.1	
								52	5096.90	0.14	2.50	0.09	18.9	
								53	5102.06	0.16	1.78	0.11	18.0	
								54	5107.24	0.14	3.22	0.10	18.0	

TABLE 3—Continued

No.	λ_{obs}	$\sigma(\lambda)$	W_{obs}	$\sigma(W)$	S/N	ID	z_{abs}
Q0014+813							
55	5110.32	0.15	0.81	0.08	17.7		
56	5115.28	0.14	3.56	0.12	18.1		
57	5130.05	0.34	0.65	0.12	16.7		
58	5138.52	0.14	3.51	0.11	16.7	HI(1215)	3.2269
59	5141.57	0.14	2.02	0.10	16.6		
60	5145.85	0.15	1.88	0.10	16.9		
61	5153.54	0.15	2.44	0.11	17.0		
62	5157.78	0.21	0.80	0.11	16.7		
63	5167.16	0.23	0.85	0.11	17.6		
64	5170.70	0.15	1.11	0.09	18.2		
65	5173.95	0.14	1.85	0.09	17.9		
66	5179.49	0.14	2.39	0.10	18.4		
67	5182.90	0.14	0.75	0.07	18.2		
68	5185.26	0.14	1.06	0.08	18.3		
69	5189.42	0.15	1.91	0.10	19.2		
70	5198.67	0.14	1.94	0.09	20.0		
71	5202.68	0.14	3.01	0.09	19.7		
72	5206.31	0.15	1.05	0.08	19.8		
73	5219.50	0.18	1.39	0.10	21.0		
74	5225.88	0.14	3.15	0.09	21.8		
75	5229.75	0.15	1.20	0.08	23.2		
76	5239.54	0.20	1.45	0.11	21.9		
77	5249.00	0.14	2.48	0.08	23.0		
78	5254.39	0.15	6.47	0.12	23.9		
79	5265.53	0.22	0.74	0.08	26.1		
80	5274.59	0.18	0.68	0.07	27.6		
81	5278.20	0.25	0.29	0.06	28.9		
82	5282.56	0.24	0.28	0.05	31.4	SiIV(1393)	2.8001
83	5296.44	0.20	1.49	0.08	30.2		
84	5302.69	0.23	0.29	0.05	32.5		
85	5309.47	0.14	1.55	0.06	37.1		
86	5319.72	0.14	1.43	0.05	39.2		
87	5331.19	0.17	1.01	0.06	37.4	SiIV(1402)	2.8005
88	5342.02	0.16	0.61	0.04	41.0		
89	5359.82	0.18	0.25	0.03	43.3		
90	5408.12	0.14	0.45	0.03	46.6	CIV(1548)	2.4932
91	5417.51	0.19	0.31	0.04	40.6	CIV(1550)	2.4934
92	5443.50	0.17	0.53	0.05	39.6		
93	5460.36	0.14	0.80	0.04	40.8	FeII(2586)	1.1110
94	5464.34	0.13	4.02	0.05	42.3	FeII(2586)	1.1125
95	5480.74	0.17	0.81	0.05	37.3		
96	5488.96	0.13	1.11	0.04	39.9	FeII(2600)	1.1110
97	5492.92	0.13	4.52	0.06	41.3	FeII(2600)	1.1125
98	5844.92	0.21	0.31	0.05	30.3		
99	5880.09	0.23	0.40	0.08	21.0	CIV(1548)	2.7980
100	5883.78	0.16	2.30	0.09	27.5	CIV(1548)	2.8004
101	5889.97	0.15	0.51	0.05	28.6	CIV(1550)	2.7981
102	5892.47	0.14	1.00	0.05	28.5	+SiIV(1393)	3.2260
103	5902.85	0.14	1.79	0.06	27.9	CIV(1550)	2.7997
104	5908.02	0.14	5.22	0.09	27.9	MgII(2796)	1.1109
105	5915.05	0.15	0.33	0.04	27.1	MgII(2796)	1.1128
106	5918.27	0.14	1.40	0.06	27.2	MgII(2803)	1.1110
107	5922.78	0.13	5.37	0.09	26.5	MgII(2803)	1.1126
Q0014+813							
108	6023.09	0.15	0.43	0.04	33.5	MgI(2852)	1.1112
109	6026.39	0.14	0.85	0.05	34.0	MgI(2852)	1.1123
110	6028.61	0.15	0.50	0.04	34.6		
111	6049.19	0.20	0.31	0.05	34.8		
112	6061.31	0.18	0.18	0.03	35.8		
113	6100.57	0.19	0.22	0.04	38.9		
114	6400.87	0.18	0.25	0.05	28.8		
115	6543.46	0.19	0.91	0.08	25.0	CIV(1548)	3.2265
116	6554.54	0.27	0.51	0.08	26.3	CIV(1550)	3.2266
117	6659.90	0.19	0.43	0.06	25.1		
Q0058+019							
1	3394.89	0.09	0.46	0.05	12.5		
2	3397.30	0.11	0.82	0.07	12.5		
3	3416.31	0.10	1.05	0.07	13.6		
4	3422.66	0.08	1.02	0.05	15.2		
5	3424.27	0.08	1.47	0.05	15.5		
6	3428.88	0.09	0.53	0.04	16.4		
7	3430.66	0.10	0.53	0.05	16.5		
8	3433.64	0.09	1.03	0.05	17.8	SiIV(1393)	1.4636
9	3438.79	0.09	0.48	0.04	17.4		
10	3448.05	0.10	0.68	0.05	16.6		
11	3454.22	0.08	1.21	0.05	17.2		
12	3455.98	0.09	0.63	0.04	17.3	SiIV(1402)	1.4637
13	3477.51	0.09	0.58	0.04	18.3		
14	3480.96	0.11	0.24	0.04	17.9		
15	3482.72	0.09	0.49	0.04	18.4		
16	3492.17	0.11	0.41	0.04	19.3		
17	3501.87	0.10	0.22	0.03	20.4		
18	3511.94	0.11	0.40	0.04	20.9		
19	3528.93	0.08	1.24	0.03	25.3		
20	3533.66	0.08	1.23	0.03	26.5		
21	3536.18	0.08	2.32	0.04	28.1		
22	3540.37	0.09	1.07	0.03	29.3		
23	3564.38	0.12	0.20	0.03	32.5		
24	3572.85	0.09	0.34	0.02	38.9		
25	3576.34	0.10	0.16	0.02	38.9		
26	3582.37	0.09	0.44	0.02	36.4		
27	3585.20	0.09	0.43	0.02	35.7		
28	3628.34	0.07	0.22	0.01	77.4		
29	3632.93	0.13	0.25	0.02	67.2		
30	3636.62	0.09	0.13	0.02	35.7		
31	3646.17	0.08	0.17	0.01	75.5		
32	3761.60	0.16	0.24	0.03	39.8	SiII(1526)	1.4638
33	3780.50	0.11	1.53	0.04	38.1	FeII(2344)	0.6127
34	3814.16	0.11	1.26	0.04	38.6	CIV(1548)	1.4636
35	3820.53	0.11	1.35	0.04	37.3	CIV(1550)	1.4636
36	3829.20	0.12	1.30	0.05	36.0	FeII(2374)	0.6127
37	3842.86	0.11	2.21	0.05	38.1	FeII(2382)	0.6128
38	4091.77	0.15	0.17	0.03	41.6		

TABLE 3—Continued

No.	λ_{obs}	$\sigma(\lambda)$	W_{obs}	$\sigma(W)$	S/N	ID	z_{abs}
Q0058+019							
39	4116.69	0.16	0.29	0.03	42.4	AlII(1670)	1.4639
40	4155.87	0.14	0.41	0.04	39.2		
41	4171.74	0.10	1.62	0.04	42.7	FeII(2586)	0.6128
42	4184.11	0.15	0.34	0.04	39.3		
43	4193.58	0.11	2.24	0.05	41.2	FeII(2600)	0.6128
44	4204.06	0.20	0.24	0.04	37.8		
45	4509.89	0.11	2.74	0.05	38.9	MgII(2796)	0.6128
46	4521.49	0.10	2.43	0.05	39.0	MgII(2803)	0.6128
47	4569.41	0.13	0.46	0.04	36.1	AlIII(1854)	1.4637
48	4589.79	0.15	0.15	0.03	41.3	AlIII(1862)	1.4639
49	4600.86	0.12	0.56	0.03	43.4	MgI(2852)	0.6127
Q0112+030							
1	4772.43	0.26	0.79	0.08	28.3	SiIV(1393)	2.4242
2	4877.91	0.18	0.39	0.06	25.9	CIV(1548)	2.1507
3	4886.10	0.16	0.47	0.06	25.7	CIV(1550)	2.1507
4	4943.48	0.21	0.34	0.06	24.2		
5	5208.49	0.14	0.34	0.05	24.9		
6	5225.81	0.12	2.63	0.08	26.9	SiII(1526)	2.4229
7	5263.13	0.12	4.08	0.10	26.3	FeII(2344)	1.2452
8	5300.08	0.17	0.97	0.08	27.5	CIV(1548)	2.4234
9	5308.79	0.14	0.44	0.05	29.8	CIV(1550)	2.4233
10	5331.62	0.12	2.37	0.07	31.3	FeII(2374)	1.2454
11	5349.90	0.12	5.36	0.10	31.5	FeII(2382)	1.2453
12	5505.51	0.21	1.55	0.19	10.9	FeII(1608)	2.4229
13	5715.84	0.18	0.64	0.10	15.9		
14	5718.92	0.11	2.05	0.10	15.9	AlII(1670)	2.4229
15	5806.65	0.13	2.26	0.12	16.3	FeII(2586)	1.2449
16	5809.09	0.11	2.30	0.10	16.3	FeII(2586)	1.2458
17	5838.46	0.13	5.37	0.18	14.8	FeII(2600)	1.2454
Q0114-089							
16	4872.97	0.11	1.32	0.07	20.3		
17	4876.35	0.11	2.18	0.08	20.3		
18	4879.79	0.11	1.38	0.07	19.2		
19	4882.98	0.11	3.19	0.09	18.8		
20	4886.96	0.12	2.28	0.10	18.6		
21	4894.46	0.14	2.26	0.12	17.7		
22	4901.89	0.13	2.05	0.11	18.0		
23	4910.03	0.12	2.08	0.10	18.6		
24	4914.58	0.15	0.94	0.09	19.2		
25	4924.96	0.12	2.66	0.10	19.8		
26	4929.10	0.17	0.42	0.07	18.9		
27	4933.15	0.13	0.96	0.08	19.5		
28	4935.93	0.14	0.85	0.08	19.2		
29	4944.05	0.11	1.76	0.08	20.3		
30	4948.10	0.11	1.99	0.08	20.9		
31	4951.37	0.11	1.61	0.07	21.3		
32	4954.12	0.11	1.69	0.07	21.0		
33	4959.68	0.11	3.41	0.09	22.0		
34	4967.91	0.17	0.70	0.08	21.9		
35	4981.28	0.17	0.71	0.08	22.1		
36	4985.00	0.15	0.64	0.07	22.6		
37	4991.80	0.11	7.80	0.11	23.7		
38	5004.67	0.12	4.21	0.10	24.6		
39	5022.25	0.13	0.48	0.05	26.6		
40	5025.05	0.13	0.99	0.06	27.3		
41	5033.55	0.12	0.86	0.05	30.5		
42	5036.59	0.12	0.53	0.05	29.4		
43	5039.23	0.13	0.50	0.05	29.3		
44	5048.97	0.11	0.99	0.05	30.7		
45	5051.61	0.12	0.79	0.05	29.9		
46	5056.71	0.15	0.24	0.04	29.6		
47	5066.22	0.13	0.59	0.05	31.1		
48	5070.92	0.11	2.64	0.06	33.7		
49	5076.32	0.13	0.81	0.05	33.1		
50	5087.25	0.11	1.44	0.05	35.0		
51	5108.32	0.12	1.18	0.05	39.5	CIV(1548)	2.2995
52	5116.70	0.12	0.97	0.04	39.0	CIV(1550)	2.2994
53	5182.77	0.16	0.19	0.03	52.9		
54	5479.73	0.21	0.60	0.07	28.7	CIV(1548)	2.5394
55	5488.72	0.18	0.48	0.06	27.6	CIV(1550)	2.5393
56	5723.29	0.25	0.53	0.09	22.0		
57	5756.90	0.21	0.39	0.08	20.8		
58	5759.34	0.18	0.31	0.07	20.5		
59	5761.26	0.25	0.33	0.08	19.8		
Q0142-100							
1	3665.67	0.07	0.56	0.03	25.5		
2	3675.14	0.08	0.25	0.03	21.4		
3	3679.54	0.07	1.94	0.05	18.7		
4	3683.16	0.08	0.72	0.05	16.8		

TABLE 3—Continued

No.	λ_{obs}	$\sigma(\lambda)$	W_{obs}	$\sigma(W)$	S/N	ID	z_{abs}
Q0142-100							
5	3684.31	0.09	0.38	0.04	16.5		
6	3688.65	0.08	0.63	0.05	15.7		
7	3699.12	0.08	0.95	0.05	17.3		
8	3706.14	0.08	0.66	0.04	18.1	SiII(1260)	1.9404
9	3708.00	0.08	0.88	0.04	18.1		
10	3713.25	0.08	1.24	0.05	17.5		
11	3718.10	0.08	0.28	0.03	18.4		
12	3720.73	0.07	1.93	0.05	18.1		
13	3722.91	0.07	0.68	0.04	17.9		
14	3726.86	0.08	6.08	0.08	17.9		
15	3733.04	0.09	0.36	0.04	18.0		
16	3738.96	0.07	0.91	0.04	19.0		
17	3744.70	0.08	1.09	0.05	18.9		
18	3756.19	0.08	0.87	0.05	18.0		
19	3759.36	0.07	1.76	0.05	17.9		
20	3763.30	0.07	1.41	0.05	17.6		
21	3765.70	0.08	0.63	0.04	18.0		
22	3769.78	0.11	0.20	0.04	17.6		
23	3777.96	0.10	0.35	0.04	17.8		
24	3783.33	0.07	1.49	0.05	18.9		
25	3786.29	0.07	2.13	0.05	18.3		
26	3789.18	0.08	0.73	0.05	18.3		
27	3792.38	0.08	2.16	0.06	18.7		
28	3795.91	0.09	0.45	0.04	20.0		
29	3801.50	0.08	2.64	0.06	20.4		
30	3809.28	0.10	0.28	0.04	20.6		
31	3813.26	0.09	0.98	0.05	20.3		
32	3819.53	0.08	0.47	0.04	22.1		
33	3822.47	0.08	1.32	0.05	21.9		
34	3831.71	0.07	1.43	0.04	24.3		
35	3833.69	0.07	0.72	0.03	24.4		
36	3836.66	0.08	0.85	0.04	24.5		
37	3844.19	0.08	0.68	0.04	22.4		
38	3850.26	0.11	0.24	0.04	22.2		
39	3855.32	0.08	0.51	0.04	21.9		
40	3857.82	0.10	0.79	0.05	21.0		
41	3864.81	0.10	0.28	0.04	20.8		
42	3866.99	0.08	0.81	0.04	20.6		
43	3868.90	0.08	1.01	0.04	20.6		
44	3871.94	0.08	0.57	0.04	20.6		
45	3876.43	0.08	0.45	0.04	20.9		
46	3878.51	0.09	0.67	0.05	19.3		
47	3882.38	0.12	0.26	0.04	19.2		
48	3911.08	0.08	1.61	0.05	19.2		
49	3917.79	0.09	0.22	0.03	19.0		
50	3920.61	0.08	0.75	0.04	19.4		
51	3924.14	0.08	0.90	0.05	19.1	CII(1334)	1.9405
52	3939.88	0.08	1.12	0.05	19.0		
53	3946.22	0.10	0.22	0.04	18.6		
54	3951.97	0.08	0.56	0.04	18.8		
55	3954.81	0.07	1.19	0.04	19.3		
56	3966.60	0.08	0.98	0.05	17.1		
57	3974.62	0.09	0.46	0.05	17.1		

No.	λ_{obs}	$\sigma(\lambda)$	W_{obs}	$\sigma(W)$	S/N	ID	z_{abs}
Q0142-100							
58	3982.13	0.10	0.57	0.06	16.7		
59	3987.59	0.08	0.97	0.05	17.5		
60	3991.39	0.08	1.10	0.05	17.7		
61	3997.98	0.08	0.83	0.04	18.0		
62	4004.26	0.09	0.32	0.04	17.8		
63	4005.52	0.09	0.40	0.04	17.6		
64	4009.75	0.08	0.24	0.03	17.2		
65	4027.85	0.09	0.71	0.05	17.1		
66	4037.55	0.08	0.97	0.05	17.2		
67	4039.83	0.07	1.16	0.04	17.3		
68	4042.02	0.08	1.00	0.05	18.1		
69	4044.33	0.09	0.55	0.05	17.4		
70	4048.38	0.07	1.38	0.05	17.8	SiIII(1206)	2.3554
71	4049.93	0.07	1.05	0.04	17.5	SiIII(1206)	2.3567
72	4057.56	0.09	0.60	0.05	17.6		
73	4065.99	0.08	0.90	0.05	16.6		
74	4068.19	0.10	0.38	0.05	16.5		
75	4080.94	0.08	6.15	0.09	17.3	HI(1215)	2.3569
76	4092.78	0.08	1.37	0.05	17.5		
77	4095.62	0.07	1.73	0.05	17.8		
78	4098.28	0.07	1.64	0.05	18.1	SiIV(1393)	1.9405
79	4107.77	0.08	0.97	0.05	17.6		
80	4109.76	0.08	1.31	0.05	17.3		
81	4117.62	0.08	1.69	0.06	16.3		
82	4119.79	0.07	1.08	0.05	16.5		
83	4121.60	0.07	0.82	0.04	16.3		
84	4123.04	0.07	0.65	0.04	16.2		
85	4124.80	0.07	0.86	0.05	15.9	SiIV(1402)	1.9405
86	4126.16	0.08	0.75	0.05	16.0		
87	4130.41	0.08	1.20	0.06	16.1		
88	4136.14	0.10	0.49	0.05	16.3		
89	4141.76	0.09	0.34	0.04	16.8		
90	4152.39	0.08	1.04	0.05	17.1		
91	4154.07	0.07	0.75	0.04	17.8		
92	4156.40	0.08	1.20	0.05	17.8		
93	4165.38	0.09	0.32	0.04	17.5		
94	4170.65	0.09	0.96	0.06	16.9		
95	4182.81	0.09	1.91	0.08	17.7		
96	4194.35	0.06	0.64	0.03	32.4		
97	4197.02	0.06	0.58	0.03	31.9		
98	4209.20	0.08	1.93	0.04	26.2		
99	4224.25	0.10	0.30	0.03	26.8		
100	4227.81	0.05	1.14	0.03	30.8		
101	4229.56	0.05	0.97	0.03	30.4	SiII(1260)	2.3557
102	4230.92	0.07	0.51	0.03	25.2		
103	4232.21	0.06	0.38	0.02	30.2		
104	4235.16	0.06	3.05	0.04	28.9		
105	4240.24	0.10	0.16	0.03	24.5		
106	4244.52	0.06	1.93	0.03	29.9		
107	4250.53	0.08	0.88	0.04	24.4		
108	4254.48	0.07	1.95	0.04	24.4		
109	4259.52	0.07	1.42	0.04	24.0		
110	4262.13	0.08	0.38	0.03	25.5		

TABLE 3—Continued

No.	λ_{obs}	$\sigma(\lambda)$	W_{obs}	$\sigma(W)$	S/N	ID	z_{abs}
Q0142-100							
111	4264.09	0.09	0.42	0.03	24.3		
112	4268.43	0.11	0.19	0.03	23.6		
113	4276.76	0.08	0.55	0.03	22.9		
114	4278.40	0.07	0.66	0.03	22.9		
115	4292.20	0.08	0.44	0.03	23.5		
116	4297.53	0.08	0.54	0.03	23.2		
117	4299.36	0.08	0.77	0.04	22.7		
118	4308.65	0.08	0.18	0.02	23.8		
119	4312.53	0.09	0.31	0.03	23.1		
120	4324.78	0.10	0.26	0.03	23.0		
121	4337.18	0.08	0.72	0.04	20.1		
122	4342.06	0.08	0.59	0.04	19.6		
123	4346.74	0.11	0.32	0.04	19.0		
124	4355.95	0.07	0.88	0.04	19.2		
125	4357.28	0.08	0.43	0.03	19.0		
126	4361.63	0.07	1.73	0.05	19.6		
127	4366.57	0.07	1.47	0.05	18.9		
128	4372.60	0.08	1.09	0.05	20.6		
129	4379.59	0.08	1.65	0.05	19.3		
130	4383.63	0.08	1.83	0.05	19.1		
131	4387.90	0.08	0.31	0.03	19.4		
132	4392.72	0.11	0.20	0.03	21.8		
133	4394.47	0.12	0.18	0.03	21.9		
134	4397.50	0.09	0.41	0.04	21.6		
135	4401.33	0.08	2.59	0.06	22.0		
136	4405.69	0.10	0.23	0.03	24.0		
137	4419.56	0.12	0.29	0.04	25.0		
138	4424.08	0.07	1.04	0.04	25.4		
139	4426.41	0.08	0.86	0.04	25.0		
140	4434.28	0.10	0.23	0.03	22.8		
141	4438.96	0.08	0.92	0.04	23.8		
142	4444.22	0.07	0.33	0.02	24.0		
143	4455.69	0.07	2.55	0.04	24.1		
144	4457.97	0.07	1.00	0.03	26.1		
145	4460.33	0.07	2.24	0.04	24.1		
146	4464.37	0.08	1.11	0.04	23.5		
147	4478.63	0.08	1.28	0.05	22.8		
148	4481.30	0.10	0.36	0.04	23.8		
149	4484.99	0.07	1.44	0.03	24.6		
150	4486.40	0.07	1.17	0.03	24.9		
151	4488.49	0.07	2.51	0.04	24.7		
152	4491.03	0.07	1.37	0.03	25.8		
153	4493.72	0.07	1.48	0.04	27.1		
154	4502.21	0.07	0.75	0.03	29.0		
155	4503.99	0.07	0.59	0.02	28.8		
156	4506.12	0.07	2.24	0.04	28.6		
157	4517.64	0.07	0.75	0.03	28.6		
158	4520.16	0.07	1.61	0.03	29.9		
159	4538.24	0.11	0.16	0.02	30.8		
160	4542.38	0.07	3.05	0.04	32.6		
161	4552.48	0.07	1.21	0.02	34.0		
162	4554.20	0.07	0.62	0.02	34.1		
163	4558.52	0.07	0.57	0.02	33.4		
164	4560.28	0.07	0.91	0.02	33.3		
Q0151+048							
1	3867.24	0.14	0.21	0.03	45.2		
2	3881.95	0.13	0.69	0.04	45.5		
3	3884.73	0.14	0.26	0.03	44.9		
4	3894.77	0.13	0.44	0.03	43.6		
5	4144.14	0.13	0.40	0.04	29.0		
6	4195.31	0.18	0.25	0.05	27.2		
7	4237.86	0.18	0.23	0.04	30.6		
8	4240.97	0.14	0.49	0.05	31.4		
9	4283.18	0.12	0.46	0.04	33.0		
10	4290.34	0.16	0.27	0.04	32.1		
11	4534.22	0.15	0.27	0.04	27.6		
12	4541.86	0.14	0.23	0.04	27.3		
13	4657.41	0.12	0.41	0.04	25.8		
14	4659.88	0.15	0.32	0.05	26.1		
15	4665.15	0.15	0.23	0.04	25.6		
16	4667.10	0.17	0.26	0.05	25.5		
17	4720.13	0.14	0.24	0.04	27.5		
18	4977.43	0.14	0.64	0.07	23.1		
19	4990.78	0.21	0.37	0.07	22.3		
Q0150-203							
1	3867.24	0.14	0.21	0.03	45.2		
2	3881.95	0.13	0.69	0.04	45.5		
3	3884.73	0.14	0.26	0.03	44.9		
4	3894.77	0.13	0.44	0.03	43.6		
5	4144.14	0.13	0.40	0.04	29.0		
6	4195.31	0.18	0.25	0.05	27.2		
7	4237.86	0.18	0.23	0.04	30.6		
8	4240.97	0.14	0.49	0.05	31.4		
9	4283.18	0.12	0.46	0.04	33.0		
10	4290.34	0.16	0.27	0.04	32.1		
11	4534.22	0.15	0.27	0.04	27.6		
12	4541.86	0.14	0.23	0.04	27.3		
13	4657.41	0.12	0.41	0.04	25.8		
14	4659.88	0.15	0.32	0.05	26.1		
15	4665.15	0.15	0.23	0.04	25.6		
16	4667.10	0.17	0.26	0.05	25.5		
17	4720.13	0.14	0.24	0.04	27.5		
18	4977.43	0.14	0.64	0.07	23.1		
19	4990.78	0.21	0.37	0.07	22.3		
Q0142-100							
165	4561.76	0.07	0.36	0.02	32.3	CIV(1550)	1.9416
166	4565.90	0.08	0.42	0.03	32.0	CIV(1550)	1.9443
167	4677.36	0.08	1.42	0.04	23.8	SiIV(1393)	2.3559
168	4709.33	0.16	0.60	0.04	36.7	SiIV(1402)	2.3572
169	4747.58	0.14	0.48	0.03	38.1		
170	4777.75	0.15	0.29	0.03	40.1		
171	4783.25	0.16	0.22	0.03	38.4		
172	4818.48	0.16	0.30	0.03	41.3		
173	4913.94	0.14	0.77	0.04	43.2	AlII(1670)	1.9411
174	5146.99	0.15	0.27	0.03	33.5	CIV(1548)	2.3245
175	5155.76	0.15	0.15	0.03	35.0	CIV(1550)	2.3246
176	5195.96	0.13	2.80	0.06	35.5	CIV(1548)	2.3561
177	5204.58	0.14	1.70	0.06	34.0	CIV(1550)	2.3561
178	5230.22	0.23	0.23	0.04	32.9		
179	5334.00	0.22	0.39	0.06	26.4		
180	5477.48	0.21	0.51	0.07	24.3		
181	5563.02	0.16	0.30	0.06	18.6		
182	5690.57	0.16	0.21	0.04	27.1		
Q0151+048							
1	3649.79	0.17	0.25	0.04	28.9	SiIV(1393)	1.6187
2	3669.05	0.15	0.18	0.03	26.4	SiIV(1402)	1.6194
3	3674.42	0.15	0.38	0.05	25.5		
4	3698.48	0.14	0.85	0.05	27.5	SiIV(1393)	1.6536
5	3725.54	0.15	0.39	0.04	29.0	SiIV(1402)	1.6558
6	3727.82	0.14	0.23	0.03	28.4	+SiII(1260)	1.9343

TABLE 3—Continued

No.	λ_{obs}	$\sigma(\lambda)$	W_{obs}	$\sigma(W)$	S/N	ID	z_{abs}
Q0151+048							
7	3793.57	0.16	0.30	0.04	28.9		
8	3803.13	0.17	0.28	0.04	28.5		
9	3820.97	0.13	0.72	0.04	27.9	CIV(1548)	1.4680
10	3827.19	0.19	0.30	0.05	28.4	CIV(1550)	1.4679
11	3915.55	0.15	0.78	0.05	30.7	CII(1334)	1.9340
12	3934.16	0.16	0.22	0.04	30.4		
13	3965.38	0.14	0.56	0.04	32.3	CIV(1548)	1.5613
14	3971.66	0.14	0.37	0.04	31.2	CIV(1550)	1.5611
15	4048.93	0.15	0.32	0.04	35.4	SiII(1526)	1.6520
16	4054.48	0.13	1.72	0.05	36.4	CIV(1548)	1.6188
						+SiII(1526)	1.6557
17	4061.40	0.13	1.58	0.05	35.6	CIV(1550)	1.6190
						+SiII(1526)	1.6602
18	4066.25	0.15	0.27	0.04	33.2		
19	4089.44	0.14	0.65	0.04	33.4	SiIV(1393)	1.9341
20	4107.80	0.16	0.43	0.04	32.5	CIV(1548)	1.6533
21	4111.78	0.13	0.95	0.04	33.3	CIV(1548)	1.6558
22	4115.29	0.12	1.27	0.04	35.7	CIV(1550)	1.6537
						+CIV(1548)	1.6581
23	4118.33	0.13	0.69	0.04	36.0	CIV(1550)	1.6557
						+CIV(1548)	1.6601
24	4122.07	0.13	1.04	0.05	36.0	CIV(1550)	1.6581
25	4125.03	0.14	0.28	0.03	37.9	CIV(1550)	1.6600
26	4196.05	0.17	0.42	0.04	36.4		
27	4376.09	0.20	0.31	0.04	35.2	AlII(1670)	1.6192
						+CIV(1548)	1.8266
28	4383.22	0.19	0.25	0.04	35.1	CIV(1550)	1.8265
29	4479.94	0.13	0.35	0.03	37.0	SiII(1526)	1.9344
30	4542.69	0.15	1.04	0.06	32.6	CIV(1548)	1.9342
31	4550.33	0.13	0.80	0.04	32.9	CIV(1550)	1.9342
Q0207-003							
1	4815.81	0.14	0.62	0.03	48.3		
2	4825.98	0.17	0.21	0.03	47.8		
3	4831.56	0.15	0.56	0.03	52.6	FeII(2367)	1.0451
4	4842.05	0.21	0.18	0.03	47.7	FeII(2382)	1.0441
5	4870.49	0.21	0.45	0.04	47.6	SiIV(1393)	2.5232
6	4910.48	0.14	1.56	0.04	51.5		
7	4974.23	0.16	0.23	0.03	49.2	SiIV(1393)	2.5747
8	4982.32	0.15	0.42	0.03	56.5	SiIV(1393)	2.5749
9	5014.82	0.16	0.25	0.03	51.7	SiIV(1402)	2.5747
10	5151.62	0.17	0.24	0.03	47.7		
11	5315.07	0.20	0.37	0.04	42.9	FeII(2600)	1.0441
12	5378.85	0.14	1.96	0.05	43.3	SiII(1526)	2.5231
13	5454.37	0.14	2.03	0.06	31.8	CIV(1548)	2.5230
						+SiII(1526)	2.5725
14	5463.62	0.14	1.69	0.06	32.8	CIV(1550)	2.5232
15	5490.32	0.19	0.48	0.06	28.5		
16	5533.94	0.17	0.80	0.08	21.0	CIV(1548)	2.5744
17	5543.04	0.23	0.60	0.09	21.9	CIV(1550)	2.5744
18	5560.44	0.18	0.72	0.08	21.6	CIV(1548)	2.5915
Q0216+080							
1	4766.41	0.14	0.40	0.03	33.9		
2	4768.51	0.16	0.73	0.05	33.0		
3	4782.04	0.15	0.70	0.04	37.0		
4	4785.90	0.15	0.52	0.04	38.9		
5	4791.19	0.14	2.48	0.05	42.7		
6	4820.71	0.13	3.74	0.05	50.1		
7	4830.18	0.16	0.37	0.03	46.2		
8	5027.65	0.14	3.00	0.08	29.2	SiII(1526)	2.2931
9	5081.28	0.16	0.59	0.06	27.6	CIV(1548)	2.2821
10	5089.80	0.16	0.31	0.05	26.5	CIV(1550)	2.2821
11	5092.83	0.14	1.15	0.06	27.7	SiII(1526)	2.3358
12	5098.53	0.14	4.61	0.09	26.7	CIV(1548)	2.2932
13	5106.36	0.14	2.68	0.07	29.1	CIV(1550)	2.2928
14	5135.13	0.15	0.57	0.05	27.1		
15	5164.92	0.18	0.31	0.05	31.4	CIV(1548)	2.3361
16	5173.40	0.26	0.29	0.05	35.2	CIV(1550)	2.3360
17	5296.78	0.15	1.61	0.07	30.4	FeII(1608)	2.2931
18	5315.84	0.18	0.24	0.05	26.7		
19	5501.65	0.14	3.54	0.09	26.2	AlII(1670)	2.2929
20	5760.12	0.18	0.67	0.08	19.1	CIV(1548)	2.7205
21	5769.34	0.20	0.55	0.09	18.4	CIV(1550)	2.7203
Q0226-038							
1	3889.90	0.18	0.56	0.05	31.2		
2	4041.49	0.13	0.45	0.04	29.2		
3	4242.23	0.13	0.49	0.03	40.3	SiIV(1393)	2.0437
4	4270.69	0.19	0.54	0.05	39.4	SiIV(1402)	2.0445
5	4282.52	0.17	0.30	0.04	39.9		
6	4300.31	0.15	0.34	0.03	40.4		
7	4318.23	0.15	0.33	0.03	39.0		
8	4524.93	0.15	0.50	0.05	30.6		
9	4711.86	0.14	0.84	0.05	36.9	CIV(1548)	2.0434
10	4719.90	0.14	0.61	0.04	34.5	CIV(1550)	2.0436
11	4794.60	0.17	0.28	0.04	31.1		

TABLE 3—Continued

No.	λ_{obs}	$\sigma(\lambda)$	W_{obs}	$\sigma(W)$	S/N	ID	z_{abs}
Q0229+131							
1	3815.73	0.14	0.47	0.04	30.2	CII(1334)	1.8592
2	3819.33	0.12	1.47	0.05	30.4	CII(1334)	1.8619
3	3823.79	0.15	0.32	0.04	29.9	CIV(1548)	1.4698
4	3830.18	0.16	0.21	0.04	29.0	CIV(1550)	1.4699
5	3836.96	0.18	0.47	0.05	28.2	MgII(2796)	0.3721
6	3847.64	0.19	0.29	0.05	28.9	MgII(2803)	0.3724
7	3964.23	0.13	0.95	0.05	26.9	MgII(2796)	0.4176
8	3974.48	0.13	1.06	0.05	25.9	MgII(2803)	0.4177
9	3977.38	0.16	0.24	0.04	25.6		
10	3989.14	0.14	0.53	0.05	24.3	SiIV(1393)	1.8622
11	4015.16	0.16	0.74	0.07	22.5	SiIV(1402)	1.8623
12	4045.18	0.15	0.49	0.05	25.2	SiIV(1393)	1.9024
13	4072.11	0.19	0.29	0.05	24.5	+MgI(2852)	0.4179
14	4077.83	0.18	0.31	0.05	24.7	SiIV(1402)	1.9029
15	4122.74	0.16	0.48	0.05	26.3	SiIV(1393)	1.9580
16	4292.77	0.14	0.44	0.04	33.0		
17	4370.93	0.23	0.72	0.07	27.8	SiII(1526)	1.8630
18	4428.57	0.13	0.77	0.04	28.1	CIV(1548)	1.8605
19	4431.20	0.12	0.88	0.04	28.5	CIV(1548)	1.8622
20	4433.90	0.13	0.42	0.04	27.2	+SiII(1526)	1.9024
21	4435.86	0.13	0.61	0.05	26.4	CIV(1548)?	1.8639
22	4438.70	0.13	0.82	0.05	27.2	CIV(1550)	1.8604
23	4468.30	0.20	0.48	0.06	25.8	CIV(1550)	1.8622
24	4493.27	0.14	2.21	0.08	27.7	CIV(1548)	1.9024
25	4501.04	0.15	1.15	0.07	27.5	CIV(1550)	1.9024
26	4580.18	0.17	0.50	0.05	29.9	CIV(1548)	1.9584
27	4587.11	0.18	0.25	0.04	29.2	+AlII(1854)	1.4695
28	4781.84	0.17	0.41	0.04	38.9	CIV(1550)	1.9579
						AlII(1670)	1.8620
Q0237-233							
1	3470.57	0.08	0.40	0.04	20.0		
20	3480.30	0.06	0.75	0.03	20.4		
21	3486.03	0.07	0.41	0.03	20.0		
22	3488.67	0.07	0.41	0.03	20.4		
23	3500.31	0.06	1.32	0.04	21.3		
24	3502.16	0.06	1.27	0.04	21.8		
25	3504.73	0.07	1.67	0.04	22.7		
26	3508.24	0.08	0.47	0.04	21.6		
27	3518.11	0.06	0.91	0.03	25.1		
28	3520.07	0.07	0.75	0.03	26.0		
29	3525.03	0.06	2.45	0.04	26.6	HI(1215)	1.8997
30	3528.27	0.06	2.39	0.04	24.3		
31	3543.74	0.07	0.95	0.04	24.0		
32	3546.67	0.07	1.14	0.04	23.8	CII(1334)	1.6576
33	3556.20	0.06	2.71	0.05	25.4		
34	3564.63	0.06	0.50	0.03	23.1	CII(1334)	1.6711
35	3566.33	0.06	1.40	0.04	22.6	CII(1334)	1.6723
36	3571.13	0.07	1.57	0.04	23.4	CII(1334)	1.6759
37	3589.07	0.08	0.97	0.05	23.0		
38	3591.68	0.08	0.35	0.03	23.8		
39	3594.11	0.06	1.70	0.04	23.8		
40	3596.31	0.07	0.80	0.04	23.8		
41	3610.52	0.06	1.51	0.04	24.1	SiII(1526)	1.3649
42	3612.58	0.07	0.38	0.03	24.1		
43	3632.03	0.07	0.63	0.04	23.4		
44	3635.18	0.07	0.17	0.02	22.2		
45	3638.72	0.07	1.78	0.05	22.1	SiIV(1393)	1.6107
46	3646.07	0.08	0.62	0.04	23.0	SiIV(1402)	1.6105
47	3659.88	0.06	1.09	0.03	23.5	CIV(1548)	1.3640
48	3661.90	0.06	2.50	0.04	23.6	CIV(1548)	1.3653
49	3666.22	0.06	0.95	0.03	24.8	CIV(1550)	1.3641
50	3668.28	0.06	1.93	0.04	24.1	CIV(1550)	1.3655
51	3677.57	0.07	1.08	0.04	25.2		
52	3684.70	0.07	0.22	0.02	25.2		
53	3686.70	0.07	0.57	0.03	25.0		
54	3697.27	0.07	2.45	0.05	24.5		
55	3704.03	0.06	2.18	0.04	25.7	SiIV(1393)	1.6576
56	3716.17	0.06	0.55	0.03	25.8		
57	3718.05	0.07	0.73	0.03	25.5		
58	3719.73	0.07	0.16	0.02	25.3		
59	3720.97	0.07	0.34	0.03	25.3		
60	3722.84	0.07	0.40	0.03	25.9	SiIV(1393)	1.6711
61	3724.55	0.06	1.21	0.03	26.3	SiIV(1393)	1.6723
62	3728.22	0.08	1.65	0.05	23.9	SiIV(1402)	1.6578
						+SiIV(1393)	1.6700
						SiIV(1402)	1.6724
63	3748.70	0.07	0.89	0.03	26.4		
64	3761.15	0.07	0.88	0.03	29.6		
65	3768.77	0.08	0.21	0.03	27.7		
66	3774.63	0.07	0.68	0.03	27.2		
67	3778.35	0.06	1.99	0.04	28.0		
68	3788.90	0.07	0.51	0.03	28.2		
69	3791.05	0.06	0.76	0.03	28.6		
70	3793.10	0.07	0.52	0.03	29.8		

TABLE 3—Continued

No.	λ_{obs}	$\sigma(\lambda)$	W_{obs}	$\sigma(W)$	S/N	ID	z_{abs}
Q0237-233							
71	3800.24	0.07	0.35	0.03	29.5		
72	3804.26	0.07	0.33	0.02	30.0		
73	3805.77	0.07	0.29	0.02	29.9		
74	3812.75	0.09	0.24	0.03	30.9		
75	3822.17	0.07	0.29	0.02	32.5		
76	3839.17	0.06	0.97	0.03	37.8		
77	3841.20	0.07	0.32	0.02	36.1		
78	3858.76	0.05	0.24	0.01	64.9		
79	3863.29	0.04	2.23	0.02	57.1	SiIII(1206)	2.2020
80	3875.42	0.05	0.68	0.02	58.6		
81	3881.77	0.05	0.83	0.01	57.6		
82	3885.52	0.05	0.25	0.01	56.8		
83	3887.76	0.04	1.60	0.01	61.2		
84	3893.59	0.04	3.13	0.02	58.4	HI(1215)	2.2028
85	3900.94	0.05	0.62	0.02	73.3		
86	3906.74	0.03	1.07	0.01	74.8		
87	3912.26	0.04	0.65	0.02	71.4		
88	3918.35	0.07	0.23	0.02	73.7		
89	3925.87	0.04	0.45	0.01	79.0		
90	3934.44	0.04	1.28	0.01	70.4		
91	3951.31	0.06	1.44	0.02	48.1	AlII(1670)	1.3649
92	4018.95	0.06	1.01	0.02	37.8	CIV(1548)	1.5959
93	4020.90	0.06	1.26	0.02	38.2	CIV(1548)	1.5971
94	4025.73	0.06	1.10	0.03	36.6	CIV(1550)	1.5959
95	4027.76	0.06	0.93	0.02	36.5	CIV(1550)	1.5973
96	4042.14	0.07	0.52	0.03	34.1	CIV(1548)	1.6109
97	4048.86	0.07	0.31	0.02	35.5	CIV(1550)	1.6109
98	4057.13	0.07	0.26	0.02	38.8	SiII(1526)	1.6574
99	4079.88	0.06	1.05	0.02	44.3	SiII(1526)	1.6723
100	4082.50	0.08	0.20	0.02	40.4	SiII(1526)	1.6740
101	4112.49	0.06	0.87	0.03	31.0	CIV(1548)	1.6563
102	4114.46	0.06	1.66	0.03	29.5	CIV(1548)	1.6576
103	4116.40	0.07	0.20	0.02	28.1	CIV(1548)	1.6588
104	4119.08	0.06	0.96	0.03	26.3	CIV(1550)	1.6561
105	4121.36	0.06	1.22	0.03	26.6	+CIV(1548)	1.6606
106	4123.25	0.08	0.10	0.02	26.3	CIV(1550)	1.6576
107	4125.17	0.10	0.14	0.03	25.8	CIV(1550)	1.6588
108	4135.37	0.06	0.83	0.03	29.1	CIV(1548)	1.6601
109	4137.43	0.06	1.56	0.03	27.7	CIV(1548)	1.6711
110	4139.85	0.06	0.85	0.03	29.3	CIV(1548)	1.6724
111	4141.98	0.06	1.13	0.03	28.9	CIV(1550)	1.6709
112	4144.33	0.06	1.38	0.03	30.2	+CIV(1548)	1.6753
113	4146.83	0.06	0.58	0.02	30.2	CIV(1550)	1.6724
114	4146.69	0.06	0.57	0.02	30.2	CIV(1550)	1.6740
115	4298.44	0.06	0.47	0.02	30.7	CIV(1550)	1.6752
116	4342.48	0.10	0.17	0.02	37.3	FeII(1608)	1.6724
117	4386.70	0.07	0.85	0.02	39.7		
118	4404.24	0.08	0.29	0.03	36.1	AlIII(1854)	1.3652
119	4406.11	0.07	0.60	0.03	31.9	AlIII(1862)	1.3653
120	4439.91	0.06	0.40	0.02	37.3	AlII(1670)	1.6574
121	4459.81	0.09	0.18	0.03	24.1		
Q0237-233							
122	4464.59	0.07	1.61	0.05	23.3	AlII(1670)	1.6721
123	4467.87	0.11	0.20	0.03	24.4	+SiIV(1393)	2.2033
124	4489.20	0.09	0.46	0.04	25.8	AlII(1670)	1.6740
125	4496.47	0.11	0.34	0.04	24.5	CIV(1548)	1.8996
126	4709.95	0.07	0.22	0.02	24.6	CIV(1550)	1.8996
127	4717.80	0.08	0.23	0.03	23.3	CIV(1548)	2.0422
128	4928.36	0.15	0.30	0.03	50.2	CIV(1550)	2.0422
129	4950.79	0.15	0.30	0.03	50.2	AlIII(1854)	1.6572
130	4958.26	0.14	1.54	0.04	52.0	AlIII(1862)	1.6577
131	4967.26	0.16	0.61	0.04	51.0	CIV(1548)	2.2026
132	4978.21	0.16	0.18	0.03	49.5	CIV(1550)	2.2031
133	5436.61	0.22	0.27	0.05	50.4	AlIII(1862)	1.6724
134	5459.22	0.16	0.22	0.05	29.2		
135	5462.37	0.12	0.76	0.06	28.3		
136	5543.57	0.13	1.17	0.09	20.2	FeII(2344)	1.3648
137	5614.09	0.27	0.58	0.09	21.2		
138	5635.18	0.16	2.33	0.12	20.8	FeII(2382)	1.3650
Q0329-255							
1	4815.04	0.16	0.79	0.05	35.5	SiIV(1393)	2.4547
2	4846.47	0.20	0.38	0.04	37.2	SiIV(1402)	2.4549
3	5349.12	0.17	1.11	0.06	32.9	CIV(1548)	2.4551
4	5357.80	0.18	0.49	0.05	32.9	CIV(1550)	2.4549
5	5742.08	0.25	0.40	0.07	25.2		
Q0348+061							
1	3913.82	0.16	0.60	0.08	16.8	MgII(2796)	0.3996
2	3924.73	0.22	0.76	0.10	16.8	MgII(2803)	0.3999
3	3960.37	0.18	0.82	0.09	17.8	CII(1334)	1.9676
4	3986.23	0.16	0.57	0.08	17.1		
5	4077.10	0.16	0.55	0.08	18.0		
6	4125.46	0.17	0.35	0.07	17.8		
7	4132.85	0.22	0.36	0.08	17.3		
8	4137.40	0.23	1.10	0.12	17.3	SiIV(1393)	1.9685
9	4215.04	0.17	1.12	0.09	20.5	SiIV(1393)	2.0242
10	4226.59	0.20	0.82	0.09	20.9	SiIV(1393)	2.0325
11	4241.82	0.18	1.10	0.09	22.5	SiIV(1402)	2.0239
12	4331.04	0.15	1.43	0.09	21.9	CIV(1548)	1.7975
13	4338.46	0.15	1.27	0.09	20.7	CIV(1550)	1.7976
14	4398.34	0.14	1.11	0.09	17.2	CIV(1548)	1.8409
15	4400.50	0.16	0.74	0.09	16.9		
16	4405.72	0.21	1.02	0.12	17.0	CIV(1550)	1.8410
17	4592.63	0.21	0.50	0.08	22.1	CIV(1548)?	1.9664
18	4595.40	0.14	1.46	0.09	22.1	CIV(1548)	1.9682
19	4602.69	0.17	0.98	0.09	21.4	CIV(1550)	1.9680
20	4681.25	0.13	2.49	0.09	22.8	CIV(1548)	2.0237

TABLE 3—Continued

No.	λ_{obs}	$\sigma(\lambda)$	W_{obs}	$\sigma(W)$	S/N	ID	z_{abs}
Q0348+061							
21	4689.11	0.15	2.15	0.10	22.3	CIV(1550)	2.0237
22	4695.93	0.16	1.72	0.10	22.9	CIV(1548)	2.0332
23	4703.04	0.16	1.15	0.09	22.4	CIV(1550)	2.0327
Q0424-131							
1	3537.54	0.08	0.52	0.04	14.9		
2	3543.09	0.09	0.24	0.04	14.6		
3	3562.06	0.08	2.65	0.07	15.6		
4	3570.25	0.08	0.37	0.04	17.0	SiIV(1393)	1.5616
5	3580.98	0.08	3.33	0.07	16.4		
6	3584.92	0.08	0.71	0.04	17.0		
7	3594.18	0.08	1.51	0.06	15.9		
8	3611.52	0.08	0.51	0.04	17.6		
9	3612.91	0.07	0.58	0.04	17.8		
10	3614.32	0.08	0.39	0.04	17.9		
11	3620.84	0.08	1.34	0.06	17.7		
12	3624.38	0.08	0.69	0.04	18.3	CII(1334)	1.7158
13	3632.88	0.10	0.38	0.05	16.7		
14	3641.17	0.08	0.55	0.05	16.9		
15	3646.66	0.08	0.58	0.04	17.5		
16	3652.50	0.08	0.91	0.05	18.3		
17	3655.25	0.08	0.33	0.03	18.8		
18	3660.88	0.08	1.72	0.05	19.5	SiIII(1206)	2.0343
19	3672.58	0.11	0.35	0.05	17.9		
20	3678.35	0.08	0.98	0.05	17.6		
21	3680.32	0.09	0.50	0.04	18.2		
22	3687.49	0.07	2.23	0.05	18.9		
23	3690.05	0.07	2.52	0.05	19.8		
24	3696.98	0.07	1.44	0.04	22.0		
25	3708.40	0.08	0.29	0.03	23.2		
26	3716.73	0.08	0.59	0.03	22.8		
27	3729.57	0.09	0.61	0.04	22.8		
28	3735.87	0.08	0.27	0.03	23.6		
29	3738.33	0.08	0.40	0.03	25.0		
30	3740.75	0.09	0.45	0.03	25.6		
31	3748.39	0.07	0.70	0.03	25.2		
32	3749.79	0.07	0.58	0.03	25.8		
33	3763.24	0.10	0.43	0.04	23.4		
34	3766.98	0.07	1.23	0.03	23.7		
35	3768.91	0.07	1.28	0.03	24.1		
36	3773.03	0.11	0.33	0.04	25.0		
37	3776.45	0.08	1.14	0.04	23.9		
38	3783.80	0.07	0.93	0.03	27.7	SiIV(1393)	1.7160
39	3785.45	0.07	0.52	0.03	27.5		
40	3796.61	0.07	1.30	0.03	27.7		
41	3806.33	0.08	0.63	0.03	28.5		
42	3809.27	0.07	3.09	0.05	26.5	SiIV(1402) +HI(1215)	1.7155 2.1335
43	3817.77	0.07	0.88	0.03	29.8		
44	3820.50	0.08	0.99	0.03	29.3		
Q0424-131							
45	3823.73	0.07	0.92	0.03	31.6		
46	3825.31	0.07	0.84	0.02	32.1	SiII(1260)	2.0349
47	3836.27	0.08	0.36	0.02	33.8		
48	3841.12	0.07	1.44	0.02	36.9		
49	3845.37	0.07	1.75	0.02	35.5		
50	3847.96	0.07	1.85	0.03	36.1		
51	3857.33	0.07	1.06	0.02	39.2	HI(1215)	2.1730
52	3859.54	0.07	0.50	0.02	38.9		
53	3881.96	0.08	1.78	0.04	40.0	NV(1238)	2.1336
54	3894.04	0.08	1.89	0.04	42.4	NV(1242)	2.1333
55	3906.83	0.08	0.35	0.02	40.0		
56	3934.65	0.13	0.19	0.03	25.8	CaII(3934)	0.0000
57	3950.90	0.07	0.27	0.02	26.8	CIV(1548)	1.5519
58	3952.14	0.08	0.51	0.03	28.2	CIV(1548)	1.5527
59	3957.50	0.10	0.16	0.03	26.2	CIV(1550)	1.5520
60	3958.67	0.08	0.29	0.03	26.7	CIV(1550)	1.5527
61	3965.84	0.08	2.69	0.06	24.9	CIV(1548)	1.5616
62	3972.12	0.08	2.47	0.06	24.8	CIV(1550)	1.5614
63	4023.63	0.10	0.22	0.03	21.2		
64	4049.75	0.07	1.89	0.03	33.5	CII(1334)	2.0346
65	4205.06	0.15	0.94	0.06	27.7	CIV(1548)	1.7161
66	4212.10	0.20	0.47	0.06	26.6	CIV(1550)	1.7161
67	4229.40	0.21	0.38	0.06	25.6	SiIV(1393)	2.0345
68	4317.41	0.14	0.68	0.06	21.7	CIV(1548)	1.7887
69	4320.61	0.16	0.63	0.06	21.6		
70	4324.37	0.21	0.37	0.07	21.2	CIV(1550)	1.7885
71	4537.22	0.16	0.84	0.06	32.1	AlII(1670)	1.7156
72	4633.03	0.15	0.92	0.06	29.4	SiII(1526)	2.0346
73	4769.82	0.14	1.63	0.07	28.5	FeII(2344)	1.0347
74	4831.34	0.18	0.68	0.07	27.6	FeII(2374)	1.0347
75	4849.37	0.13	4.15	0.08	30.4	FeII(2382) +CIV(1548)	1.0352 2.1323
76	4858.90	0.14	0.74	0.05	30.6	CIV(1550)	2.1332
77	4912.39	0.14	0.39	0.04	33.0	CIV(1548)	2.1730
78	4920.95	0.16	0.38	0.04	32.3	CIV(1550)	2.1732
79	4966.28	0.25	0.29	0.06	27.7		
80	5071.24	0.17	1.21	0.08	24.5	AlII(1670)	2.0352
Q0440-168							
1	4765.88	0.16	1.65	0.07	26.7	FeII(2374)	1.0071
2	4782.62	0.15	2.92	0.08	29.1	FeII(2382)	1.0072
3	4970.89	0.16	0.90	0.06	28.6		
4	4976.36	0.17	0.95	0.06	29.1	CIV(1548)	2.2143
5	4980.14	0.19	0.32	0.05	27.8		
6	4984.25	0.19	0.56	0.06	27.3	CIV(1550)	2.2140
7	4999.31	0.16	0.99	0.06	27.6	CIV(1548)	2.2291
8	5007.21	0.16	0.50	0.05	27.4	CIV(1550)	2.2288
9	5074.39	0.24	0.24	0.05	33.7		
10	5190.35	0.15	1.50	0.06	26.4	FeII(2586)	1.0066

TABLE 3—Continued

No.	λ_{obs}	$\sigma(\lambda)$	W_{obs}	$\sigma(W)$	S/N	ID	z_{abs}
Q0440-168							
11	5193.39	0.17	0.97	0.07	25.3	FeII(2586) +FeII(1608)	1.0078 2.2288
12	5205.81	0.17	0.32	0.05	24.8	FeII(2600)	1.0066
13	5217.48	0.15	2.30	0.07	26.0	FeII(2600)	1.0076
14	5219.98	0.15	1.48	0.06	25.4	FeII(2796)	1.0077
15	5611.52	0.15	2.16	0.10	17.0	MgII(2803)	1.0068
16	5614.17	0.15	2.14	0.10	17.3	MgII(2803)	1.0076
17	5626.11	0.15	2.50	0.10	17.6	MgII(2803)	1.0076
18	5628.42	0.15	1.77	0.09	17.1	MgI(2582)	1.0078
19	5724.81	0.21	0.54	0.07	24.1	MgI(2582)	1.0066
20	5728.11	0.23	0.33	0.07	24.5	MgI(2582)	1.0078
21	5869.35	0.20	0.70	0.11	15.4		
Q0449-135							
37	5650.07	0.21	5.81	0.28	11.8	SiIV(1393)	3.0538
38	5663.69	0.26	0.81	0.12	17.5		
39	5673.73	0.16	1.17	0.11	17.9	SiIV(1402)	3.0537
40	5686.45	0.17	4.98	0.18	17.7		
41	5697.56	0.14	0.54	0.08	17.9		
42	5700.00	0.13	0.36	0.06	18.0		
43	5767.20	0.13	1.51	0.10	18.2		
44	5770.97	0.18	0.80	0.10	18.3		
45	5843.43	0.35	1.02	0.18	12.7		
Q0450-132							
1	4092.77	0.14	2.72	0.07	30.7	CII(1334)	2.0668
2	4145.91	0.22	0.61	0.07	27.1	CII(1334)	2.1066
3	4177.80	0.18	1.69	0.09	27.5	MgII(2796)	0.4940
4	4188.49	0.15	1.08	0.06	27.4	MgII(2803)	0.4940
5	4274.40	0.14	2.07	0.07	30.7	SiIV(1393)	2.0668
6	4302.23	0.15	1.65	0.07	29.5	SiIV(1402)	2.0670
7	4328.87	0.15	1.39	0.07	28.6	SiIV(1393)	2.1059
8	4340.04	0.17	0.54	0.06	28.2		
9	4356.81	0.16	0.64	0.05	29.2	SiIV(1402)	2.1059
10	4365.17	0.23	0.31	0.06	28.8		
11	4502.55	0.16	0.69	0.05	37.8	SiIV(1393)	2.2305
12	4531.10	0.16	0.39	0.04	35.7	SiIV(1402)	2.2301
13	4650.28	0.16	0.32	0.05	28.7		
14	4681.87	0.14	1.77	0.07	25.3	SiII(1526)	2.0666
15	4748.18	0.14	3.27	0.09	23.1	CIV(1548)	2.0669
16	4755.98	0.15	2.51	0.09	23.3	CIV(1550)	2.0668
17	4809.23	0.14	2.56	0.08	25.5	CIV(1548)	2.1063
18	4817.24	0.16	2.33	0.10	25.4	CIV(1550)	2.1063
19	4932.52	0.16	0.67	0.06	30.9	FeII(1608) +SiII(1526)	2.0666 2.2308
20	5002.98	0.14	3.68	0.07	32.8	CIV(1548)	2.2315
21	5011.00	0.14	3.09	0.08	33.1	CIV(1550)	2.2313
22	5097.65	0.15	1.85	0.08	27.9	FeII(2344)	1.1746
23	5123.84	0.15	2.12	0.09	25.4	AlII(1670)	2.0667
24	5163.10	0.17	1.24	0.09	23.0	FeII(2374)	1.1744
25	5181.46	0.16	2.27	0.10	23.1	FeII(2382)	1.1746
Q0528-250							
1	4766.42	0.19	0.49	0.07	24.3		
2	4779.53	0.14	1.43	0.08	24.6		
3	4795.77	0.11	1.77	0.07	24.8	SiII(1526) +SiII(1260)	2.1412 2.8049
4	4802.24	0.11	4.49	0.09	23.4	SiII(1260)	2.8100
5	4807.10	0.11	4.42	0.09	23.1	SiII(1260)	2.8139
6	4827.32	0.21	0.34	0.06	23.9		
7	4862.41	0.11	1.84	0.07	25.0	CIV(1548)	2.1407

TABLE 3—Continued

No.	λ_{obs}	$\sigma(\lambda)$	W_{obs}	$\sigma(W)$	S/N	ID	z_{abs}
Q0528-250							
8	4870.75	0.12	1.54	0.07	26.8	CIV(1550)	2.1409
9	4932.10	0.19	0.84	0.08	23.7	SiIV(1393)	2.5387
10	4962.91	0.10	3.67	0.07	25.5	CIV(1548)	2.2056
11	4966.82	0.10	3.62	0.07	26.7	CIV(1548)	2.2081
12	4971.55	0.10	3.01	0.06	26.5	CIV(1550)	2.2059
13	4974.87	0.10	2.64	0.06	26.6	CIV(1550)	2.2080
14	5020.59	0.15	0.41	0.06	24.8		
15	5052.48	0.12	1.02	0.06	29.2	FeII(1608)	2.1412
16	5085.45	0.11	4.66	0.08	28.0	CII(1334)	2.8107
17	5090.98	0.11	5.01	0.09	26.6	CII(1334)	2.8148
18	5105.45	0.20	0.34	0.06	27.1		
19	5120.07	0.14	0.44	0.05	26.9	SiIV(1393)	2.6736
20	5221.87	0.25	0.68	0.08	26.9		
21	5247.75	0.11	2.00	0.07	28.1	AlII(1670)	2.1409
22	5311.48	0.12	3.26	0.09	27.0	SiIV(1393)	2.8109
23	5316.28	0.18	0.58	0.07	26.7	SiIV(1393)	2.8144
24	5345.86	0.12	2.38	0.08	29.6	SiIV(1402)	2.8109
25	5350.93	0.13	0.56	0.05	29.3	SiIV(1402)	2.8145
26	5436.50	0.18	0.86	0.08	24.0	MgII(2796)	0.9441
27	5450.31	0.17	0.45	0.07	22.6	MgII(2803)	0.9441
28	5477.82	0.13	0.88	0.07	23.9	CIV(1548)	2.5382
29	5486.97	0.19	0.67	0.08	22.5	CIV(1550)	2.5382
30	5687.50	0.19	0.47	0.08	19.5	CIV(1548)	2.6736
31	5696.91	0.13	0.31	0.06	19.1	CIV(1550)	2.6736
32	5818.53	0.14	4.49	0.19	13.9	SiII(1526)	2.8111
33	5823.23	0.12	3.48	0.15	14.0	SiII(1526)	2.8142
34	5890.78	0.17	1.40	0.16	11.9	CIV(1548)	2.8049
35	5901.80	0.12	3.89	0.18	11.5	CIV(1550)	2.8057
36	5910.36	0.19	3.87	0.24	11.5	AlII(1670)	2.8120
						+CIV(1550)	2.8112
Q0831+128							
1	4775.37	0.12	2.87	0.09	22.1	CIV(1548)	2.0845
2	4783.07	0.13	2.65	0.10	20.9	CIV(1550)	2.0843
3	5092.30	0.22	0.60	0.08	23.7		
4	5153.23	0.19	0.42	0.06	25.0	AlII(1670)	2.0843
5	5380.74	0.20	0.33	0.06	23.6		
6	5643.44	0.17	0.67	0.12	11.1		
7	5686.34	0.14	0.60	0.07	19.7		
8	5703.23	0.17	0.40	0.07	19.2		
9	5774.54	0.21	0.38	0.07	22.4		
10	5779.85	0.15	1.23	0.09	22.3		
Q0837+109							
1	4852.50	0.07	1.16	0.06	14.5		
2	4855.93	0.08	0.86	0.06	14.4		

Q0837+109

No.	λ_{obs}	$\sigma(\lambda)$	W_{obs}	$\sigma(W)$	S/N	ID	z_{abs}
3	4859.95	0.07	0.30	0.04	16.0		
4	4861.15	0.07	0.61	0.05	16.1		
5	4867.96	0.07	0.28	0.04	15.8		
6	4869.31	0.08	0.50	0.05	15.1		
7	4880.00	0.08	0.59	0.05	15.1		
8	4883.94	0.07	1.87	0.07	15.1		
9	4886.51	0.06	1.86	0.06	14.7		
10	4888.99	0.07	2.60	0.07	14.8		
11	4892.40	0.08	0.63	0.05	15.3		
12	4897.20	0.06	1.11	0.05	15.3		
13	4898.49	0.06	1.05	0.04	15.3		
14	4900.39	0.07	2.29	0.06	15.0		
15	4906.34	0.06	2.28	0.06	15.9		
16	4919.78	0.07	0.29	0.04	15.5		
17	4920.92	0.07	0.37	0.04	15.4		
18	4922.29	0.08	0.37	0.04	15.5		
19	4932.20	0.07	1.19	0.06	15.8		
20	4934.79	0.07	2.24	0.06	15.9		
21	4941.69	0.06	1.65	0.05	17.2		
22	4960.43	0.07	0.91	0.05	17.5		
23	4962.46	0.07	1.07	0.05	16.9		
24	4966.10	0.07	3.73	0.08	16.2		
25	4971.32	0.07	0.60	0.04	15.6		
26	4973.71	0.07	1.98	0.07	15.3		
27	4977.75	0.08	0.82	0.06	15.0		
28	4980.56	0.07	0.42	0.04	15.6		
29	4982.66	0.07	0.64	0.05	16.1		
30	4984.76	0.10	0.42	0.05	15.8		
31	4987.14	0.07	0.71	0.04	16.4		
32	4998.78	0.06	0.82	0.04	16.1		
33	5000.03	0.07	0.55	0.04	16.0		
34	5008.82	0.07	1.97	0.06	15.1		
35	5016.55	0.08	0.56	0.05	15.5		
36	5018.09	0.07	0.88	0.04	16.1		
37	5024.28	0.08	0.39	0.04	16.8		
38	5027.04	0.07	1.88	0.06	16.4		
39	5029.36	0.07	0.40	0.04	17.0		
40	5031.38	0.06	1.61	0.05	17.6		
41	5035.48	0.06	2.63	0.05	17.8	HI(1215)	3.1421
42	5038.40	0.06	3.01	0.06	17.9	HI(1215)	3.1445
43	5042.58	0.06	1.87	0.05	17.7		
44	5044.76	0.07	0.83	0.04	17.7		
45	5048.87	0.07	0.50	0.04	17.7		
46	5050.42	0.07	0.92	0.04	17.5		
47	5054.52	0.07	1.11	0.05	17.3		
48	5057.58	0.07	0.72	0.04	17.0		
49	5060.03	0.06	1.33	0.04	17.1		
50	5061.76	0.07	1.38	0.05	17.2		
51	5065.08	0.07	0.81	0.05	17.5		
52	5068.13	0.07	2.26	0.06	18.1		
53	5071.37	0.06	2.02	0.05	17.8		
54	5081.80	0.07	2.55	0.06	18.7		
55	5096.98	0.07	2.01	0.06	18.1		

TABLE 3—Continued

No.	λ_{obs}	$\sigma(\lambda)$	W_{obs}	$\sigma(W)$	S/N	ID	z_{abs}
Q0837+109							
56	5099.47	0.07	0.73	0.04	18.2		
57	5102.14	0.06	2.15	0.05	18.0		
58	5104.59	0.06	1.66	0.04	17.9		
59	5106.53	0.06	1.90	0.05	18.4		
60	5110.09	0.06	1.98	0.05	18.1		
61	5112.47	0.06	2.23	0.05	19.1		
62	5118.29	0.06	1.25	0.04	20.5		
63	5119.72	0.06	1.12	0.04	20.6		
64	5121.89	0.06	0.99	0.04	20.6		
65	5126.60	0.07	1.64	0.05	19.8		
66	5130.43	0.07	0.57	0.04	19.2		
67	5132.66	0.06	0.78	0.04	19.8		
68	5135.59	0.07	2.58	0.06	19.3		
69	5143.04	0.07	5.40	0.08	18.8		
70	5157.65	0.07	0.69	0.04	20.0		
71	5160.93	0.06	0.89	0.04	20.6		
72	5162.97	0.06	1.87	0.04	20.2		
73	5166.20	0.07	0.81	0.04	20.7		
74	5169.94	0.07	2.90	0.06	19.9		
75	5174.27	0.07	0.97	0.05	21.1		
76	5182.01	0.06	1.85	0.04	21.4		
77	5184.84	0.06	1.72	0.05	21.2		
78	5190.08	0.08	0.31	0.03	22.1		
79	5195.54	0.06	2.92	0.05	23.4		
80	5201.61	0.07	0.79	0.04	23.7		
81	5205.06	0.06	2.91	0.05	23.9		
82	5209.66	0.09	0.61	0.04	25.8		
83	5220.93	0.06	0.62	0.03	28.8		
84	5230.33	0.06	2.06	0.04	30.0		
85	5241.78	0.07	1.56	0.03	33.6		
86	5248.42	0.06	1.06	0.03	34.0		
87	5251.65	0.06	0.58	0.02	35.2		
88	5259.75	0.06	3.82	0.04	38.5		
89	5289.43	0.07	0.61	0.03	30.4	CIV(1548)	2.4165
90	5298.22	0.07	0.35	0.02	29.4	CIV(1550)	2.4165
91	5785.85	0.27	0.41	0.07	26.3		
92	5860.62	0.21	0.38	0.07	21.6		
93	6124.38	0.22	0.57	0.09	20.8		
94	6134.62	0.14	0.53	0.06	23.9		
95	6164.66	0.16	0.72	0.07	27.7		
96	6305.70	0.20	0.67	0.12	12.8		
97	6413.96	0.18	1.13	0.10	20.5		
98	6425.38	0.18	0.66	0.08	22.1		
99	6552.89	0.18	0.37	0.06	25.9		
100	6672.44	0.24	0.35	0.05	46.2		
101	6899.86	0.14	0.49	0.04	51.4		
102	8723.67	0.16	0.31	0.05	28.8		
103	8988.41	0.22	0.93	0.11	19.9	MgII(2796)	1.4634
104	8992.28	0.15	1.20	0.10	21.0	MgII(2796)	1.4647
105	8999.90	0.16	0.66	0.08	20.2		
106	8906.26	0.21	0.44	0.08	19.8	MgII(2803)	1.4634
107	8910.59	0.20	0.85	0.10	20.2	MgII(2803)	1.4650
Q0848+163							
1	3360.92	0.08	0.28	0.03	21.7		
2	3369.34	0.08	0.24	0.03	22.9		
3	3386.32	0.07	0.55	0.03	26.8		
4	3396.32	0.07	1.03	0.03	28.7		
5	3399.75	0.08	0.44	0.03	30.0		
6	3422.30	0.08	0.18	0.02	31.1		
7	3424.81	0.06	1.67	0.03	33.4	SiIV(1393)	1.4573
8	3428.98	0.07	0.24	0.02	32.5		
9	3439.27	0.06	1.24	0.03	32.3		
10	3446.17	0.09	0.49	0.03	31.2	SiIV(1402)	1.4567
11	3467.00	0.06	0.69	0.02	33.1		
12	3470.58	0.06	1.16	0.03	34.1		
13	3476.41	0.07	0.58	0.02	32.9		
14	3480.61	0.06	2.42	0.04	32.3		
15	3484.47	0.09	0.31	0.03	32.6		
16	3493.38	0.07	0.43	0.02	35.0		
17	3495.12	0.07	0.20	0.02	33.6		
18	3499.52	0.06	0.68	0.02	35.3		
19	3501.92	0.06	2.49	0.03	34.8		
20	3504.82	0.07	0.32	0.02	32.9		
21	3528.51	0.07	0.24	0.02	40.4		
22	3531.03	0.06	1.37	0.02	46.5		
23	3532.95	0.06	0.72	0.01	47.6		
24	3537.21	0.06	0.33	0.01	48.2		
25	3538.86	0.07	0.35	0.02	49.9		
26	3546.20	0.06	2.03	0.02	53.5	HI(1215)	1.9171
27	3555.67	0.06	10.85	0.05	47.7		
28	3605.68	0.07	0.77	0.02	60.1		
29	3614.16	0.07	2.21	0.02	64.5	MV(1238)	1.9174
30	3624.99	0.06	1.75	0.02	67.0	MV(1242)	1.9168
31	3767.63	0.07	0.18	0.01	60.8	SiII(1526)	1.4678
32	3804.65	0.07	0.20	0.01	56.8	CIV(1548)	1.4575
33	3811.02	0.06	0.17	0.01	56.6	CIV(1550)	1.4575
34	3821.59	0.07	0.19	0.01	57.2	CIV(1548)	1.4684
35	3824.64	0.06	1.74	0.02	60.1	CIV(1548)	1.4704
36	3828.80	0.07	0.19	0.01	57.6	CIV(1550)	1.4690
37	3831.03	0.06	1.26	0.02	58.2	CIV(1550)	1.4704
38	3934.56	0.08	0.15	0.01	57.9	CaII(3934)	-0.0001
39	4435.55	0.13	0.69	0.05	35.6	MgII(2796)	0.5862
40	4447.04	0.15	0.60	0.05	34.1	MgII(2803)	0.5862
41	4458.48	0.19	0.43	0.05	32.5	+MgII(2796)	0.5903
42	4514.41	0.11	0.74	0.04	33.2	MgII(2803)	0.5903
43	4516.99	0.11	1.60	0.06	33.4	CIV(1548)	1.9159
44	4521.63	0.12	0.43	0.04	32.4	CIV(1548)	1.9176
45	4524.46	0.11	0.99	0.05	32.4	CIV(1550)	1.9157
						MgI(2852)	0.5859
						+CIV(1550)	1.9175
Q0848+155							
1	4437.32	0.19	0.57	0.07	24.7		

TABLE 3—Continued

No.	λ_{obs}	$\sigma(\lambda)$	W_{obs}	$\sigma(W)$	S/N	ID	z_{abs}
Q0852+197							
1	3891.60	0.16	0.52	0.05	29.2		
2	3894.44	0.16	0.66	0.06	29.0		
3	3907.14	0.18	0.26	0.04	30.1		
4	3911.13	0.14	0.97	0.05	29.7		
5	3914.35	0.14	1.20	0.05	29.8		
6	3927.80	0.25	0.30	0.06	29.0		
7	3939.25	0.18	0.53	0.06	27.5		
8	3944.47	0.19	0.28	0.05	26.8		
9	3953.98	0.17	0.46	0.06	26.5		
10	3957.42	0.18	0.49	0.06	26.5	MgII(2796)	0.4152
11	3966.98	0.16	0.42	0.05	25.8	MgII(2803)	0.4150
12	3969.73	0.20	0.60	0.07	25.6		
13	4164.06	0.24	0.67	0.10	19.1		
14	4269.39	0.26	0.82	0.11	18.2		
15	4406.92	0.17	0.44	0.07	17.7		
16	4420.39	0.20	0.50	0.09	16.9	SiIV(1393)	2.1716
17	4448.91	0.17	0.41	0.07	18.1	SiIV(1402)	2.1715
18	4475.78	0.22	0.77	0.10	17.9		
19	4551.60	0.16	0.92	0.08	21.4	CIV(1548)	1.9399
20	4555.24	0.16	0.68	0.07	22.1		
21	4559.35	0.17	1.22	0.09	22.2	CIV(1550)	1.9400
22	4863.36	0.25	0.61	0.11	17.1		
23	4869.37	0.35	0.40	0.11	16.8		
24	4910.45	0.16	2.09	0.12	18.2	CIV(1548)	2.1717
25	4917.80	0.19	1.12	0.11	18.6	CIV(1550)	2.1712
Q0854+191							
1	3891.60	0.16	0.52	0.05	29.2		
2	3894.44	0.16	0.66	0.06	29.0		
3	3907.14	0.18	0.26	0.04	30.1		
4	3911.13	0.14	0.97	0.05	29.7		
5	3914.35	0.14	1.20	0.05	29.8		
6	3927.80	0.25	0.30	0.06	29.0		
7	3939.25	0.18	0.53	0.06	27.5		
8	3944.47	0.19	0.28	0.05	26.8		
9	3953.98	0.17	0.46	0.06	26.5		
10	3957.42	0.18	0.49	0.06	26.5	MgII(2796)	0.4152
11	3966.98	0.16	0.42	0.05	25.8	MgII(2803)	0.4150
12	3969.73	0.20	0.60	0.07	25.6		
13	4164.06	0.24	0.67	0.10	19.1		
14	4269.39	0.26	0.82	0.11	18.2		
15	4406.92	0.17	0.44	0.07	17.7		
16	4420.39	0.20	0.50	0.09	16.9	SiIV(1393)	2.1716
17	4448.91	0.17	0.41	0.07	18.1	SiIV(1402)	2.1715
18	4475.78	0.22	0.77	0.10	17.9		
19	4551.60	0.16	0.92	0.08	21.4	CIV(1548)	1.9399
20	4555.24	0.16	0.68	0.07	22.1		
21	4559.35	0.17	1.22	0.09	22.2	CIV(1550)	1.9400
22	4863.36	0.25	0.61	0.11	17.1		
23	4869.37	0.35	0.40	0.11	16.8		
24	4910.45	0.16	2.09	0.12	18.2	CIV(1548)	2.1717
25	4917.80	0.19	1.12	0.11	18.6	CIV(1550)	2.1712
Q0913+072							
1	3879.48	0.15	0.90	0.06	25.6		
2	3885.87	0.12	0.39	0.04	25.8		
3	3888.54	0.14	0.49	0.05	25.2		
4	3896.94	0.11	2.80	0.07	26.3		
5	3904.65	0.17	0.26	0.05	25.4		
6	3908.88	0.15	0.30	0.05	25.7		
7	3918.67	0.16	0.34	0.05	26.6		
8	3921.58	0.17	0.24	0.04	26.6		
9	3942.72	0.12	0.34	0.04	27.8		
10	3962.63	0.16	12.24	0.16	26.4		
11	3998.82	0.11	2.31	0.06	27.2		
12	4004.03	0.11	1.97	0.06	27.6	CII(1334)	2.0003
13	4017.81	0.11	2.06	0.07	26.1		
14	4023.73	0.12	0.72	0.05	25.8		
15	4027.69	0.11	2.48	0.07	26.0		
16	4037.00	0.14	0.74	0.06	25.4		
17	4041.45	0.13	0.64	0.05	25.8		
18	4044.67	0.13	0.79	0.06	24.6		
19	4053.50	0.14	1.00	0.07	24.9		
20	4057.01	0.13	0.84	0.06	24.6		
21	4062.49	0.13	1.19	0.07	24.8		
22	4068.18	0.13	0.46	0.05	24.3		
23	4072.99	0.12	1.47	0.07	24.6		
24	4081.95	0.11	2.01	0.07	24.5		
25	4096.31	0.15	0.45	0.05	25.1		
26	4100.17	0.12	0.86	0.05	26.0		
27	4104.28	0.11	1.26	0.06	25.8		
28	4109.80	0.11	1.96	0.07	25.9		
29	4116.39	0.14	0.52	0.05	25.9		
Q0854+191							
18	3839.30	0.17	0.40	0.05	26.6	AlII(1670)	1.2979
19	3935.93	0.20	0.44	0.06	27.1	+CIV(1550)	1.4757
20	4167.27	0.17	0.74	0.07	25.9	AlII(1670)	1.3557
21	4173.41	0.18	0.57	0.06	27.0	CIV(1548)	1.6917
22	4179.00	0.21	1.10	0.09	25.5	CIV(1550)	1.6912
23	4224.53	0.19	0.44	0.06	24.8	SiII(1526)	1.7372
24	4230.13	0.19	1.46	0.10	24.8	CIV(1548)	1.7323
25	4237.02	0.15	1.67	0.08	25.1	CIV(1550)	1.7322
26	4243.82	0.17	0.71	0.07	25.6	+CIV(1548)	1.7367
27	4259.78	0.21	0.64	0.08	26.1	SiII(1808)	1.3561
28	4400.88	0.16	1.49	0.08	26.4	CIV(1548)	1.8426
29	4407.42	0.21	0.67	0.08	26.3	CIV(1550)	1.8421
30	4419.87	0.19	0.79	0.08	25.8	CIV(1548)	1.8548
31	4427.90	0.21	0.91	0.09	25.3	CIV(1550)	1.8553
32	4523.24	0.17	1.06	0.08	24.7	MGI(1927)	1.4745
33	4573.09	0.18	0.88	0.08	22.8	AlII(1670)	1.7371
						+FeII(1608)	1.8432
Q0854+191							
1	3879.48	0.15	0.90	0.06	25.6		
2	3885.87	0.12	0.39	0.04	25.8		
3	3888.54	0.14	0.49	0.05	25.2		
4	3896.94	0.11	2.80	0.07	26.3		
5	3904.65	0.17	0.26	0.05	25.4		
6	3908.88	0.15	0.30	0.05	25.7		
7	3918.67	0.16	0.34	0.05	26.6		
8	3921.58	0.17	0.24	0.04	26.6		
9	3942.72	0.12	0.34	0.04	27.8		
10	3962.63	0.16	12.24	0.16	26.4		
11	3998.82	0.11	2.31	0.06	27.2		
12	4004.03	0.11	1.97	0.06	27.6	CII(1334)	2.0003
13	4017.81	0.11	2.06	0.07	26.1		
14	4023.73	0.12	0.72	0.05	25.8		
15	4027.69	0.11	2.48	0.07	26.0		
16	4037.00	0.14	0.74	0.06	25.4		
17	4041.45	0.13	0.64	0.05	25.8		
18	4044.67	0.13	0.79	0.06	24.6		
19	4053.50	0.14	1.00	0.07	24.9		
20	4057.01	0.13	0.84	0.06	24.6		
21	4062.49	0.13	1.19	0.07	24.8		
22	4068.18	0.13	0.46	0.05	24.3		
23	4072.99	0.12	1.47	0.07	24.6		
24	4081.95	0.11	2.01	0.07	24.5		
25	4096.31	0.15	0.45	0.05	25.1		
26	4100.17	0.12	0.86	0.05	26.0		
27	4104.28	0.11	1.26	0.06	25.8		
28	4109.80	0.11	1.96	0.07	25.9		
29	4116.39	0.14	0.52	0.05	25.9		
Q0854+191							
1	3879.48	0.15	0.90	0.06	25.6		
2	3885.87	0.12	0.39	0.04	25.8		
3	3888.54	0.14	0.49	0.05	25.2		
4	3896.94	0.11	2.80	0.07	26.3		
5	3904.65	0.17	0.26	0.05	25.4		
6	3908.88	0.15	0.30	0.05	25.7		
7	3918.67	0.16	0.34	0.05	26.6		
8	3921.58	0.17	0.24	0.04	26.6		
9	3942.72	0.12	0.34	0.04	27.8		
10	3962.63	0.16	12.24	0.16	26.4		
11	3998.82	0.11	2.31	0.06	27.2		
12	4004.03	0.11	1.97	0.06	27.6	CII(1334)	2.0003
13	4017.81	0.11	2.06	0.07	26.1		
14	4023.73	0.12	0.72	0.05	25.8		
15	4027.69	0.11	2.48	0.07	26.0		
16	4037.00	0.14	0.74	0.06	25.4		
17	4041.45	0.13	0.64	0.05	25.8		
18	4044.67	0.13	0.79	0.06	24.6		
19	4053.50	0.14	1.00	0.07	24.9		
20	4057.01	0.13	0.84	0.06	24.6		
21	4062.49	0.13	1.19	0.07	24.8		
22	4068.18	0.13	0.46	0.05	24.3		
23	4072.99	0.12	1.47	0.07	24.6		
24	4081.95	0.11	2.01	0.07	24.5		
25	4096.31	0.15	0.45	0.05	25.1		
26	4100.17	0.12	0.86	0.05	26.0		
27	4104.28	0.11	1.26	0.06	25.8		
28	4109.80	0.11	1.96	0.07	25.9		
29	4116.39	0.14	0.52	0.05	25.9		
Q0854+191							
1	3879.48	0.15	0.90	0.06	25.6		
2	3885.87	0.12	0.39	0.04	25.8		
3	3888.54	0.14	0.49	0.05	25.2		
4	3896.94	0.11	2.80	0.07	26.3		
5	3904.65	0.17	0.26	0.05	25.4		
6	3908.88	0.15	0.30	0.05	25.7		
7	3918.67	0.16	0.34	0.05	26.6		
8	3921.58	0.17	0.24	0.04	26.6		
9	3942.72	0.12	0.34	0.04	27.8		
10	3962.63	0.16	12.24	0.16	26.4		

TABLE 3—Continued

No.	λ_{obs}	$\sigma(\lambda)$	W_{obs}	$\sigma(W)$	S/N	ID	z_{abs}
Q0913+072							
30	4122.28	0.10	1.56	0.05	26.9		
31	4127.29	0.10	4.89	0.07	26.7		
32	4132.80	0.11	1.40	0.05	27.0		
33	4135.74	0.11	1.12	0.05	27.1		
34	4138.50	0.10	1.28	0.04	28.1		
35	4140.63	0.10	1.22	0.04	28.1		
36	4144.21	0.11	1.55	0.06	27.4		
37	4152.16	0.11	2.10	0.06	28.2		
38	4156.75	0.11	1.45	0.05	28.6		
39	4165.24	0.10	1.78	0.05	30.5		
40	4168.06	0.11	1.18	0.04	30.5		
41	4172.92	0.10	3.55	0.06	30.0		
42	4177.91	0.11	1.18	0.05	30.0		
43	4183.18	0.11	0.88	0.05	29.7	SiIV(1393)	2.0014
44	4188.25	0.11	1.44	0.05	29.6		
45	4193.71	0.12	1.77	0.07	28.6		
46	4202.95	0.12	3.42	0.08	29.7		
47	4209.64	0.14	0.24	0.04	29.9	SiIV(1402)	2.0010
48	4211.91	0.14	0.60	0.05	29.3		
49	4217.37	0.11	0.63	0.04	28.9		
50	4219.92	0.14	0.64	0.05	28.9		
51	4232.03	0.11	1.11	0.05	29.0		
52	4238.59	0.11	2.28	0.06	29.2		
53	4242.14	0.11	2.69	0.06	28.1	SiIV(1393)	2.0437
54	4246.95	0.11	1.12	0.05	27.7		
55	4249.66	0.11	0.69	0.04	28.3		
56	4251.74	0.12	0.75	0.05	28.3		
57	4255.84	0.12	1.27	0.06	27.5		
58	4262.36	0.12	0.94	0.05	27.9		
59	4267.11	0.11	1.14	0.05	28.0		
60	4270.67	0.11	1.83	0.06	29.8	SiIV(1402) +SiIV(1393)	2.0445 2.0641
61	4282.02	0.11	1.02	0.04	28.7		
62	4284.13	0.11	0.99	0.05	28.4		
63	4289.74	0.10	2.43	0.06	28.7		
64	4292.31	0.10	2.34	0.05	29.5		
65	4295.84	0.10	2.71	0.05	29.2		
66	4298.86	0.10	2.63	0.05	29.7	SiIV(1402)	2.0646
67	4308.24	0.13	0.58	0.05	27.8		
68	4314.43	0.12	1.10	0.06	27.5		
69	4320.13	0.13	0.63	0.05	26.6		
70	4323.39	0.13	0.74	0.06	25.3		
71	4336.60	0.11	6.01	0.10	26.6		
72	4343.68	0.12	0.62	0.05	27.6		
73	4346.52	0.12	0.85	0.05	28.3		
74	4350.69	0.12	1.15	0.06	28.5		
75	4360.66	0.13	0.46	0.04	31.1		
76	4364.35	0.12	0.49	0.04	28.0		
77	4368.04	0.11	2.52	0.06	27.1		
78	4371.80	0.11	1.65	0.06	26.7		
79	4376.25	0.12	1.45	0.06	26.9		
80	4384.80	0.11	1.65	0.06	31.0		
81	4400.73	0.11	22.81	0.15	27.3		
82	4417.03	0.12	0.98	0.05	30.2		
Q0958+551							
1	3471.01	0.21	0.68	0.09	20.2	MgII(2796)	0.2413
2	3480.24	0.36	0.47	0.09	21.2	MgII(2803)	0.2414
3	3518.06	0.14	1.01	0.06	23.0	CIV(1548)	1.2724
4	3524.62	0.15	1.32	0.08	23.0	CIV(1550) +CIV(1548)	1.2728 1.2766
5	3527.90	0.16	0.70	0.07	22.8	CIV(1548)	1.2787
6	3531.50	0.16	0.85	0.07	22.9	CIV(1550)	1.2772
7	3545.99	0.24	0.39	0.07	23.2		
8	3599.04	0.18	0.45	0.06	27.2	SiIII(1526)	1.3574
9	3638.42	0.18	0.44	0.05	28.0		
10	3642.04	0.15	0.86	0.06	28.6		

TABLE 3—Continued

No.	λ_{obs}	$\sigma(\lambda)$	W_{obs}	$\sigma(W)$	S/N	ID	z_{abs}
Q0958+551							
11	3647.59	0.18	1.54	0.08	27.3	CIV(1548)	1.3560
12	3655.17	0.20	0.25	0.05	27.8	+CII(1334)	1.7332
13	3680.18	0.25	0.33	0.06	29.5	CIV(1550)	1.3570
14	3686.41	0.19	0.36	0.05	30.2	CIV(1548)	1.3771
15	3712.05	0.16	0.48	0.05	32.2	CIV(1550)	1.3771
16	3725.69	0.17	0.32	0.04	31.9		
17	3744.88	0.21	0.72	0.07	31.6		
18	3808.07	0.16	1.39	0.06	39.1	SiIV(1393)	1.7322
19	3832.86	0.19	0.71	0.05	40.8	SiIV(1402)	1.7324
20	3843.71	0.15	0.35	0.03	41.6		
21	3854.34	0.24	0.51	0.05	39.9		
22	3882.59	0.21	0.33	0.04	41.8		
23	4218.93	0.17	0.63	0.05	37.1		
24	4228.13	0.15	1.34	0.05	38.7	CIV(1548)	1.7310
25	4231.34	0.14	1.41	0.04	39.6	CIV(1548)	1.7331
26	4235.02	0.14	0.79	0.04	38.0	CIV(1550)	1.7309
27	4237.87	0.14	1.09	0.05	38.3	CIV(1550)	1.7327
28	4380.86	0.21	0.42	0.06	32.0		
Q1017+280							
31	3531.83	0.08	0.18	0.02	50.7		
32	3539.23	0.08	0.19	0.02	51.4		
33	3541.36	0.07	0.20	0.01	54.9		
34	3546.09	0.09	0.19	0.02	61.8		
35	3635.00	0.05	0.55	0.01	125.6	SiIV(1393)	1.6081
36	3658.39	0.06	0.39	0.01	113.6	SiIV(1402)	1.6080
37	3900.41	0.12	0.22	0.01	104.1	SiIV(1393)	1.7985
38	3927.27	0.13	0.35	0.02	103.5	CIV(1548)	1.5367
39	3934.49	0.10	0.45	0.01	105.7	+CII(3934)	-0.0001
40	3969.43	0.15	0.21	0.02	92.7	+CIV(1550)	1.5371
41	4017.68	0.11	0.37	0.02	80.1	CaII(3969)	0.0000
42	4024.42	0.13	0.28	0.02	79.1	CIV(1550)	1.5951
43	4037.87	0.10	0.96	0.02	89.8	CIV(1548)	1.5951
44	4044.46	0.11	0.63	0.02	86.6	CIV(1550)	1.6080
45	4283.47	0.11	0.16	0.01	74.1	CIV(1548)	1.7667
46	4290.55	0.17	0.09	0.02	72.5	CIV(1550)	1.7667
47	4332.56	0.10	1.18	0.02	78.5	CIV(1548)	1.7984
48	4339.80	0.11	0.83	0.02	76.1	CIV(1550)	1.7985
49	4388.19	0.13	0.28	0.02	75.3	CIV(1548)	1.8344
50	4395.26	0.13	0.14	0.02	78.1	CIV(1550)	1.8342
Q1054-034							
1	3757.51	0.14	3.23	0.09	25.3		
2	3766.60	0.20	0.49	0.07	23.6		
3	3774.53	0.18	0.46	0.06	24.3		
Q1138+040							
1	3769.37	0.17	0.59	0.06	22.9		
2	4000.59	0.15	0.89	0.05	35.7	CIV(1548)	1.5840
3	4006.84	0.17	0.85	0.06	34.1	CIV(1550)	1.5838
Q1148-001							
1	3819.24	0.16	2.06	0.09	22.5	CIV(1548)	1.4669
2	3825.78	0.16	1.50	0.08	22.7	CIV(1550)	1.4670
3	4279.88	0.29	0.84	0.08	35.0		
4	4291.80	0.25	0.41	0.06	34.6		
5	4623.01	0.18	0.80	0.06	31.8	CIV(1548)	1.9861
6	4630.94	0.17	0.53	0.05	31.4	CIV(1550)	1.9862

TABLE 3—Continued

No.	λ_{obs}	$\sigma(\lambda)$	W_{obs}	$\sigma(W)$	S/N	ID	z_{abs}
Q1159+124							
1	4613.92	0.14	2.88	0.09	23.7		
2	4622.88	0.13	2.27	0.07	23.0		
3	4635.72	0.15	0.56	0.06	22.2	HI(1025)	3.5254
4	4641.79	0.13	5.38	0.11	21.1		
5	4650.32	0.14	2.54	0.09	21.9		
6	4663.05	0.14	0.88	0.07	21.2		
7	4670.81	0.13	3.23	0.09	21.0	OVI(1031)	3.5262
8	4674.47	0.13	1.16	0.06	22.2		
9	4678.73	0.13	1.56	0.07	21.9		
10	4688.90	0.16	0.67	0.07	21.4		
11	4697.00	0.13	2.51	0.08	21.8	OVI(1037)	3.5267
12	4700.87	0.13	1.83	0.07	20.8		
13	4709.83	0.17	1.09	0.09	20.0		
14	4714.06	0.14	0.75	0.06	20.1		
15	4717.25	0.14	1.04	0.07	19.7		
16	4722.57	0.13	3.85	0.10	20.6		
17	4734.28	0.17	0.77	0.08	19.3		
18	4740.77	0.13	2.28	0.09	20.5		
19	4746.23	0.13	2.48	0.09	21.1		
20	4765.08	0.13	3.10	0.08	21.4		
21	4769.99	0.13	2.48	0.08	21.6		
22	4775.68	0.15	0.62	0.06	21.4		
23	4784.48	0.15	1.34	0.08	20.9		
24	4788.48	0.13	1.99	0.07	22.4		
25	4793.86	0.14	1.97	0.08	22.1		
26	4809.83	0.20	0.33	0.06	21.6		
27	4819.81	0.17	0.58	0.07	21.3	FeII(1608)	1.9965
28	4823.25	0.14	0.89	0.07	21.3		
29	4835.07	0.14	0.97	0.07	21.7		
30	4837.56	0.14	0.73	0.06	21.9		
31	4849.66	0.14	2.60	0.10	20.3		
32	4858.54	0.14	2.19	0.09	20.7		
33	4877.18	0.25	0.59	0.09	18.1		
34	4893.26	0.13	1.32	0.08	17.3		
35	4909.78	0.13	2.58	0.10	16.5		
36	4921.64	0.14	1.47	0.09	16.7		
37	4925.65	0.14	2.08	0.11	16.3		
38	4930.11	0.14	1.29	0.09	16.6		
39	4935.87	0.20	0.45	0.09	16.0		
40	4945.65	0.13	1.85	0.09	16.4		
41	4948.63	0.13	1.45	0.09	16.0		
42	4955.37	0.14	2.82	0.12	16.1		
43	4966.33	0.15	1.86	0.11	16.0		
44	4970.01	0.17	0.62	0.09	15.6		
45	4975.73	0.14	3.64	0.13	16.2		
46	4980.55	0.15	1.49	0.10	16.5		
47	4985.73	0.15	1.40	0.10	17.1		
48	4992.18	0.13	5.94	0.12	17.6		
49	4997.12	0.13	1.42	0.07	18.5		
50	5001.78	0.16	1.58	0.10	18.4		
51	5008.69	0.15	3.78	0.12	18.7	AlII(1670)	1.9978
52	5029.91	0.14	2.02	0.09	18.7		
53	5064.29	0.13	3.68	0.11	17.5		
54	5073.51	0.15	0.54	0.07	17.6		
Q1159+124							
55	5076.48	0.13	1.75	0.09	17.7		
56	5080.22	0.13	2.10	0.08	17.2		
57	5083.20	0.13	2.06	0.10	17.3		
58	5090.40	0.16	0.75	0.08	17.2		
59	5096.08	0.15	2.34	0.11	17.7		
60	5104.45	0.23	0.95	0.11	16.9		
61	5113.62	0.14	4.22	0.13	16.5		
62	5119.29	0.15	0.81	0.09	16.4		
63	5128.64	0.15	2.33	0.12	15.8		
64	5136.71	0.14	3.62	0.14	15.5	HI(1215)	3.2254
65	5149.73	0.18	0.77	0.10	16.1		
66	5153.10	0.17	1.17	0.11	16.0		
67	5159.42	0.16	0.80	0.09	15.8		
68	5171.02	0.15	0.97	0.10	15.0		
69	5174.68	0.13	3.12	0.11	14.8	FeII(1143)	3.5263
70	5180.38	0.13	4.91	0.14	15.2	HI(1215)	3.2613
71	5185.29	0.13	1.42	0.10	15.1		
72	5188.87	0.15	1.35	0.11	14.8		
73	5193.37	0.16	1.34	0.11	14.9		
74	5211.32	0.13	3.48	0.12	14.2		
75	5215.28	0.13	1.92	0.10	14.4		
76	5218.42	0.13	1.84	0.10	14.7		
77	5221.83	0.13	2.08	0.10	14.5	CaII(3934)	0.3271
78	5225.55	0.13	3.73	0.13	14.4		
79	5229.44	0.16	1.23	0.11	14.4		
80	5234.08	0.14	2.01	0.12	14.4		
81	5247.63	0.14	2.19	0.12	14.3		
82	5253.68	0.14	3.38	0.14	14.4		
83	5267.92	0.15	1.48	0.11	14.8		
84	5272.02	0.15	1.34	0.11	14.7		
85	5278.43	0.15	3.65	0.15	14.1		
86	5289.67	0.16	2.15	0.13	15.3		
87	5296.69	0.13	3.09	0.11	15.3		
88	5300.07	0.13	2.00	0.09	16.2		
89	5309.41	0.13	2.51	0.11	16.1		
90	5317.45	0.24	0.58	0.10	15.6		
91	5322.47	0.13	3.10	0.12	15.4		
92	5329.36	0.14	4.10	0.14	15.3		
93	5339.51	0.14	5.17	0.16	15.4		
94	5344.66	0.13	1.50	0.08	15.9		
95	5347.30	0.14	1.27	0.09	15.9		
96	5354.84	0.13	5.07	0.13	15.6		
97	5359.40	0.14	1.34	0.09	16.3		
98	5368.26	0.20	1.62	0.14	15.5		
99	5375.40	0.16	1.45	0.11	16.2		
100	5381.76	0.13	4.17	0.11	16.8		
101	5386.79	0.13	2.70	0.10	17.3		
102	5395.11	0.14	3.00	0.12	17.0		
103	5404.51	0.15	2.62	0.12	17.8		
104	5415.90	0.13	1.54	0.08	18.4		
105	5418.61	0.13	1.13	0.07	18.6	SiII(1808)	1.9970
106	5429.66	0.13	2.00	0.09	18.9		
107	5432.96	0.14	1.53	0.09	18.0		
108	5442.38	0.13	3.12	0.10	18.7		

TABLE 3—Continued

No.	λ_{obs}	$\sigma(\lambda)$	W_{obs}	$\sigma(W)$	S/N	ID	z_{abs}
Q1159+124							
109	5457.07	0.14	1.71	0.09	21.0		
110	5461.11	0.13	2.16	0.08	21.9	SiIII(1206)	3.5264
111	5464.99	0.16	0.67	0.07	22.1		
112	5476.21	0.14	1.32	0.07	24.8		
113	5486.12	0.14	1.38	0.07	25.7		
114	5493.64	0.12	1.70	0.06	26.3		
115	5496.25	0.13	1.19	0.06	26.9		
116	5502.40	0.12	5.90	0.08	28.2	HI(1215)	3.5262
117	5607.57	0.17	0.88	0.07	28.9	NI(1238)	3.5265
118	5625.37	0.24	0.59	0.08	25.6	NI(1242)	3.5264
119	5664.66	0.21	0.47	0.07	25.1		
120	6225.12	0.14	0.38	0.03	53.7	FeII(2586)	1.4066
121	6244.14	0.20	0.28	0.04	45.9		
122	6257.53	0.23	0.23	0.04	44.9	FeII(2600)	1.4066
123	6308.53	0.10	1.63	0.04	49.7	SiIV(1393)	3.5263
124	6317.82	0.15	0.25	0.03	47.1		
125	6349.33	0.10	1.30	0.04	50.4	SiIV(1402)	3.5263
126	6449.92	0.19	0.65	0.05	47.3	SiII(1526)	3.2247
127	6542.43	0.19	0.50	0.05	42.9	CIV(1548)	3.2258
128	6552.15	0.24	0.51	0.06	36.3	CIV(1550)	3.2251
129	6597.29	0.11	0.58	0.04	51.0	CIV(1548)	3.2613
130	6608.82	0.19	0.33	0.05	36.1	CIV(1550)	3.2616
131	6614.84	0.27	0.27	0.05	35.9		
132	6633.26	0.12	1.32	0.04	43.3		
133	7007.29	0.11	4.05	0.07	42.1	CIV(1548)	3.5261
134	7018.92	0.10	3.52	0.06	42.1	CIV(1550)	3.5261
135	7024.98	0.12	1.67	0.06	39.6	FeII(2344)	1.9967
136	7115.30	0.17	0.62	0.05	47.4	FeII(2374)	1.9975
137	7138.84	0.11	1.42	0.04	51.3		
138	7141.49	0.10	1.48	0.04	48.4	FeII(2382)	1.9972
Q1213+093							
19	4472.55	0.17	1.73	0.08	25.7		
20	4478.03	0.16	1.61	0.07	25.3		
21	4481.21	0.16	1.21	0.06	25.2		
22	4489.30	0.16	1.13	0.06	27.1		
23	4494.33	0.17	1.32	0.07	27.4		
24	4500.38	0.18	0.61	0.06	27.8		
25	4504.05	0.15	2.83	0.06	29.0		
26	4508.17	0.15	2.76	0.07	29.9	SiIV(1393)	2.2345
27	4537.07	0.17	1.51	0.07	29.1	SiIV(1402)	2.2344
28	4588.00	0.16	1.91	0.05	43.9	CIV(1548)	1.9634
29	4595.53	0.16	1.09	0.05	41.5	CIV(1550)	1.9634
30	4615.05	0.20	0.34	0.04	36.7		
31	4666.07	0.22	0.42	0.05	32.2		
32	4701.89	0.16	2.30	0.06	34.0	CII(1334)	2.5233
33	4789.38	0.16	0.57	0.04	34.3	CIV(1548)	2.0935
34	4797.54	0.19	0.59	0.05	33.6	CIV(1550)	2.0936
35	4910.06	0.18	0.88	0.07	27.8	SiIV(1393)	2.5229
36	4937.53	0.17	0.94	0.07	23.8	SiII(1526)	2.2341
37	4941.67	0.19	0.69	0.07	23.7	SiIV(1402)	2.5228
38	4949.33	0.44	0.34	0.09	22.4		
39	5007.62	0.16	2.85	0.10	22.9	CIV(1548)	2.2345
40	5015.84	0.17	2.04	0.09	24.7	CIV(1550)	2.2344
41	5379.18	0.21	1.71	0.15	14.4	SiII(1526)	2.5234
42	5402.75	0.26	1.13	0.16	12.5	AlII(1670)	2.2336
43	5453.87	0.25	1.65	0.19	11.7	CIV(1548)	2.5227
44	5463.35	0.20	1.10	0.15	11.5	CIV(1550)	2.5230
Q1222+228							
1	3803.90	0.18	0.37	0.06	26.4		
2	3849.80	0.13	0.81	0.06	25.2	CIV(1548)	1.4866
3	3856.62	0.13	0.77	0.06	24.6	CIV(1550)	1.4869
4	3907.67	0.14	0.62	0.06	25.5	CIV(1548)	1.5240
5	3913.89	0.17	0.61	0.07	24.2	CIV(1550)	1.5238
6	3919.36	0.16	0.36	0.05	25.0	CII(1334)	1.9369
7	4093.05	0.16	0.76	0.06	31.1	SiIV(1393)	1.9367
8	4119.41	0.26	0.56	0.07	30.0	SiIV(1402)	1.9366
9	4547.43	0.13	3.48	0.09	30.2	CIV(1548)	1.9372
10	4555.08	0.12	2.71	0.08	30.8	CIV(1550)	1.9373
11	4614.43	0.15	0.50	0.05	29.5	CIV(1548)	1.9805
12	4622.41	0.21	0.28	0.06	29.0	CIV(1550)	1.9807
13	4664.57	0.14	0.71	0.06	31.9	MgII(2796)	0.6681
14	4676.89	0.17	0.68	0.07	30.3	MgII(2803)	0.6682
15	4730.51	0.17	0.77	0.07	28.3	CIV(1548)	2.0555
16	4738.35	0.19	0.65	0.07	27.8	CIV(1550)	2.0555
Q1213+093							
1	4282.82	0.16	16.31	0.17	20.8	HI(1215)	2.5230
2	4316.48	0.17	2.20	0.09	22.9	CII(1334)	2.2345
3	4324.00	0.19	0.39	0.06	22.8		
4	4331.82	0.17	1.67	0.09	22.2		
5	4349.46	0.17	5.07	0.12	22.6		
6	4358.81	0.17	2.09	0.09	21.5		
7	4364.05	0.17	0.80	0.07	22.5		
8	4367.66	0.16	1.78	0.08	21.8		
9	4384.81	0.17	1.53	0.08	22.1		
10	4390.53	0.16	3.59	0.10	22.0		
11	4401.29	0.18	1.40	0.09	22.0		
12	4416.20	0.16	3.81	0.10	22.1		
13	4424.80	0.16	1.70	0.08	21.6		
14	4435.87	0.16	2.47	0.09	21.9		
15	4441.65	0.17	3.06	0.10	21.9	SiII(1260)	2.5239
16	4451.58	0.25	0.47	0.08	21.8		
17	4458.59	0.18	0.88	0.07	23.3		
18	4461.33	0.16	0.47	0.05	23.8		

TABLE 3—Continued

No.	λ_{obs}	$\sigma(\lambda)$	W_{obs}	$\sigma(W)$	S/N	ID	z_{abs}
Q1245+345							
1	4041.81	0.17	0.99	0.07	25.6	CIV(1548)	1.6106
2	4048.50	0.19	0.59	0.07	26.5	CIV(1550)	1.6106
3	4145.73	0.14	1.59	0.06	25.9	CIV(1548)	1.6778
4	4152.48	0.14	1.41	0.07	25.6	CIV(1550)	1.6777
5	4554.74	0.21	0.44	0.06	29.2		
Q1247+267							
1	3259.89	0.07	0.37	0.03	23.8		
2	3261.80	0.07	0.33	0.03	24.1		
3	3263.34	0.07	0.47	0.03	24.1		
4	3281.56	0.08	0.73	0.04	24.6		
5	3286.03	0.07	1.16	0.04	24.3		
6	3289.95	0.07	0.35	0.02	26.3		
7	3291.41	0.07	0.54	0.03	26.4		
8	3301.29	0.07	0.88	0.04	27.5		
9	3352.51	0.07	0.24	0.02	27.6		
10	3354.48	0.07	0.50	0.03	27.3	SiIV(1393)	1.4068
11	3356.29	0.07	0.53	0.03	28.4	SiIV(1393)	1.4081
12	3367.64	0.06	1.05	0.03	30.5		
13	3372.79	0.07	0.98	0.03	31.7		
14	3382.85	0.08	0.31	0.03	32.5		
15	3388.42	0.11	0.18	0.02	33.1		
16	3390.74	0.08	0.36	0.03	33.8		
17	3394.20	0.07	0.28	0.02	36.1		
18	3400.19	0.08	0.49	0.03	36.3		
19	3408.52	0.07	0.54	0.02	41.2		
20	3441.38	0.06	1.56	0.03	33.2		
21	3444.07	0.06	0.57	0.02	34.8		
22	3447.41	0.07	0.58	0.03	31.4		
23	3451.25	0.07	0.39	0.02	31.0		
24	3457.71	0.08	0.23	0.02	29.4		
25	3468.53	0.06	1.20	0.03	31.8		
26	3479.87	0.07	0.92	0.03	32.2		
27	3484.38	0.07	0.56	0.03	32.3		
28	3494.63	0.08	0.19	0.02	32.3		
29	3513.41	0.06	2.96	0.03	36.2		
30	3518.22	0.07	0.31	0.02	35.8		
31	3528.29	0.06	1.11	0.03	33.0		
32	3544.09	0.07	1.58	0.03	33.0		
33	3550.16	0.07	0.66	0.03	34.0		
34	3555.64	0.06	1.06	0.03	33.1		
35	3560.39	0.07	0.76	0.03	32.8		
36	3570.88	0.07	0.35	0.02	32.3	SiIII(1206)	1.9597
37	3573.78	0.09	0.46	0.03	30.8		
38	3592.28	0.07	0.43	0.02	37.3	HI(1215)	1.9592
39	3597.45	0.06	3.21	0.04	34.0		
40	3607.80	0.07	0.26	0.02	36.5		
41	3627.14	0.06	0.92	0.03	36.5		
42	3631.23	0.06	0.50	0.02	36.2		
43	3633.27	0.08	0.23	0.02	35.1		
44	3634.86	0.12	0.11	0.02	35.5		
Q1247+267							
45	3644.23	0.07	0.22	0.02	38.7		
46	3645.58	0.07	0.43	0.02	38.5		
47	3648.51	0.06	0.61	0.02	39.5		
48	3653.37	0.07	0.54	0.02	37.0		
49	3697.54	0.07	0.21	0.02	45.8		
50	3714.48	0.07	0.45	0.02	42.0		
51	3725.41	0.08	0.21	0.02	39.0	CIV(1548)	1.4063
52	3728.51	0.06	1.51	0.03	39.2	CIV(1548)	1.4083
53	3731.64	0.11	0.16	0.02	39.0	CIV(1550)	1.4063
54	3734.70	0.07	1.01	0.03	39.4	CIV(1550)	1.4083
55	4124.83	0.10	0.20	0.03	29.0	SiIV(1393)	1.9595
56	4582.02	0.13	0.37	0.04	32.2	CIV(1548)	1.9596
57	4590.09	0.14	0.51	0.05	31.1	CIV(1550)	1.9599
Q1329+412							
1	3784.50	0.19	0.57	0.07	23.8		
2	3826.55	0.16	1.28	0.08	24.4	CIV(1548)	1.4716
3	3832.88	0.16	0.80	0.07	24.6	CIV(1550)	1.4716
4	4022.59	0.14	1.54	0.07	24.8		
5	4027.20	0.14	3.59	0.08	25.2	CIV(1548)	1.6012
6	4032.92	0.14	2.16	0.07	25.9	CIV(1550)	1.6006
7	4196.92	0.17	0.40	0.05	30.0	MgII(2796)	0.5009
8	4208.18	0.23	0.30	0.05	30.8	MgII(2803)	0.5010
9	4390.87	0.21	0.36	0.05	31.7	CIV(1548)	1.8361
10	4397.12	0.17	1.29	0.07	32.9	CIV(1550)	1.8354
11	4404.28	0.21	0.36	0.05	32.0	CIV(1550)	1.8401
12	4552.45	0.15	1.30	0.06	38.2	CIV(1548)	1.9405
13	4559.92	0.15	1.06	0.05	37.7	CIV(1550)	1.9404
Q1331+170							
1	3766.41	0.16	1.07	0.06	32.3		
2	3787.34	0.17	0.50	0.05	31.7	CIV(1548)	1.4463
3	3793.38	0.18	0.37	0.05	32.0	CIV(1550)	1.4461
4	3869.42	0.16	2.30	0.09	27.1	SiIV(1393)	1.7763
5	3890.77	0.15	1.21	0.07	27.2		
6	3894.89	0.16	1.31	0.07	26.4	SiIV(1402)	1.7766
7	3934.09	0.23	0.40	0.06	26.2	CaII(3934)	-0.0002
8	3950.29	0.30	0.36	0.07	25.9		
9	3969.53	0.21	0.34	0.05	28.6	CaII(3969)	0.0000
10	4089.03	0.20	0.38	0.05	29.3	FeII(2344)	0.7443
11	4091.71	0.19	0.29	0.05	29.2	FeII(2344)	0.7455
12	4156.87	0.15	0.64	0.06	28.6	FeII(2382)	0.7446
13	4174.06	0.18	0.35	0.06	25.7		
14	4239.36	0.13	1.47	0.07	24.5	SiII(1526)	1.7768
15	4253.95	0.15	0.79	0.07	25.1		
16	4297.33	0.12	2.85	0.07	27.4	CIV(1548)	1.7757

TABLE 3—Continued

No.	λ_{obs}	$\sigma(\lambda)$	W_{obs}	$\sigma(W)$	S/N	ID	z_{abs}
Q1331+170							
17	4300.22	0.12	1.66	0.05	27.8	CIV(1548)	1.7776
18	4304.23	0.12	2.15	0.06	27.3	CIV(1550)	1.7755
19	4307.22	0.13	1.72	0.07	27.2	CIV(1550)	1.7775
20	4361.29	0.21	0.38	0.06	28.6		
21	4465.73	0.15	0.76	0.06	27.7	FeII(1608)	1.7764
22	4482.03	0.19	0.49	0.06	26.9		
23	4535.55	0.21	0.47	0.07	23.9	FeII(2600)	0.7443
24	4538.44	0.15	0.60	0.06	24.5	FeII(2600)	0.7454
25	4639.38	0.14	1.57	0.09	21.8	FeII(2374)	0.9539
26	4655.77	0.16	1.15	0.09	21.6	FeII(2382)	0.9539
27	4877.63	0.13	1.52	0.09	18.9	MgII(2796)	0.7443
28	4880.68	0.14	1.58	0.10	19.3	MgII(2796)	0.7454
29	4890.37	0.14	1.32	0.09	18.9	MgII(2803)	0.7444
30	4893.31	0.16	1.15	0.10	18.9	MgII(2803)	0.7454
Q1435+638							
1	3807.33	0.16	0.19	0.03	35.7	CIV(1548)	1.4592
2	3813.04	0.18	0.24	0.04	34.5	CIV(1550)	1.4588
3	3838.08	0.17	0.42	0.05	30.9	CIV(1548)	1.4791
4	3844.84	0.19	0.24	0.04	30.4	CIV(1550)	1.4793
5	3901.79	0.15	0.98	0.06	28.7	CII(1334)	1.9237
6	3968.74	0.18	0.35	0.05	26.1		
7	4013.69	0.17	0.69	0.06	27.4	CIV(1548)	1.5925
8	4020.28	0.19	0.32	0.05	26.7	CIV(1550)	1.5924
9	4074.73	0.15	0.61	0.05	27.4	SiIV(1393)	1.9236
10	4360.02	0.21	0.44	0.06	32.5		
11	4526.13	0.14	1.35	0.06	28.8	CIV(1548)	1.9235
12	4533.82	0.17	1.14	0.07	28.3	CIV(1550)	1.9236
Q1442+101							
1	5577.10	0.17	0.39	0.05	24.9	MgII(2803)	0.9893
2	5625.57	0.14	0.74	0.06	26.0	CIV(1548)	2.6336
3	5634.95	0.19	0.48	0.06	25.3	CIV(1550)	2.6336
4	5675.92	0.17	0.57	0.06	26.9	MgI(2852)	0.9895
5	5682.84	0.20	0.73	0.07	27.0	CIV(1548)	2.6706
6	5687.32	0.19	0.31	0.05	25.9		
7	5691.92	0.16	0.54	0.06	26.3	CIV(1550)	2.6704
8	5718.80	0.21	0.58	0.07	22.8	CIV(1548)	2.6938
9	5728.55	0.20	0.77	0.08	23.4	CIV(1550)	2.6940
10	5760.63	0.17	0.50	0.07	20.4	+SiIV(1393)	3.1102
11	5881.45	0.26	0.62	0.11	14.5	AlIII(1854)	2.1711
12	5907.51	0.17	0.65	0.08	16.3	AlIII(1862)	2.1713
13	6258.07	0.18	0.24	0.05	30.1		
14	6265.83	0.20	0.74	0.07	30.4	CIV(1548)	3.0472
15	6276.91	0.21	0.55	0.07	29.2	CIV(1550)	3.0476
16	6282.32	0.22	0.28	0.05	30.0		
Q1442+101							
17	6300.24	0.18	0.35	0.06	28.2		
18	6354.42	0.16	0.29	0.05	28.1		
19	6363.25	0.24	0.47	0.07	27.6	CIV(1548)	3.1101
20	6374.06	0.15	0.33	0.05	27.3	CIV(1550)	3.1102
21	6561.53	0.09	0.68	0.04	33.9		
22	6701.66	0.09	0.32	0.03	36.1		
23	6738.58	0.16	0.40	0.05	38.3	AlIII(1854)	2.6332
24	6949.29	0.14	0.25	0.04	35.0		
Q1510+115							
1	3513.67	0.17	1.54	0.14	11.1		
2	3531.70	0.15	1.24	0.11	12.1		
3	3535.89	0.21	0.84	0.12	11.8		
4	3539.82	0.14	1.08	0.10	12.2		
5	3570.00	0.16	1.12	0.10	14.3		
6	3578.95	0.14	3.54	0.14	14.1		
7	3594.01	0.15	1.15	0.10	15.3		
8	3600.05	0.14	3.93	0.13	15.6		
9	3615.61	0.16	0.75	0.08	17.4		
10	3631.24	0.15	2.02	0.11	17.9		
11	3636.85	0.14	0.91	0.07	18.5		
12	3643.30	0.20	0.60	0.08	18.5		
13	3674.94	0.13	2.43	0.08	21.9		
14	3682.40	0.13	0.92	0.06	22.0		
15	3696.48	0.17	0.58	0.06	25.0		
16	3702.99	0.17	0.87	0.07	26.2		
17	3717.11	0.12	0.96	0.04	26.8		
18	3720.39	0.12	1.92	0.06	27.8		
19	3724.95	0.15	0.88	0.06	27.0		
20	3736.64	0.13	1.27	0.05	30.7		
21	3751.51	0.12	4.81	0.07	32.1	HI(1215)	2.0860
22	3757.87	0.12	6.88	0.07	32.5	HI(1215)	2.0912
23	3763.84	0.13	2.81	0.06	34.7	HI(1215)	2.0961
24	3770.22	0.12	1.28	0.04	36.8	HI(1215)	2.1014
25	3830.08	0.13	17.84	0.11	33.8	NV(TROUGH)	2.0885
26	3842.32	0.12	4.52	0.05	+NV(1238)	2.0917	
27	3847.64	0.12	2.74	0.05	NV(1242)	2.0917	
28	3854.47	0.13	0.47	0.03	+NV(1238)	2.1016	
29	3934.57	0.19	0.41	0.03	NV(1242)	2.1014	
30	3969.87	0.19	0.20	0.05	28.2	CaII(3934)	-0.0001
31	4121.08	0.19	0.42	0.06	30.2	CaII(3969)	0.0001
32	4124.64	0.16	0.39	0.06	22.7		
33	4235.81	0.22	0.33	0.06	23.1		
34	4300.38	0.14	1.20	0.07	23.6	SiIV(1393)	2.0855
35	4304.88	0.14	3.71	0.10	22.9	SiIV(1393)	2.0887
36	4315.17	0.20	0.83	0.08	23.4	SiIV(1393)	2.0961
37	4328.25	0.16	0.83	0.07	23.5	SiIV(1402)	2.0855
38	4332.20	0.13	2.79	0.08	23.0	SiIV(1402)	2.0883

TABLE 3—Continued

No.	λ_{obs}	$\sigma(\lambda)$	W_{obs}	$\sigma(W)$	S/N	ID	z_{abs}
Q1510+115							
39	4336.74	0.18	0.51	0.07	23.1	SiIV(1402)	2.0916
40	4343.63	0.15	0.97	0.08	22.3	SiIV(1402)	2.0965
41	4785.97	0.15	21.64	0.23	19.0	CIV(1549)	2.0897
42	4800.79	0.13	3.08	0.09	20.6	CIV(1548)	2.1009
43	4809.30	0.17	0.91	0.09	21.1	CIV(1550)	2.1012
Q1511+091							
1	4205.13	0.12	1.50	0.06	26.4		
2	4209.04	0.16	0.74	0.06	25.2		
3	4218.03	0.19	0.54	0.07	24.7		
4	4223.95	0.12	2.80	0.07	24.9		
5	4228.73	0.11	2.77	0.07	24.7		
6	4238.32	0.15	0.51	0.06	24.8		
7	4245.72	0.13	0.70	0.06	25.3		
8	4248.41	0.15	0.37	0.05	25.1		
9	4253.79	0.14	0.85	0.06	24.7		
10	4263.43	0.14	0.95	0.07	24.3		
11	4267.55	0.12	0.85	0.06	25.3		
12	4289.74	0.19	0.50	0.07	22.6		
13	4292.50	0.13	0.85	0.05	23.7		
14	4294.84	0.13	0.77	0.05	23.3		
15	4297.49	0.15	0.66	0.06	23.0		
16	4302.17	0.15	0.67	0.06	23.5		
17	4305.20	0.19	0.38	0.06	23.4		
18	4316.08	0.14	0.60	0.06	25.2		
19	4319.60	0.15	0.36	0.05	25.0		
20	4327.05	0.12	4.95	0.09	25.2		
21	4332.94	0.13	1.65	0.07	24.4		
22	4340.43	0.15	0.60	0.06	23.3		
23	4343.61	0.12	1.28	0.07	23.5		
24	4355.00	0.21	0.53	0.07	22.7		
25	4375.85	0.18	0.44	0.07	21.0		
26	4380.29	0.14	0.90	0.07	21.0	SiIII(1193)	2.6708
27	4386.44	0.13	1.66	0.08	20.9		
28	4390.34	0.14	0.50	0.06	20.8		
29	4397.93	0.14	1.29	0.08	20.4		
30	4401.76	0.12	1.20	0.07	20.3		
31	4409.01	0.12	2.58	0.09	20.1		
32	4423.41	0.13	1.39	0.08	19.5		
33	4428.43	0.18	0.51	0.08	18.7	SiIII(1206)	2.6704
34	4432.30	0.12	2.14	0.09	19.1		
35	4437.04	0.13	2.39	0.10	19.0		
36	4450.52	0.17	0.98	0.09	18.9		
37	4455.92	0.12	3.45	0.10	18.9		
38	4461.68	0.12	3.74	0.10	19.0		
39	4465.74	0.12	1.05	0.07	19.1	HI(1215)	2.6701
40	4474.56	0.14	3.32	0.12	19.2		
41	4479.46	0.12	2.18	0.08	20.1		
42	4483.38	0.14	0.82	0.08	19.4		
43	4486.04	0.18	0.51	0.08	18.7		
Q1511+091							
44	4493.07	0.21	0.42	0.08	19.2		
45	4502.61	0.19	0.59	0.08	19.6		
46	4524.59	0.16	0.41	0.06	20.5		
47	4529.82	0.15	0.08	0.08	20.7		
48	4535.22	0.13	1.64	0.08	21.1		
49	4540.15	0.12	2.97	0.09	20.5		
50	4545.83	0.16	0.77	0.08	20.5		
51	4553.79	0.12	5.04	0.11	22.0		
52	4569.38	0.16	1.00	0.08	21.7	SiII(1190)	2.8385
53	4576.95	0.12	1.83	0.08	20.8		
54	4580.45	0.13	1.43	0.08	20.6	SiII(1193) +SiII(1190)	2.8385 2.8478
55	4583.92	0.14	0.63	0.07	20.3		
56	4599.15	0.13	2.21	0.09	21.9	SiII(1190)	2.8635
57	4608.27	0.13	1.52	0.08	22.8		
58	4616.43	0.12	6.49	0.11	22.8		
59	4623.25	0.15	0.80	0.07	23.3		
60	4630.95	0.17	0.53	0.07	22.3	SiIII(1206)	2.8383
61	4634.91	0.14	1.08	0.08	22.2		
62	4638.57	0.14	0.82	0.07	22.1		
63	4642.46	0.12	2.35	0.08	22.8	SiIII(1206)	2.8478
64	4648.23	0.12	3.66	0.09	22.6	SiIII(1206)	2.8526
65	4653.21	0.15	0.85	0.07	22.6	SiIII(1206)	2.8568
66	4658.48	0.20	0.54	0.08	21.8		
67	4666.74	0.13	3.39	0.10	22.2	HI(1215) +SiIII(1206)	2.8388 2.8680
68	4671.85	0.15	0.62	0.06	23.9		
69	4679.52	0.16	0.72	0.07	23.4	HI(1215)	2.8493
70	4683.74	0.13	1.49	0.08	22.9	HI(1215)	2.8528
71	4695.89	0.12	5.73	0.10	25.3	HI(1215)	2.8628
72	4702.21	0.14	0.80	0.06	24.3	HI(1215)	2.8680
73	4716.59	0.14	0.89	0.06	27.1		
74	4720.75	0.13	1.07	0.06	28.4		
75	4726.07	0.12	3.03	0.07	29.1		
76	4731.04	0.16	0.78	0.07	27.9		
77	4744.09	0.23	0.36	0.06	28.5		
78	4747.78	0.12	1.25	0.05	29.9		
79	4751.77	0.12	1.76	0.06	29.6		
80	4757.63	0.15	1.91	0.08	28.1	NV(1238)	2.8404
81	4772.44	0.14	2.04	0.08	29.8	NV(1242)	2.8401
82	4786.74	0.13	6.77	0.10	33.8	NV(1238)	2.8524
83	4801.08	0.12	3.59	0.06	37.2	NV(1238)	2.8639
84	4806.20	0.12	1.04	0.05	37.2	NV(1242)	2.8631
85	4813.96	0.12	1.97	0.06	35.7	NV(1238)	2.8659
86	4823.64	0.16	0.34	0.04	41.4		
87	4829.62	0.12	1.60	0.05	40.9	NV(1242)	2.8861
88	4837.13	0.19	0.64	0.05	39.4		
89	4961.98	0.23	0.36	0.06	30.4	SiIV(1393)	2.5602
90	5160.28	0.16	0.49	0.06	23.8	CII(1334)?	2.8667
91	5352.10	0.15	1.07	0.06	38.0	SiIV(1393)	2.8401
92	5369.38	0.18	0.62	0.05	38.5	SiIV(1393)	2.8525
93	5381.69	0.11	1.00	0.04	39.6	SiIV(1393)	2.8613

TABLE 3—Continued

No.	λ_{obs}	$\sigma(\lambda)$	W_{obs}	$\sigma(W)$	S/N	ID	z_{abs}
Q1511+091							
94	5386.00	0.11	1.49	0.04	39.2	SiIV(1402)	2.8395
						+SiIV(1393)	2.8644
95	5404.14	0.14	0.57	0.04	38.4	SiIV(1402)	2.8525
96	5415.57	0.11	1.12	0.04	39.3	SiIV(1402)	2.8606
						+SiIV(1393)	2.8856
97	5419.81	0.12	0.95	0.04	40.9	SiIV(1402)	2.8637
98	5425.47	0.17	0.31	0.04	39.5		
99	5450.23	0.21	0.57	0.05	39.6	SiIV(1402)	2.8853
100	5510.76	0.12	0.38	0.03	37.0	CIV(1548)	2.5595
101	5520.52	0.16	0.23	0.04	32.8	CIV(1550)	2.5598
102	5682.23	0.11	1.03	0.06	26.4	CIV(1548)	2.6702
103	5691.51	0.13	0.67	0.06	24.9	CIV(1550)	2.6701
104	5937.68	0.17	0.52	0.06	28.3	CIV(1548)	2.8352
105	5943.42	0.12	2.61	0.08	27.8	CIV(1548)	2.8389
106	5947.59	0.11	0.97	0.05	28.1	CIV(1550)	2.8352
107	5953.21	0.11	1.79	0.07	27.9	CIV(1550)	2.8389
108	5956.53	0.11	1.02	0.05	29.5	CIV(1548)	2.8474
109	5961.06	0.12	1.85	0.07	28.9	CIV(1548)	2.8503
110	5965.55	0.11	1.71	0.06	29.2	CIV(1550)	2.8468
						+CIV(1548)	2.8532
111	5971.06	0.11	1.69	0.06	29.5	CIV(1550)	2.8504
						+CIV(1548)	2.8568
112	5974.49	0.10	1.20	0.05	30.3	CIV(1550)	2.8526
113	5977.62	0.10	2.13	0.05	28.9	CIV(1548)	2.8610
114	5981.60	0.10	3.45	0.07	28.4	CIV(1550)	2.8572
						+CIV(1548)	2.8636
115	5986.29	0.10	1.51	0.05	28.5	CIV(1550)	2.8602
						+CIV(1548)	2.8666
116	5990.61	0.11	3.94	0.07	28.5	CIV(1550)	2.8630
117	5996.95	0.14	1.83	0.08	29.0	CIV(1550)	2.8671
118	6016.58	0.12	2.79	0.08	27.4	CIV(1548)	2.8855
119	6024.72	0.12	2.79	0.08	27.4	CIV(1550)	2.8850
120	6029.02	0.11	0.79	0.05	29.0		
121	6036.88	0.15	0.64	0.06	27.6		
Q1517+239							
1	4471.71	0.20	0.43	0.07	26.4		
2	4860.49	0.15	0.53	0.07	17.4	MgII(2796)	0.7382
3	4873.10	0.22	0.59	0.10	16.9	MgII(2803)	0.7382
Q1548+093							
1	4266.30	0.12	1.40	0.09	16.2		
2	4269.01	0.12	1.17	0.09	16.5		
3	4291.58	0.14	1.42	0.10	17.3		
4	4304.32	0.23	0.81	0.11	17.4		
5	4314.50	0.19	1.21	0.11	18.3		
6	4325.11	0.12	2.53	0.10	18.7	NV(1238)	2.4913
Q1548+093							
7	4337.58	0.12	2.35	0.10	19.6	NV(1242)	2.4902
8	4341.81	0.16	0.76	0.08	20.2		
9	4345.53	0.20	0.42	0.07	20.1		
10	4354.24	0.13	1.17	0.08	21.4		
11	4359.00	0.18	0.59	0.08	21.6		
12	4371.60	0.13	1.53	0.08	22.8		
13	4387.00	0.11	7.54	0.12	22.7		
14	4394.57	0.12	0.94	0.07	23.1		
15	4411.17	0.12	0.64	0.06	24.5		
16	4414.03	0.20	0.36	0.06	24.7		
17	4424.82	0.16	1.20	0.08	24.9		
18	4431.48	0.17	0.77	0.08	23.1	CII(1334)	2.3206
19	4438.63	0.16	0.82	0.08	23.6		
20	4445.85	0.18	0.60	0.07	22.8		
21	4456.86	0.11	2.26	0.10	22.9		
22	4463.08	0.11	3.69	0.08	22.8		
23	4467.10	0.14	0.85	0.07	23.2		
24	4477.33	0.14	1.89	0.09	23.3		
25	4489.67	0.12	4.43	0.11	23.8		
26	4497.86	0.11	2.92	0.07	25.6		
27	4501.71	0.11	1.54	0.06	26.4		
28	4507.11	0.15	0.38	0.05	25.4		
29	4514.46	0.11	1.13	0.06	27.8		
30	4518.68	0.11	1.55	0.06	27.0		
31	4524.55	0.10	3.25	0.07	28.2		
32	4528.30	0.10	2.48	0.06	30.3	SiIV(1393)	2.2490
33	4547.02	0.23	0.41	0.06	32.0	OI(1302)	2.4919
34	4558.68	0.14	0.69	0.05	33.0	SiIV(1402)	2.2498
35	4566.99	0.25	1.34	0.09	33.6		
36	4627.14	0.12	0.43	0.03	54.4	SiIV(1393)	2.3199
37	4885.20	0.15	0.36	0.04	34.2		
38	4951.69	0.13	0.48	0.05	32.1	MgII(2796)	0.7708
39	4964.27	0.18	0.54	0.06	31.5	MgII(2803)	0.7707
40	5029.27	0.18	0.76	0.07	27.9	CIV(1548)	2.2485
41	5037.45	0.16	0.26	0.05	27.9	CIV(1550)	2.2483
42	5062.16	0.19	0.61	0.07	26.5		
43	5068.14	0.16	0.41	0.06	26.7	SiII(1526)	2.3196
44	5139.38	0.15	0.67	0.07	26.9	CIV(1548)	2.3196
45	5147.70	0.21	0.43	0.07	25.0	CIV(1550)	2.3194
46	5273.60	0.35	1.13	0.13	21.3		
47	5405.57	0.23	1.05	0.15	13.5	CIV(1548)	2.4915
48	5414.73	0.27	0.93	0.16	12.7	CIV(1550)	2.4916
Q1623+269							
1	3302.72	0.10	1.41	0.10	11.4		
2	3305.49	0.10	0.81	0.08	11.5		
3	3308.19	0.10	1.44	0.09	11.7		
4	3323.05	0.16	0.40	0.08	13.0	HI(1025)	2.2397
5	3327.65	0.11	1.13	0.08	13.7		
6	3331.12	0.11	0.43	0.06	13.7		
7	3340.15	0.17	0.62	0.09	13.3		

TABLE 3—Continued

Q1623+269								Q1623+269							
No.	λ_{obs}	$\sigma(\lambda)$	W_{obs}	$\sigma(W)$	S/N	ID	z_{abs}	No.	λ_{obs}	$\sigma(\lambda)$	W_{obs}	$\sigma(W)$	S/N	ID	z_{abs}
8	3346.32	0.15	0.44	0.07	13.3			61	3669.08	0.10	0.95	0.05	25.6		
9	3349.83	0.11	1.73	0.10	13.4			62	3676.56	0.10	1.41	0.06	24.1		
10	3356.63	0.10	3.37	0.11	14.2			63	3680.06	0.11	0.29	0.04	23.6	SiIII(1206)	2.0502
11	3361.62	0.10	1.26	0.08	15.7			64	3683.42	0.09	1.72	0.05	23.9	SiIII(1206)	2.0530
12	3366.29	0.12	0.51	0.06	15.9			65	3698.27	0.09	1.19	0.05	23.7		
13	3369.15	0.09	1.33	0.07	16.5			66	3710.71	0.09	7.33	0.09	22.2	HI(1215)	2.0524
14	3373.47	0.09	0.20	0.03	16.7			67	3716.04	0.08	1.34	0.04	24.7	MgII(2796)	0.3289
15	3378.00	0.14	1.00	0.08	16.7			68	3726.94	0.09	0.87	0.04	25.4	MgII(2803)	0.3294
16	3390.51	0.14	0.23	0.05	17.4			69	3737.25	0.11	1.04	0.05	25.4		
17	3404.37	0.13	0.44	0.06	17.1			70	3760.65	0.10	0.40	0.04	24.4		
18	3408.27	0.12	0.59	0.06	17.7	AlII(1670)	1.0399	71	3764.90	0.19	0.23	0.05	24.1		
19	3420.20	0.09	1.59	0.07	19.4			72	3769.79	0.09	1.49	0.05	24.0		
20	3426.85	0.10	0.94	0.06	20.2			73	3774.80	0.19	0.15	0.04	22.5		
21	3431.97	0.13	0.52	0.06	20.5	HI(972)	2.5289	74	3778.23	0.17	0.41	0.06	22.0	NV(1238)	2.0499
22	3437.11	0.11	0.83	0.06	20.4	SiIII(1193)	1.8804	75	3782.66	0.09	1.13	0.05	22.8		
23	3440.28	0.72	1.53	0.16	19.6			76	3785.99	0.09	1.61	0.06	22.4		
24	3457.90	0.14	0.29	0.05	19.5			77	3789.92	0.11	0.34	0.04	22.2		
25	3462.25	0.10	0.63	0.05	19.3			78	3792.52	0.10	0.70	0.05	22.8	NV(1242)	2.0495
26	3466.35	0.10	2.33	0.08	19.6			79	3794.46	0.10	0.29	0.04	22.5	MgI(2852)	0.3293
27	3470.67	0.12	0.36	0.05	20.2			80	3808.75	0.10	0.50	0.05	20.6	NV(1242)	2.0532
28	3475.98	0.17	0.40	0.06	19.6	SiIII(1206)	1.8810	81	3812.48	0.10	0.71	0.05	21.0		
29	3487.82	0.13	0.97	0.07	21.1	HI(1025)	2.4004	82	3816.14	0.09	1.24	0.06	21.8		
30	3497.15	0.10	0.54	0.05	21.2			83	3820.43	0.18	0.57	0.07	21.0		
31	3498.82	0.09	0.42	0.04	21.7			84	3827.81	0.10	1.76	0.07	20.5		
32	3501.16	0.08	1.42	0.05	21.7	HI(1215)	1.8800	85	3834.79	0.13	0.60	0.06	19.7		
33	3503.03	0.08	0.68	0.04	22.3	AlIII(1854)	0.8887	86	3842.54	0.10	3.02	0.09	18.9	HI(1215)	2.1608
34	3504.94	0.11	0.44	0.04	21.4			87	3848.05	0.20	0.39	0.07	16.4	SiII(1260)	2.0530
35	3509.47	0.09	1.77	0.06	21.9	OVI(1031)	2.4008	88	3854.68	0.15	0.49	0.07	15.7		
36	3513.57	0.12	0.35	0.04	22.3			89	3862.89	0.11	1.03	0.08	15.8		
37	3515.62	0.10	0.39	0.04	22.0	AlIII(1862)	0.8873	90	3865.46	0.10	0.56	0.06	16.1	SiII(1193)	2.2394
38	3517.81	0.09	0.87	0.04	21.7	AlIII(1862)	0.8885	91	3868.66	0.09	2.64	0.09	16.0		
39	3519.94	0.10	0.64	0.05	21.8			92	3895.16	0.17	0.41	0.07	15.6		
40	3529.07	0.10	1.24	0.06	21.9	OVI(1037)	2.4011	93	3906.76	0.13	0.36	0.06	15.7		
41	3533.71	0.09	1.89	0.06	21.8			94	3938.81	0.12	1.48	0.09	15.0	HI(1215)	2.2400
42	3537.03	0.13	0.38	0.05	21.3	HI(1025)	2.4483	95	3943.89	0.09	2.62	0.09	15.7		
43	3547.00	0.24	0.26	0.06	20.8	SiIII(1193)	1.9725	96	3947.08	0.11	0.95	0.07	15.1		
44	3553.33	0.11	1.19	0.06	20.4			97	3952.94	0.18	0.39	0.07	15.4		
45	3558.00	0.10	1.88	0.07	21.3	OVI(1031)	2.4478	98	3961.04	0.15	0.69	0.08	16.3		
46	3561.40	0.09	0.39	0.04	21.3			99	3964.32	0.16	0.36	0.07	18.1		
47	3563.64	0.11	0.82	0.06	20.7			100	3971.07	0.12	1.55	0.09	18.8		
48	3569.81	0.10	1.74	0.07	21.6			101	3992.43	0.08	3.79	0.11	18.4		
49	3573.26	0.10	0.61	0.05	21.5			102	3997.74	0.11	1.44	0.09	18.1		
50	3577.49	0.09	1.07	0.05	21.8	OVI(1037)	2.4478	103	4007.81	0.14	1.57	0.11	17.3		
51	3590.98	0.10	1.03	0.06	21.0			104	4025.95	0.16	1.20	0.10	17.7		
52	3601.03	0.09	1.89	0.06	20.9			105	4034.60	0.10	0.65	0.07	18.5		
53	3613.63	0.09	4.30	0.08	22.8	HI(1215)	1.9725	106	4039.51	0.24	0.46	0.08	18.4		
54	3619.49	0.10	0.96	0.05	24.7	HI(1025)	2.5287	107	4054.35	0.20	0.43	0.08	19.3		
55	3629.11	0.11	1.25	0.06	25.2			108	4059.95	0.15	1.14	0.09	19.5		
56	3632.27	0.09	0.43	0.03	26.0	SiII(1260)	1.8818	109	4073.35	0.08	2.06	0.08	21.8	CII(1334)	2.0523
57	3638.49	0.09	0.80	0.04	26.8			110	4082.30	0.10	0.72	0.06	20.9		
58	3641.48	0.13	0.34	0.04	24.9	SiII(1193)	2.0517	111	4102.20	0.11	0.81	0.07	21.9	SiIII(1206)	2.4001
59	3658.54	0.12	0.32	0.04	23.4			112	4107.04	0.16	0.64	0.07	21.7		
60	3661.63	0.16	0.40	0.05	23.4	OVI(1037)	2.5288	113	4133.67	0.10	3.51	0.10	22.0	HI(1215)	2.4003

TABLE 3—Continued

No.	λ_{obs}	$\sigma(\lambda)$	W_{obs}	$\sigma(W)$	S/N	ID	z_{abs}
Q1623+269							
114	4145.01	0.08	2.07	0.08	22.9		
115	4152.74	0.19	0.26	0.06	22.2		
116	4160.41	0.17	0.39	0.06	22.5	SiIII(1206)	2.4483
117	4166.54	0.13	0.54	0.06	21.7		
118	4170.42	0.13	0.71	0.07	20.9		
119	4178.12	0.22	0.50	0.08	20.1		
120	4182.09	0.11	0.76	0.07	20.4		
121	4187.56	0.07	4.38	0.10	19.9		
122	4191.81	0.07	1.51	0.07	21.0	HI(1215)	2.4481
123	4198.29	0.13	0.59	0.07	19.9		
124	4201.11	0.09	0.84	0.06	20.4	SiII(1190)	2.5291
125	4204.38	0.08	1.81	0.07	21.8		
126	4210.33	0.08	1.75	0.07	21.9		
127	4213.68	0.09	1.28	0.07	21.8	NV(1238)	2.4014
128	4221.23	0.07	1.23	0.06	21.6		
129	4223.70	0.07	1.93	0.07	21.1		
130	4227.29	0.15	0.37	0.06	20.8	NV(1242)	2.4014
131	4243.21	0.14	0.27	0.05	21.4		
132	4254.48	0.11	0.84	0.06	23.7	SiIV(1393)	2.0525
133	4268.75	0.14	0.39	0.05	27.4		
134	4271.52	0.14	0.22	0.04	28.0	NV(1238)	2.4481
135	4275.14	0.08	0.68	0.04	30.3		
136	4281.79	0.09	1.20	0.05	32.2	SiIV(1402)	2.0524
137	4289.55	0.07	1.54	0.04	38.3	HI(1215)	2.5285
138	4455.94	0.15	0.19	0.05	21.8		
139	4459.35	0.18	0.40	0.07	21.9	CIV(1548)	1.8803
140	4466.10	0.18	0.32	0.06	21.8	CIV(1550)	1.8799
141	4497.43	0.12	0.30	0.06	18.1	FeII(2382)	0.8875
142	4499.47	0.09	0.27	0.05	17.9	FeII(2382)	0.8883
143	4602.62	0.15	0.42	0.05	24.8	CIV(1548)	1.9729
144	4610.51	0.20	0.20	0.05	24.6	CIV(1550)	1.9730
145	4722.36	0.09	0.88	0.04	26.7	CIV(1548)	2.0502
146	4726.03	0.09	2.83	0.06	26.3	CIV(1548)	2.0526
147	4730.31	0.10	0.60	0.04	25.7	CIV(1550)	2.0503
148	4734.13	0.09	2.06	0.05	26.5	CIV(1550)	2.0528
149	4781.75	0.10	0.40	0.04	24.2	FeII(2344)	1.0398
150	4860.30	0.10	0.54	0.04	25.9	FeII(2382)	1.0398
151	4884.70	0.11	0.22	0.03	24.6	FeII(2586)	0.8884
152	4894.58	0.11	0.57	0.05	23.8	CIV(1548)	2.1615
153	4902.69	0.15	0.32	0.05	25.1	CIV(1550)	2.1615
154	4908.38	0.13	0.16	0.03	26.5	FeII(2600)	0.8877
155	4910.23	0.09	0.24	0.03	26.0	FeII(2600)	0.8884
156	5023.31	0.11	0.32	0.04	20.0	CIV(1550)	2.2392
157	5265.83	0.11	1.09	0.06	22.6	CIV(1548)	2.4013
158	5275.20	0.10	1.06	0.06	23.0	FeII(2586)	1.0394
159	5278.39	0.09	1.26	0.05	23.8	MgII(2796)	0.8876
160	5280.84	0.09	0.50	0.04	23.1	MgII(2796)	0.8885
161	5291.67	0.10	0.91	0.05	23.0	MgII(2803)	0.8875
162	5294.60	0.12	0.51	0.05	22.4	MgII(2803)	0.8885
163	5303.67	0.10	0.50	0.04	22.6	FeII(2600)	1.0397
164	5331.63	0.14	0.21	0.04	23.7		
165	5387.59	0.13	0.27	0.04	28.2	MgI(2852)	0.8884
166	5463.10	0.09	0.48	0.03	23.2	CIV(1548)	2.5287
167	5472.01	0.14	0.27	0.03	21.2	CIV(1550)	2.5286
Q1715+535							
1	3823.18	0.15	0.53	0.05	28.4	MgII(2796)	0.3672
2	3834.03	0.15	0.29	0.04	28.2	MgII(2803)	0.3676
3	3934.10	0.15	0.33	0.04	28.4	CaII(3934)	-0.0002
4	4019.40	0.16	0.45	0.05	28.7	SiII(1526)	1.6327
5	4076.43	0.14	1.65	0.05	32.4	CIV(1548)	1.6330
6	4083.32	0.14	1.32	0.06	32.2	CIV(1550)	1.6331
7	4140.98	0.18	0.38	0.05	34.0		
8	4270.96	0.15	0.47	0.04	35.5	CIV(1548)	1.7587
9	4278.21	0.23	0.36	0.05	34.5	CIV(1550)	1.7588
Q2126-158							
1	4771.19	0.12	1.91	0.08	20.4		
2	4786.13	0.21	0.68	0.09	19.3		
3	4791.14	0.12	1.29	0.08	19.5		
4	4797.28	0.14	1.52	0.09	19.0		
5	4808.67	0.14	1.55	0.10	18.2		
6	4818.29	0.12	2.59	0.09	18.8		
7	4823.53	0.12	4.03	0.10	18.5	SiIV(1393)	2.4608
8	4830.05	0.13	1.09	0.08	18.6		
9	4843.17	0.16	0.95	0.09	18.5		
10	4847.14	0.15	1.11	0.09	18.3		
11	4852.08	0.13	1.86	0.09	17.6		
12	4855.08	0.13	1.86	0.09	17.6	SiIV(1402)	2.4611
13	4860.81	0.14	2.28	0.11	17.8	CII(1334)	2.6380
14	4869.00	0.13	0.84	0.08	18.1		
15	4875.18	0.13	3.73	0.12	18.6		
16	4893.15	0.18	0.59	0.08	18.8		
17	4896.69	0.14	0.97	0.08	19.5		
18	4907.46	0.14	1.94	0.10	19.7		
19	4915.72	0.13	2.66	0.10	19.2	OI(1302)	2.7687
20	4921.71	0.12	3.29	0.10	19.6	SiII(1304)	2.7687
21	4930.05	0.15	0.98	0.08	20.5		
22	4942.36	0.19	0.48	0.07	21.8		
23	4959.02	0.17	0.42	0.07	21.2		
24	4973.50	0.25	0.46	0.09	19.9		
25	4982.96	0.13	1.99	0.09	20.2		
26	4994.93	0.17	1.10	0.10	19.4		
27	5005.81	0.16	1.15	0.09	19.7		
28	5018.49	0.13	1.89	0.09	19.7		
29	5029.20	0.12	2.75	0.08	20.3	CII(1334)	2.7685
30	5033.74	0.15	1.23	0.09	20.3		
31	5042.69	0.13	1.80	0.09	20.4		
32	5050.07	0.15	2.07	0.11	19.9		
33	5055.84	0.13	0.77	0.07	20.0		
34	5065.45	0.13	1.19	0.08	20.0		
35	5071.67	0.15	2.23	0.12	18.3	SiIV(1393)	2.6389
36	5081.38	0.19	0.57	0.09	18.2		
37	5086.06	0.17	0.69	0.09	17.5		
38	5102.25	0.19	2.31	0.14	18.8	SiIV(1402)	2.6373
39	5119.01	0.14	1.47	0.09	20.4		

TABLE 3—Continued

No.	λ_{obs}	$\sigma(\lambda)$	W_{obs}	$\sigma(W)$	S/N	ID	Z_{abs}
Q2126-158							
40	5126.19	0.12	2.87	0.09	21.7		
41	5135.13	0.12	1.30	0.07	22.6		
42	5142.04	0.12	3.75	0.08	25.9		
43	5147.02	0.13	0.90	0.06	26.4		
44	5157.77	0.15	0.62	0.06	27.6		
45	5166.22	0.18	0.43	0.06	26.9		
46	5181.47	0.12	1.00	0.05	28.2	SiII(1526)	2.3939
47	5185.34	0.19	0.40	0.06	27.2		
48	5246.98	0.17	0.21	0.03	45.6		
49	5253.60	0.12	2.99	0.06	46.3	CIV(1548) +SiIV(1393)	2.3934 2.7694
50	5263.29	0.13	0.94	0.04	55.7	CIV(1550)	2.3940
51	5286.46	0.13	0.82	0.04	52.8	SiIV(1402)	2.7686
52	5356.34	0.18	0.28	0.03	57.6	CIV(1548)	2.4597
53	5365.15	0.18	0.22	0.03	55.4	CIV(1550)	2.4597
54	5425.28	0.17	0.22	0.03	45.8		
55	5446.64	0.20	0.50	0.05	45.7		
56	5492.43	0.20	0.32	0.05	36.0		
57	5554.08	0.14	1.24	0.09	22.2	SiII(1526)	2.6379
58	5605.91	0.21	0.43	0.08	19.1		
59	5632.39	0.16	3.66	0.15	18.1	CIV(1548)	2.6380
60	5641.62	0.15	2.44	0.12	19.3	CIV(1550)	2.6379
61	5695.92	0.16	0.71	0.08	23.4	CIV(1548)	2.6791
62	5705.38	0.16	0.57	0.07	22.8	CIV(1550)	2.6791
63	5753.48	0.16	1.90	0.10	24.3	SiII(1526)	2.7685
64	5771.88	0.20	0.41	0.07	22.0		
65	5834.97	0.13	2.55	0.10	21.2	CIV(1548)	2.7689
66	5839.07	0.18	0.75	0.09	21.1		
67	5845.08	0.14	1.94	0.10	21.5	CIV(1550)	2.7691
68	5851.59	0.19	0.46	0.07	21.9	FeII(1608)	2.6380
69	5914.44	0.24	0.47	0.08	22.2		
70	6078.49	0.16	1.11	0.12	13.0	AlII(1670)	2.6381
71	6296.43	0.16	2.25	0.15	14.0	AlII(1670)	2.7685
72	6542.76	0.19	0.85	0.12	14.4		
73	6599.83	0.33	0.76	0.15	13.7		
Q2206-199							
15	3797.84	0.15	0.91	0.09	16.5	SiII(1260)	2.0132
16	3803.07	0.13	4.53	0.13	16.4	OI(1302)	1.9206
17	3809.81	0.15	2.43	0.12	16.3	SiII(1304)	1.9208
18	3837.67	0.13	3.57	0.12	15.3		
19	3840.52	0.12	2.81	0.10	15.2		
20	3843.90	0.14	2.00	0.11	15.4		
21	3855.76	0.14	2.58	0.12	15.6		
22	3863.14	0.23	0.85	0.12	15.1		
23	3886.06	0.15	1.80	0.11	16.3		
24	3897.65	0.14	3.00	0.12	16.3	CII(1334)	1.9206
25	3902.45	0.14	2.94	0.13	16.1		
26	3910.62	0.17	1.25	0.11	15.9		
27	3914.79	0.23	0.64	0.10	16.0		
28	3932.29	0.23	1.46	0.14	15.3	SiII(1304)	2.0147
29	3957.33	0.14	1.78	0.11	16.0		
30	3964.74	0.15	0.49	0.07	16.4		
31	3974.02	0.14	1.71	0.10	16.7		
32	3977.98	0.17	1.09	0.11	16.0		
33	3988.56	0.14	2.43	0.12	15.8		
34	3992.57	0.15	0.84	0.09	15.2		
35	3995.89	0.14	1.64	0.11	15.9		
36	4006.62	0.14	0.94	0.09	14.8		
37	4009.03	0.16	0.95	0.10	15.0		
38	4037.37	0.17	2.83	0.15	15.3		
39	4046.20	0.16	0.96	0.10	15.7		
40	4049.85	0.16	0.68	0.09	15.7		
41	4057.88	0.16	1.03	0.10	15.2		
42	4061.69	0.23	1.28	0.14	15.3	SiIV(1393)	1.9204
43	4070.39	0.14	2.32	0.12	16.3		
44	4074.40	0.14	2.64	0.12	16.6		
45	4087.75	0.16	1.27	0.11	16.7	MgI(2026)	1.0172
46	4091.10	0.20	0.85	0.11	16.0		
47	4097.69	0.15	3.25	0.14	16.2	SiIV(1402)	1.9211
48	4107.11	0.15	2.46	0.13	15.1	FeII(2344)	0.7520
49	4113.30	0.15	3.34	0.15	15.3		
50	4120.58	0.19	0.54	0.09	15.7		
51	4124.27	0.13	2.37	0.11	16.5		
52	4143.22	0.20	0.67	0.10	16.2		
53	4153.86	0.19	1.45	0.12	16.7		
54	4159.77	0.17	0.88	0.10	16.9	FeII(2374)	0.7519
55	4165.67	0.26	0.57	0.10	17.2		
56	4174.64	0.15	1.40	0.10	17.9	FeII(2382)	0.7520
57	4187.20	0.14	4.65	0.14	16.9		
58	4208.96	0.14	1.18	0.09	19.1		
59	4276.83	0.15	1.43	0.09	19.9		
60	4288.57	0.14	1.45	0.09	21.2		
61	4297.77	0.19	3.08	0.14	21.4		
62	4306.92	0.14	2.68	0.10	21.9		
63	4320.33	0.16	0.77	0.08	21.9		
64	4331.60	0.16	0.61	0.07	21.8		
65	4335.44	0.23	0.43	0.08	21.9		
66	4458.89	0.13	2.80	0.09	20.8	SiII(1526)	1.9206
67	4521.86	0.13	3.27	0.11	17.5	CIV(1548)	1.9207
Q2206-199							
1	3625.99	0.18	1.10	0.13	11.8		
2	3630.56	0.14	1.73	0.12	12.7	NV(1242)	1.9213
3	3633.48	0.15	1.43	0.12	12.8		
4	3644.70	0.24	0.78	0.12	13.7		
5	3651.33	0.20	1.20	0.13	14.4		
6	3659.96	0.14	2.33	0.12	14.8		
7	3663.83	0.13	3.07	0.12	14.7	HI(1215)	2.0138
8	3680.27	0.14	3.74	0.13	15.3	SiII(1260)	1.9199
9	3696.41	0.16	1.32	0.11	16.2		
10	3743.08	0.22	29.19	0.40	14.7		
11	3757.53	0.20	0.68	0.11	13.2	AlIII(1862)	1.0171
12	3764.18	0.13	2.92	0.13	13.9		
13	3772.62	0.16	0.78	0.08	17.9		
14	3783.71	0.19	0.41	0.08	17.0		

TABLE 3—Continued

N.O.	λ_{obs}	$\sigma(\lambda)$	W_{obs}	$\sigma(W)$	S/N	ID	z_{abs}
Q2206-199							
68	4529.83	0.14	3.36	0.13	17.6	CIV(1550)	1.9210
69	4554.93	0.14	1.26	0.08	21.7	FeII(2600)	0.7518
70	4666.73	0.20	0.75	0.10	18.2	CIV(1548)	2.0143
71	4676.06	0.18	0.42	0.08	18.4	CIV(1550)	2.0147
72	4697.71	0.10	2.43	0.07	28.4	FeII(1608)	1.9206
73	4729.19	0.22	1.21	0.11	20.3	FeII(2344)	1.0174
74	4762.21	0.22	0.50	0.10	17.4	FeII(2374)	1.0172
75	4789.67	0.16	1.04	0.06	26.4	FeII(2382)	1.0173
76	4806.73	0.15	1.04	0.08	19.7	FeII(2382)	1.0173
77	4879.89	0.13	3.22	0.09	21.9	AlIII(1670)	1.9207
78	4899.33	0.14	1.63	0.08	24.0	MgII(2796)	0.7520
79	4911.90	0.15	1.35	0.08	24.4	MgII(2803)	0.7520
80	4992.78	0.30	0.57	0.08	28.4	MgI(2852)	0.7520
81	4998.29	0.16	0.48	0.05	29.4	MgII(2586)	1.0171
82	5217.64	0.20	0.89	0.09	20.7	FeII(2600)	1.0172
83	5245.00	0.14	1.13	0.07	22.3	FeII(1808)	1.9206
84	5280.42	0.16	0.78	0.07	23.1	SiII(1808)	1.9203
85	5416.41	0.14	2.05	0.10	20.5	AlIII(1854)	1.9205
86	5440.27	0.17	1.36	0.11	19.0	AlIII(1862)	1.9205
87	5448.54	0.20	0.61	0.09	18.9	SiII(1808)	2.0136
88	5463.91	0.15	0.51	0.07	19.7	MgII(2796)	1.0169
89	5640.01	0.15	1.88	0.14	13.1	MgII(2803)	1.0169
90	5654.51	0.16	1.91	0.16	12.5	MgII(2803)	1.0169
Q2342+089							
1	4780.04	0.16	2.43	0.09	31.8	SiIV(1393)	2.4296
2	4811.53	0.19	1.09	0.07	31.4	SiIV(1402)	2.4300
3	4821.58	0.12	1.74	0.04	34.2	CIV(1548)	2.1143
4	4829.58	0.14	0.55	0.05	34.1	CIV(1550)	2.1143
5	4841.39	0.12	2.84	0.08	32.2	MgII(2796)	0.7313
6	4853.75	0.11	2.35	0.06	31.8	MgII(2803)	0.7313
7	4906.73	0.13	0.44	0.04	32.5	CIV(1548)	2.1693
8	4909.97	0.11	1.02	0.05	32.1	CIV(1548)	2.1714
9	4914.75	0.14	0.43	0.05	33.5	CIV(1550)	2.1692
10	4918.13	0.13	0.60	0.05	32.4	CIV(1550)	2.1714
11	5023.48	0.23	2.96	0.10	39.4	CIV(1549)?	2.2430
12	5187.28	0.16	0.37	0.05	35.5		
13	5234.40	0.11	1.03	0.05	32.0	SiII(1526)	2.4285
14	5238.10	0.11	2.48	0.06	32.6	SiII(1526)	2.4310
15	5298.79	0.14	0.43	0.05	32.0		
16	5303.65	0.13	0.46	0.05	31.2		
17	5307.97	0.11	1.64	0.05	32.7	CIV(1548)	2.4285
18	5311.42	0.11	2.16	0.06	32.2	CIV(1548)	2.4309
19	5317.03	0.11	1.04	0.04	34.1	CIV(1550)	2.4286
20	5320.12	0.11	1.24	0.05	33.6	CIV(1550)	2.4306
21	5323.68	0.17	0.28	0.04	34.1		
22	5515.76	0.20	0.93	0.06	24.5	FeII(1608)	2.4292
23	5518.87	0.12	0.93	0.06	25.3	FeII(1608)	2.4312
24	5526.48	0.14	1.07	0.07	25.6	CIV(1548)	2.5696
25	5535.48	0.16	0.86	0.08	24.8	CIV(1550)	2.5695
26	5728.90	0.11	1.52	0.07	24.2	SiII(1808)	2.1686
27	5732.57	0.11	2.15	0.07	24.3	SiII(1808)	2.1707
						+AlIII(1670)	2.4311
						+AlIII(1670)	2.4311
Q2343+125							
1	4780.04	0.16	2.43	0.09	31.8	SiIV(1393)	2.4296
2	4811.53	0.19	1.09	0.07	31.4	SiIV(1402)	2.4300
3	4821.58	0.12	1.74	0.04	34.2	CIV(1548)	2.1143
4	4829.58	0.14	0.55	0.05	34.1	CIV(1550)	2.1143
5	4841.39	0.12	2.84	0.08	32.2	MgII(2796)	0.7313
6	4853.75	0.11	2.35	0.06	31.8	MgII(2803)	0.7313
7	4906.73	0.13	0.44	0.04	32.5	CIV(1548)	2.1693
8	4909.97	0.11	1.02	0.05	32.1	CIV(1548)	2.1714
9	4914.75	0.14	0.43	0.05	33.5	CIV(1550)	2.1692
10	4918.13	0.13	0.60	0.05	32.4	CIV(1550)	2.1714
11	5023.48	0.23	2.96	0.10	39.4	CIV(1549)?	2.2430
12	5187.28	0.16	0.37	0.05	35.5		
13	5234.40	0.11	1.03	0.05	32.0	SiII(1526)	2.4285
14	5238.10	0.11	2.48	0.06	32.6	SiII(1526)	2.4310
15	5298.79	0.14	0.43	0.05	32.0		
16	5303.65	0.13	0.46	0.05	31.2		
17	5307.97	0.11	1.64	0.05	32.7	CIV(1548)	2.4285
18	5311.42	0.11	2.16	0.06	32.2	CIV(1548)	2.4309
19	5317.03	0.11	1.04	0.04	34.1	CIV(1550)	2.4286
20	5320.12	0.11	1.24	0.05	33.6	CIV(1550)	2.4306
21	5323.68	0.17	0.28	0.04	34.1		
22	5515.76	0.20	0.93	0.06	24.5	FeII(1608)	2.4292
23	5518.87	0.12	0.93	0.06	25.3	FeII(1608)	2.4312
24	5526.48	0.14	1.07	0.07	25.6	CIV(1548)	2.5696
25	5535.48	0.16	0.86	0.08	24.8	CIV(1550)	2.5695
26	5728.90	0.11	1.52	0.07	24.2	SiII(1808)	2.1686
27	5732.57	0.11	2.15	0.07	24.3	SiII(1808)	2.1707
						+AlIII(1670)	2.4311
						+AlIII(1670)	2.4311
Q2342+089							
1	4788.64	0.16	0.64	0.06	26.2	CII(1334)	2.5883
2	4818.85	0.13	2.55	0.08	27.1	MgII(2796)	0.7233
3	4831.49	0.13	1.77	0.07	28.1	MgII(2803)	0.7234
4	4840.89	0.12	2.12	0.07	28.4	CII(1334)	2.6274
5	4936.23	0.14	0.38	0.04	34.6	CIV(1548)	2.1884
6	4944.40	0.13	0.30	0.04	33.5	CIV(1550)	2.1883
7	4994.38	0.16	0.34	0.05	28.7		
8	5002.03	0.15	1.12	0.07	28.6	SiIV(1393)	2.5889
9	5023.81	0.17	0.32	0.05	28.4		
10	5032.49	0.16	0.22	0.04	28.2		
11	5035.06	0.20	0.70	0.07	28.0	SiIV(1402)	2.5894
12	5055.30	0.13	1.89	0.07	29.1	SiIV(1393)	2.6271
13	5059.00	0.16	0.38	0.05	27.4	SiIV(1393)	2.6298
14	5088.04	0.14	1.36	0.07	27.6	SiIV(1402)	2.6271
15	5091.31	0.20	0.39	0.06	26.2	SiIV(1402)	2.6295
16	5110.99	0.18	0.31	0.06	25.7	SiII(1526)	2.3477
17	5139.80	0.14	0.58	0.05	26.3	MgII(2796)	0.8380
18	5153.13	0.22	0.46	0.07	25.7	MgII(2803)	0.8381
19	5181.29	0.12	1.10	0.05	26.6	CIV(1548)	2.3466
20	5183.63	0.12	1.27	0.06	26.4	CIV(1548)	2.3482
21	5189.82	0.13	0.86	0.06	26.4	CIV(1550)	2.3466
22	5192.60	0.14	1.00	0.07	26.2	CIV(1550)	2.3484
23	5214.69	0.16	0.61	0.06	25.7		
24	5331.99	0.12	1.07	0.05	33.7	CIV(1548)	2.4443
25	5341.23	0.15	0.86	0.06	33.5	CIV(1550)	2.4440

TABLE 3—Continued

No.	λ_{obs}	$\sigma(\lambda)$	W_{obs}	$\sigma(W)$	S/N	ID	z_{abs}
Q2344+125							
1	4775.70	0.24	0.78	0.08	27.4	SiIV(1393)	2.4265
2	4796.90	0.18	1.24	0.07	28.4	FeII(2344)	1.0463
3	4806.54	0.25	0.63	0.08	26.4	SiIV(1402)	2.4265
4	4859.54	0.16	0.68	0.06	27.1	FeII(2374)	1.0466
5	4876.44	0.19	1.36	0.08	28.8	FeII(2382)	1.0466
6	5070.74	0.26	0.45	0.06	33.1	CIV(1548)	2.2752
7	5079.74	0.22	0.22	0.04	31.7	CIV(1550)	2.2756
8	5159.12	0.25	0.33	0.05	33.1	SiIV(1393)	2.7016
9	5270.36	0.20	0.42	0.06	28.2	SiIV(1393)	2.7814
10	5293.61	0.19	0.98	0.07	28.8	FeII(2586)	1.0465
11	5304.66	0.16	1.83	0.08	27.7	CIV(1548)	2.4263
12	5309.37	0.19	0.65	0.07	27.9	+SiIV(1402)	2.7816
13	5314.05	0.16	0.99	0.07	27.8	CIV(1548)	2.4294
14	5317.74	0.20	0.32	0.05	28.9	CIV(1550)	2.4267
15	5321.42	0.16	1.40	0.07	29.6	FeII(2600)	2.4291
16	5329.78	0.25	0.32	0.06	26.3	+CIV(1548)	1.0466
17	5401.14	0.18	0.59	0.06	27.5	CIV(1550)	2.4372
18	5628.23	0.28	0.51	0.09	20.7	CIV(1548)	2.4369
19	5636.27	0.34	0.53	0.10	20.2	CIV(1550)	2.6353
20	5722.81	0.15	1.59	0.09	19.7	MgII(2796)	2.6345
21	5730.93	0.29	0.86	0.12	19.6	+CIV(1548)	1.0465
22	5738.30	0.16	2.10	0.11	19.3	+CIV(1550)	2.6964
23	5809.26	0.21	0.54	0.09	17.7	+CIV(1548)	2.6964
24	5811.47	0.19	0.68	0.10	16.7	MgII(2803)	2.7017
25	5854.63	0.18	0.98	0.12	13.7	+CIV(1550)	1.0468
26	5864.77	0.22	1.00	0.14	13.2	CIV(1548)	2.7003
						CIV(1550)	2.7816
						CIV(1550)	2.7818

$z_{\text{abs}} = 1.1109, 1.127$.—This very strong low-redshift system is double, with a velocity splitting of $\sim 250 \text{ km s}^{-1}$. We observe the splitting in the lines of both Mg II and Fe II.

$z_{\text{abs}} = 2.4933$.—This redshift is based on the C IV doublet only, and although the doublet is fairly weak, we regard this system as almost certain because of the good redshift agreement and the reasonable relative strengths of the lines.

$z_{\text{abs}} = 2.7980, 2.8002$.—This multiple C IV system is certain, although some confusion does result from the very strong Mg II lines in the same spectral region. Si IV lines are identified for the higher redshift component.

$z_{\text{abs}} = 3.2265$.—We regard this very high redshift C IV doublet as quite probable, although the $\lambda 1550$ component appears to be affected by a noise spike. The redshift agreement is quite good, and there is a possible identification of corresponding Si IV $\lambda 1393$.

c) Q0058 + 019

This QSO is also known as PHL 938 and UM 297. Its absorption spectrum has been studied most recently by Peterson *et al.* (1977); in the wavelength range of our observations, they identify both the C IV system and the low-redshift Mg II system. Our line identifications agree well with theirs, although we have detected several lines in the C IV system which were too weak to be detected in the previous study. Also, there is a systematic difference in the wavelengths which they list; we suspect that this is because their wavelengths were not corrected to heliocentric, vacuum values.

$z_{\text{abs}} = 0.6128$.—This strong low-redshift system is based upon lines of Mg II, Fe II, and Mg I.

$z_{\text{abs}} = 1.4636$.—This is a certain system; in addition to an unambiguous C IV doublet, we find the Si IV doublet and weak lines of Al II and Al III.

d) Q0112 + 030

This object is the first of several in our sample which were discovered by Hazard on objective prism plates obtained with the UK Schmidt telescope. They were confirmed to be QSOs by the present authors, generally on the basis of low-resolution spectra. The accurate positions of these objects will be reported elsewhere as part of a larger study of Hazard's objects (Sargent, Hazard, and McMahon 1988). We chose the brightest objective prism QSOs in the appropriate redshift range for the present survey. Where necessary, rough magnitudes were established from the count rates obtained in preliminary high-resolution observations. The signal-to-noise ratios of the low-resolution observations were generally too poor to give any *a priori* knowledge of the absorption spectra of these QSOs. Q0112 + 030 has two absorption redshifts:

$z_{\text{abs}} = 1.2449, 1.2458$.—This strong double system is identified only by lines of Fe II; Mg II $\lambda\lambda 2796, 2803$ is outside the observed range.

$z_{\text{abs}} = 2.4234$.—This system is certain; in addition to the doublets of C IV and Si IV, we identify lines of Si II, Fe II, and Al II.

e) Q0114–089

There are no published high-resolution studies of this QSO. It is one of the few QSOs in the sample whose spectrum does

not include the C IV emission line; however, we find two unambiguous redshifts based upon the C IV doublet:

$z_{\text{abs}} = 2.2995$.—This certain system is established by a strong C IV doublet falling close to the Ly α forest.

$z_{\text{abs}} = 2.5394$.—This C IV doublet is somewhat weaker, but there is little doubt as to its identification.

f) Q0119–046

This QSO was the subject of a detailed study by Sargent, Young, and Boksenberg (1982). This work investigated the properties of absorption systems with $z_{\text{abs}} > z_{\text{em}}$. Because of its brightness and because it was observed using the same instrumental setup as for our new data, we have included this QSO in the sample.

g) Q0142–100

This object, also known as UM 673, was recently discovered to be gravitationally lensed by Surdej *et al.* (1988). We observed the brighter component (UM 673a). Because of the poor seeing at the time of our observations, we did not notice the fainter component, UM 673b ($B = 19.1$ mag), only 2''2 away. UM 673 has five C IV doublets in its spectrum, defining five absorption redshifts:

$z_{\text{abs}} = 1.9405, 1.9416, 1.9444$.—This complex of redshifts is based on three partially blended C IV doublets. For the strongest redshift component we find corresponding lines of Si IV, Si II, C II, and Al II.

$z_{\text{abs}} = 2.3245$.—This C IV doublet is very weak and clearly would not have been detected in a spectrum with a slightly lower signal-to-noise ratio.

$z_{\text{abs}} = 2.3561$.—This system is very strong and is quite certain. Unfortunately the spectrum cuts off on the blue end just before the expected position of the Si IV $\lambda 1393$ line, so only the weaker component of the Si IV doublet is identified. The system is clearly highly ionized, since associated Si II $\lambda 1526$ is not present.

h) Q0150–203

In the spectrum of this QSO (also known as UM 675) we find two low-redshift Mg II doublets as well as three fairly weak systems based on the identification of C IV doublets:

$z_{\text{abs}} = 0.3892$.—This system, identified only by the Mg II doublet, is probably blended with a second component at $z_{\text{abs}} = 0.3882$, although only $\lambda 2796$ is sufficiently resolved to allow separate identifications at $1.5 \text{ \AA}$ resolution.

$z_{\text{abs}} = 0.7800$.—In addition to the Mg II $\lambda\lambda 2796, 2803$ doublet, we also identify a weak line of Fe II in this system.

$z_{\text{abs}} = 1.7666$.—This certain system is identified only by a weak C IV doublet.

$z_{\text{abs}} = 1.9287$.—Another system which is only probable, based on the weak C IV doublet.

$z_{\text{abs}} = 2.0083, 2.0097$.—Although all of the components of this complex are very weak, the reasonably good redshift agreement between components causes us to regard this double system as almost certain.

i) Q0151 + 048

The spectrum of this QSO (also referred to as UM 144 and PHL 1222) has been studied previously by Weymann *et al.*

(1979). It is one of the four QSOs from the Weymann *et al.* sample which was not reobserved by Foltz *et al.* (1986). Weymann *et al.* identified four absorption systems in the spectrum, with $z_{\text{abs}} = 1.467, 1.561, 1.618, \text{ and } 1.934$. We agree in the identification of all four systems, and find several others:

$z_{\text{abs}} = 1.4680$.—This redshift is identified only by a relatively weak, but certain, C IV doublet.

$z_{\text{abs}} = 1.5612$.—This is another certain redshift indicated by a fairly weak C IV doublet only.

$z_{\text{abs}} = 1.6189$.—This system has weak Si IV lines and possible Al II $\lambda 1670$ in addition to a strong C IV doublet. We regard this system as certain based on the C IV lines. It should be noted that each of the components of the C IV doublet also corresponds to the expected location of Si II $\lambda 1526$ lines associated with the complex of systems at $z_{\text{abs}} \approx 1.66$.

$z_{\text{abs}} = 1.6534, 1.6557, 1.6581, 1.6601$.—This is a certain, unusual complex of C IV doublets; however, despite the fact that there is good redshift agreement between the C IV $\lambda\lambda 1548, 1550$ lines, the decomposition into four components may have to be revised when higher resolution observations are obtained. We find Si IV lines corresponding only to the lowest redshift component, $z_{\text{abs}} = 1.6534$. The velocity spread of this complex is $\approx 750 \text{ km s}^{-1}$. It is interesting that no feature at this redshift was identified by Weymann *et al.*, as the total equivalent width of the complex is of order 5 Å.

$z_{\text{abs}} = 1.8266$.—This system contains only a weak C IV doublet.

$z_{\text{abs}} = 1.9342$.—This is certain system which contains many lines of both high and low ionization. Its redshift is $\sim 3000 \text{ km s}^{-1}$ greater than the adopted emission redshift of the QSO.

j) Q0207-003

This QSO is also known as UM 402. We find one strong low-redshift system and three high-redshift C IV systems:

$z_{\text{abs}} = 1.0441, 1.0451$.—This strong system is very interesting because it exhibits a splitting on a scale of $\sim 150 \text{ km s}^{-1}$. The lower redshift component is somewhat stronger.

$z_{\text{abs}} = 2.5231$.—Both low- and high-ionization lines are strong in this certain system.

$z_{\text{abs}} = 2.5744$.—We regard this system as certain, as doublets of both C IV and Si IV are identified. There is a possibility that Si II $\lambda 1526$ from this system is blended with C IV $\lambda 1550$ from the previous system, but the Si II $\lambda 1526$ would have to be weak.

$z_{\text{abs}} = 2.5915$.—This system is certain because of the excellent redshift agreement between the two lines of the C IV doublet.

Line number 15 in the line list is probably C IV $\lambda 1548$ at a redshift of 2.546; the presence of the other component is suggested by the plot, but the line is not strong enough to satisfy the criterion for acceptance. There appears to be an unusual concentration of C IV doublets over the range 5440–5550 Å in this spectrum.

k) Q0216+080

We note the very large equivalent width of the Ly α emission line in this spectrum. This is another case where our data

do not extend to the C IV emission line. We find four C IV absorption redshifts in the spectrum:

$z_{\text{abs}} = 2.2821$.—We must regard this redshift as only probable, as the longer wavelength component of the C IV doublet is barely resolved from another line identified as Si II $\lambda 1526$ from another system.

$z_{\text{abs}} = 2.2931$.—This system is certain and has very strong low-ionization lines in addition to the C IV doublet.

$z_{\text{abs}} = 2.3361$.—The C IV doublet in this system just barely satisfies the criteria for acceptance. The line identified as Si II $\lambda 1526$ may not be correct, as it falls in a complex.

$z_{\text{abs}} = 2.7204$.—This redshift has only a C IV doublet, but the redshift agreement between the components is good and the doublet ratio is reasonable.

l) Q0226-038

This QSO, also known as PHL 1305, was studied by YSB. It is a known radio and X-ray source. The increased sensitivity and resolution of our new observations allow many more absorption lines to be added to the line list, and we find one absorption redshift, whereas none were found by YSB:

$z_{\text{abs}} = 2.0435$.—This redshift is confirmed by the identification of the C IV and Si IV doublets.

There are several very weak lines in this spectrum which remain unidentified.

m) Q0229+131

This QSO is a known radio and X-ray source. Its spectrum was previously studied by Kinman and Burbidge (1967) at much lower resolution. They found one unidentified absorption line shortward of Ly α emission. We identify six absorption redshifts, four of which are C IV systems:

$z_{\text{abs}} = 0.3723$.—This weak, low-redshift system has only the Mg II $\lambda\lambda 2796, 2803$ doublet.

$z_{\text{abs}} = 0.4177$.—This low-redshift system is certain; the Mg II doublet is relatively strong. There is also the possibility that Mg I $\lambda 2852$ may be blended with an Si IV line from another system.

$z_{\text{abs}} = 1.8605, 1.8622$.—The clump of absorption lines near 4435 Å is clearly a C IV complex which we have divided into two components, although there may be more. C II $\lambda 1334$ lines are identified for each of the components. Si IV lines are identified for the higher redshift component only.

$z_{\text{abs}} = 1.9024$.—This is a certain, high-ionization system. The doublets of C IV and Si IV are identified, but no C II or Si II is found.

n) Q0237-233

This QSO, a known radio and X-ray source, is also one of the most interesting and well-studied optically because of its brightness. YSB studied the spectrum at lower resolution, and it was studied by Boroson *et al.* (1978) at high resolution. Our new spectrum has similar resolution to that of Boroson *et al.*, with significantly higher signal-to-noise ratios and larger wavelength coverage. We made no attempt to identify C IV doublets which fall in the Ly α forest. Boroson *et al.* found 45 possible C IV doublets in the wavelength range 3700–4300 Å; in the same range, we find only 11. We suspect that many of

the weak doublets identified by Boroson *et al.* are spurious. A new, complete discussion of the absorption spectrum of Q0237–233 is in preparation (Sargent, Lin, and Boksenberg 1988). Below we discuss the identified absorption redshifts from our new spectra:

$z_{\text{abs}} = 1.3652$.—While the C IV doublet from this absorption system is buried in the Ly α forest, there are many other lines which make this redshift certain. The Al III $\lambda\lambda 1854$, 1862 doublet is identified, as well as Al II $\lambda 1670$ and two lines of Fe II.

$z_{\text{abs}} = 1.5959, 1.5972$.—The reality of these two strong C IV doublets is certain; however, no other lines are found for this absorption redshift.

$z_{\text{abs}} = 1.6109$.—Although only the C IV doublet defines this redshift, it is unambiguous and definitely real.

$z_{\text{abs}} = 1.6563, 1.6576, 1.6588, 1.6604$.—This complex of four C IV doublets was identified as only one redshift in the lower resolution spectrum of YSB; although the redshifts differed slightly, Boroson *et al.* also found this complex to be split into four components. An Al III doublet corresponding to the component at $z_{\text{abs}} = 1.6576$ is identified, as is the Si II $\lambda 1526$ line. Si II $\lambda 1260$ lines are found for all four components.

$z_{\text{abs}} = 1.6711, 1.6724, 1.6740, 1.6754$.—This is another, slightly better resolved complex of four C IV doublets. Our identifications are again consistent with those of Boroson *et al.* Si II $\lambda 1526$ lines are identified for the middle two components, and C II, Si IV, and Si II $\lambda 1260$ lines are identified for several of the components.

$z_{\text{abs}} = 2.0422$.—This redshift has only a weak C IV doublet. We regard it as possible.

$z_{\text{abs}} = 2.2028$.—Although the C IV doublet line strength ratio is unphysical (because of uncertainty in the continuum level in the vicinity of the C IV emission line), the reality of this system is certain. We have made tentative identifications of Si IV $\lambda 1393$, Si III $\lambda 1206$, and H I $\lambda 1216$ from this system.

o) Q0329–255

This QSO is a Parkes radio source. We have identified one absorption redshift in its spectrum:

$z_{\text{abs}} = 2.4550$.—This redshift is certain, as both the C IV and Si IV doublets are identified.

p) Q0348 + 061

We find six absorption redshifts in the spectrum of this QSO, five of them identified by doublets of C IV:

$z_{\text{abs}} = 0.3997$.—A single Mg II doublet defines this redshift.

$z_{\text{abs}} = 1.7975$.—This redshift is certain and is based upon the relatively strong C IV doublet.

$z_{\text{abs}} = 1.8409$.—While the identification of this C IV doublet appears to be certain, there is a third line (or noise spike) in between the two components of the doublet.

$z_{\text{abs}} = 1.9681$.—This redshift is certain and is based on the C IV doublet and C II $\lambda 1334$ and possibly Si IV $\lambda 1393$.

$z_{\text{abs}} = 2.0237$.—This redshift is based on the strong C IV doublet and a possible identification of Si IV $\lambda 1393$.

$z_{\text{abs}} = 2.0330$.—Doublets of both C IV and Si IV define this certain redshift.

q) Q0421 + 019

This QSO is a Parkes radio source; it was studied by Young, Sargent, and Boksenberg (1982*a*), where the absorption systems are discussed in detail. This is one of three objects in our sample for which the data are not new.

r) Q0424–131

This QSO is another Parkes radio source, and it is also a known X-ray source. Its absorption spectrum was studied by Roberts *et al.* (1978) using photographic image tube spectra which were not sky-subtracted. Roberts *et al.* list 92 absorption lines between 3600 and 5100 Å. We find 10 absorption redshifts in the spectrum, seven of which are identified by the C IV doublet:

$z_{\text{abs}} = 0.6602$.—Four lines of Fe II define this low-redshift absorption system. It was not found by Roberts *et al.*

$z_{\text{abs}} = 0.6999$.—This low-redshift system is less certain; two lines of Fe II, and possibly Mg I $\lambda 2852$, are identified. There is no detectable Mg II absorption at this redshift, which is also not found by Roberts *et al.*

$z_{\text{abs}} = 1.0348$.—Three lines of Fe II define this absorption redshift. The Fe II $\lambda 2382$ line is possibly blended with Mg I from the previous system. Roberts *et al.* find the same three Fe II lines and give $z_{\text{abs}} = 1.0435$.

$z_{\text{abs}} = 1.5519, 1.5527$.—We regard this pair of redshifts as certain; both components are defined by the C IV doublet. They were not listed by Roberts *et al.*

$z_{\text{abs}} = 1.5615$.—This certain redshift is identified by a strong C IV doublet; the doublet ratio indicates that either the $\lambda 1550$ component is a blend or the lines are saturated and it is simply the measurement errors which make the $\lambda 1550$ component the stronger of the two. We suggest a possible identification of the Si II $\lambda 1808$ line, although the redshift agreement is not particularly good. Roberts *et al.* find the same C IV doublet and give $z_{\text{abs}} = 1.5611$.

$z_{\text{abs}} = 1.7161$.—This redshift is certain, with the C IV doublet, Si II $\lambda 1526$, and Al II $\lambda 1670$ identified. Roberts *et al.* find six lines and give $z_{\text{abs}} = 1.7152$.

$z_{\text{abs}} = 1.7886$.—We regard this system as possible; there is again a line (unidentified) between the two components of the C IV doublet. The redshift agreement between the two components is quite good, however. Roberts *et al.* did not find this system because of blending problems between the three lines.

$z_{\text{abs}} = 2.1332$.—We suspect that this C IV doublet is real, despite the fact that the $\lambda 1548$ component is badly blended with a line of Fe II from another system. We find the corresponding Ly α line, as well as a probable strong doublet of N V, indicating very high ionization. Roberts *et al.* found the same lines at $z_{\text{abs}} = 2.1333$.

$z_{\text{abs}} = 2.1731$.—This redshift is based on Ly α and on a C IV doublet which appears just redward of the peak of the C IV emission line. The same lines were found by Roberts *et al.*, who give $z_{\text{abs}} = 2.1729$.

Roberts *et al.* found 13 additional redshifts in their spectrum, namely $z_{\text{abs}} = 0.7472, 0.8757, 1.0018, 1.0398, 1.0473, 1.5321, 1.5785, 1.7059, 1.7684, 2.1505, 2.1585, 2.1633$, and 2.1752. Of these, only $z_{\text{abs}} = 2.1633$ and 2.1752 were regarded as certain; $z_{\text{abs}} = 2.1585$ was listed as “probable,” and the rest as “possible.” On examining our line list, we find only

three out of the 10 lines identified by Roberts *et al.* with $z_{\text{abs}} = 2.1633$, namely Ly α , Si II $\lambda 1190$, and Si III $\lambda 1206$ (for which the wavelength agreement is poor). For $z_{\text{abs}} = 2.1752$, out of the six lines identified by Roberts *et al.*, we find only the line identified with Ly α (which was already identified by both us and Roberts *et al.* as Ly α at $z_{\text{abs}} = 2.1729$). Similarly, out of the four lines identified by Roberts *et al.* with $z_{\text{abs}} = 2.1585$, we find only the strongest line, which they identified as Ly α . Thus, we find no evidence for the three strongest additional redshift systems found by Roberts *et al.*

s) Q0440-168

This QSO, which was provided by Hazard (see § III d), has a spectrum which is dominated by lines from low-redshift Mg II systems. In addition, two C IV redshifts are found.

$z_{\text{abs}} = 1.0067, 1.0077$.—This is a strong, double system with velocity splitting of $\sim 150 \text{ km s}^{-1}$. Lines of Mg II, Mg I, and Fe II are identified.

$z_{\text{abs}} = 2.2142$.—We regard this system as certain; it appears that there may in fact be two overlapping C IV doublets, although no C IV $\lambda 1550$ line for the possible second doublet has made the line list.

$z_{\text{abs}} = 2.2290$.—This system is identified by an unambiguous C IV doublet and possibly Fe II $\lambda 1608$, which may be involved in a blend with Fe II $\lambda 2585$ from a lower redshift system.

t) Q0449-135

This is another unpublished Hazard QSO (see § III d). We note the extremely strong N V and Si IV absorption in the spectrum; it is possible that this object might be classified as a marginal BAL QSO. Only one C IV doublet is identified in the spectrum, although an additional high-redshift absorption system (for which C IV would be beyond the highest wavelength in our spectrum) is indicated by lines of other ions.

$z_{\text{abs}} = 1.2667$.—Three lines of Fe II define this certain redshift; the Mg II $\lambda\lambda 2796, 2803$ doublet falls outside the observed range.

$z_{\text{abs}} = 2.3132$.—An unambiguous C IV doublet defines this redshift; no other lines are identified.

$z_{\text{abs}} = 3.0536$.—Although C IV absorption is not within the wavelength range of our spectrum for this system, broad doublets of N V and Si IV make it a certain redshift.

u) Q0450-132

This QSO is also unpublished and provided by Hazard (see § III d). We find five absorption redshifts in its spectrum, three of which are high-redshift C IV systems.

$z_{\text{abs}} = 0.4940$.—This redshift is defined by an unambiguous Mg II doublet.

$z_{\text{abs}} = 1.1745$.—Three strong Fe II lines are identified in this system, which is certain. Mg II does not fall within our observed wavelength range.

$z_{\text{abs}} = 2.0669$.—This certain system has strong low- and high-ionization lines. The doublets of C IV and Si IV are identified, as well as C II $\lambda 1334$, Al II $\lambda 1670$, and Si II $\lambda 1526$. Fe II $\lambda 1608$ is possibly present and blended with Si II $\lambda 1526$ from another system.

$z_{\text{abs}} = 2.1063$.—This certain system has strong C IV and Si IV doublets and relatively weak C II $\lambda 1334$. No Si II $\lambda 1526$ line is identified.

$z_{\text{abs}} = 2.2315$.—This certain redshift has very strong C IV absorption, fairly weak Si IV, and probable Si II $\lambda 1526$ which is blended with Fe II $\lambda 1608$ from the system with $z_{\text{abs}} = 2.0669$.

v) Q0528-250

This well-studied QSO is a Parkes radio source and also a known X-ray source. Its absorption spectrum has been analyzed by several authors, most recently by Chen and Morton (1984). It is a very interesting spectrum in that the Ly α emission line is virtually nonexistent because of extremely strong absorption. Our spectrum is consistent with that of Chen and Morton, except that we have detected some weak lines which they did not identify. We find the following absorption redshifts:

$z_{\text{abs}} = 0.9441$.—This redshift is suggested by a relatively weak Mg II doublet; this was not identified by Chen and Morton.

$z_{\text{abs}} = 2.1408$.—This system is certain; in addition to the C IV doublet, Si II $\lambda 1526$, Fe II $\lambda 1608$, and Al II $\lambda 1670$ are identified.

$z_{\text{abs}} = 2.2057, 2.2080$.—This very strong double system has two barely resolved C IV doublets.

$z_{\text{abs}} = 2.5382$.—This system is suggested by the C IV doublet. In addition, we find Si IV $\lambda 1393$; the Si IV $\lambda 1402$ line is probably lost in the strong C IV features from the previous system.

$z_{\text{abs}} = 2.6736$.—This weak C IV doublet we regard as probable because of the very good redshift agreement between the two components.

$z_{\text{abs}} = 2.8052, 2.8118$.—These are the same systems that are thought to give rise to the extremely strong Ly α absorption which decimates the Ly α emission line. Both of these redshifts are suggested by strong C IV doublets which are slightly redward of the peak of the C IV line. From the lines of Si IV and Si II, an additional component is suggested at $z_{\text{abs}} = 2.8144$.

w) Q0831+128

The spectrum we have obtained of this QSO is only marginally acceptable in terms of the signal-to-noise ratio. We find only one absorption redshift in the spectrum:

$z_{\text{abs}} = 2.0844$.—A strong C IV doublet and Al II $\lambda 1670$ define this redshift.

x) Q0837+109

This is another unpublished QSO provided by Hazard (see § III d). The displayed longer wavelength spectrum is a composite of three red CCD spectra. At least some of the features near $5900 \text{ \AA}$ probably result from poor sky-subtraction. We note that the spectrum is not continuous, but is missing the region between 5400 and $5700 \text{ \AA}$. We find five absorption redshifts in the spectrum:

$z_{\text{abs}} = 1.4634, 1.4648$.—This is another case of a double Mg II absorption system; the velocity splitting between the

two doublets is $\sim 170 \text{ km s}^{-1}$. We regard the identifications as possible.

$z_{\text{abs}} = 2.4165$.—This system, identified by the clear C IV doublet, is certain, although it is not particularly strong.

$z_{\text{abs}} = 2.9558$.—Although the lines of this possible C IV doublet appear noisy, the redshift agreement between the two doublet components is quite good.

$z_{\text{abs}} = 3.1430$.—The identification of this C IV doublet is unambiguous.

y) Q0848 + 163

The spectrum of this QSO (also known as LB 8775) has been studied previously by YSB. Our line identifications are consistent with those of YSB, although we are able to detect weaker lines and to resolve one of the C IV doublets into two redshift components. We also have a possible detection of the Ca II $\lambda 3934$ line at $z_{\text{abs}} = -0.0001$. The other component of this doublet would be expected to be too weak for detection given the small equivalent width of the $\lambda 3934$ line.

$z_{\text{abs}} = 0.5862, 0.5903$.—This is a case of two relatively weak Mg II doublets whose separation is such that the long wavelength component of the first doublet coincides with the short wavelength component of the second. This makes the velocity splitting $\sim 770 \text{ km s}^{-1}$.

$z_{\text{abs}} = 1.4575$.—This very weak C IV doublet must be regarded as only probable.

$z_{\text{abs}} = 1.4686, 1.4704$.—This double system was not resolved by YSB; the low-redshift component is very weak.

$z_{\text{abs}} = 1.9158, 1.9176$.—This multiple system was not resolved into two by YSB because of the lower dispersion of the spectrum. The C IV $\lambda 1550$ line at $z_{\text{abs}} = 1.9175$ is possibly blended with Mg I $\lambda 2852$ from the system at $z_{\text{abs}} = 0.5862$. There is strong N V absorption in the system at $z_{\text{abs}} = 1.9176$.

z) Q0848 + 155

This QSO, also known as LB 8755, is a known X-ray and radio source. The absorption spectrum was studied previously by YSB, and no absorption systems were found. Even with higher dispersion and signal-to-noise ratio, we find no C IV doublets for which both components satisfy the criterion for acceptance.

aa) Q0852 + 197

This QSO is previously unpublished and was provided by Hazard (see § III d). We find three absorption redshifts in its spectrum:

$z_{\text{abs}} = 0.4151$.—This redshift is based upon a fairly weak Mg II doublet.

$z_{\text{abs}} = 1.9399$.—The reality of this C IV doublet is somewhat uncertain, as the lines appear to be affected by a noise spike. We regard its identification as probable.

$z_{\text{abs}} = 2.1716$.—This redshift is certain—the C IV and Si IV doublets are both present.

bb) Q0854 + 191

The absorption spectrum of this QSO (a known radio source) has been studied by Weymann *et al.* (1979), and more recently by Foltz *et al.* (1986). The spectrum presented by

Foltz *et al.* only extended down to $3750 \text{ \AA}$, so that the first three absorption systems or complexes listed below were not identified previously. This spectrum presented special difficulties in line identification because of the many complexes and many possible multiple identifications.

$z_{\text{abs}} = 0.2711$.—This redshift would probably have been left unidentified were it not for the corresponding line of Mg I lending credence to the identification. The Mg II doublet is buried within a probable complex of C IV doublets from another system.

$z_{\text{abs}} = 1.2954, 1.2973, 1.3019$.—The decomposition of this complex of redshifts cannot be regarded as certain because of the possibility of blending with the Mg II lines at $z_{\text{abs}} = 0.2711$, which are expected in the same wavelength region as the identified C IV doublets. However, although the redshifts of the individual components are difficult to measure with certainty, the complex is almost certainly C IV.

$z_{\text{abs}} = 1.3522, 1.3543, 1.3558$.—This is another C IV complex for which there is confusion with possible lines from other systems. Attributions of the lines to individual components must be regarded as tentative.

$z_{\text{abs}} = 1.4754$.—This redshift must be regarded as only possible, since the lines are weak and the $\lambda 1550$ line is also identified as a line of Al II from another system. Neither of the C IV lines were identified by Foltz *et al.* We also suggest the possible identification of Mg I $\lambda 1827$ associated with this redshift.

$z_{\text{abs}} = 1.6916$.—This is another possible redshift, identified only by a C IV doublet for which the redshift agreement between the lines is not particularly good. This system is possibly spurious.

$z_{\text{abs}} = 1.7323, 1.7367$.—This strong double system is also identified by Foltz *et al.*; both redshift components probably have corresponding C II $\lambda 1334$ in addition to the C IV doublet, although this cannot be said with certainty because of possible blends with C IV lines from another system. We identify Si II $\lambda 1526$ for the higher redshift component, as did Foltz *et al.*

$z_{\text{abs}} = 1.8424$.—This redshift is unambiguous because of the clear C IV doublet (although the doublet ratio is slightly unphysical, possibly indicating that the $\lambda 1548$ line is blended), and our identifications agree well with those of Foltz *et al.*

$z_{\text{abs}} = 1.8550$.—Again we agree quite well with the identification suggested by Foltz *et al.*, although we do find the lines to be significantly stronger. However, our redshift agreement between the two components of the C IV doublet is not as good, so it is possible that our spectrum is affected by a noise spike or poor sky-subtraction.

cc) Q0913 + 072

This QSO was included in our sample despite the fact that only about $500 \text{ \AA}$ of the spectrum is useful for the possible detection of C IV. Despite this, we find four absorption redshifts:

$z_{\text{abs}} = 2.0002$.—We regard this system as certain; in addition to the C IV doublet, we identify lines of C II and Si IV.

$z_{\text{abs}} = 2.0440$.—This is another certain system, as it too has the C IV and Si IV doublets, as well as C II $\lambda 1334$.

$z_{\text{abs}} = 2.0637$.—This redshift is unambiguous, with a clear C IV doublet, and possibly the Si IV doublet within the Ly α forest.

$z_{\text{abs}} = 2.1460$.—This system is less certain, as the doublet ratio for C IV is unphysical. However, the redshift agreement is fairly good.

dd) Q0958 + 551

The spectrum of this QSO (also known as Markarian 132) has been studied most recently by Foltz *et al.* (1986). Again, their spectrum covered a slightly smaller wavelength range. We find seven absorption redshifts, with only the last two in the range covered by the spectrum obtained by Foltz *et al.*

$z_{\text{abs}} = 0.2413$.—This Mg II doublet we regard as probable.

$z_{\text{abs}} = 1.2726, 1.2768$.—There is little doubt as to the reality of the first component of this complex.

$z_{\text{abs}} = 1.3563$.—This is a certain system despite the fact that C IV $\lambda 1548$ is blended with C II $\lambda 1334$ from another system. We have also identified a possible line of Si II $\lambda 1526$ in this system.

$z_{\text{abs}} = 1.3771$.—The redshift agreement for this C IV doublet is very good, although the lines are quite weak.

$z_{\text{abs}} = 1.7310, 1.7330$.—This barely resolved double redshift was identified by Foltz *et al.* as one system. In addition to the C IV doublets, the C II $\lambda 1334$ line is also identified, although it is involved in a blend with C IV from another system.

ee) Q1017 + 280

The spectrum of this QSO (also known as Ton 34) was studied previously by YSB. Our new spectra for this object have exceptionally high signal-to-noise ratios (S/N ~ 75 in the wavelength region between the Ly α and the C IV emission lines). They were obtained as part of an experiment to see if numerous weak absorption redshifts would appear. A more extended discussion of the spectrum will be given elsewhere (Sargent, Boksenberg, and Bridger 1988). In addition to the two absorption redshifts found by YSB, we find several more weak high-redshift systems and Galactic Ca II absorption:

$z_{\text{abs}} = 0.0000$.—Although the short wavelength component of the Ca II doublet is blended with a weak C IV line from another system, we regard this Galactic system as probable.

$z_{\text{abs}} = 1.5368$.—This weak C IV doublet must be regarded as only possible; the redshift agreement is not particularly good, probably due to the blending of the $\lambda 1550$ component with Ca II $\lambda 3934$ from another system.

$z_{\text{abs}} = 1.5951$.—Only the C IV doublet is identified for this redshift, but there is little doubt that the system is real because of the excellent redshift agreement between the two components.

$z_{\text{abs}} = 1.6081$.—This certain system was also found by YSB; the agreement between our wavelengths and those of YSB is quite good. In addition to the C IV doublet, we also identify the Si IV doublet (which was not found by YSB because the signal-to-noise ratio was not adequate) and C II $\lambda 1334$.

$z_{\text{abs}} = 1.7667$.—This extremely weak C IV doublet is probably real. It probably would not have been detected in any of the other spectra obtained as part of the survey.

$z_{\text{abs}} = 1.7984$.—The strong C IV doublet lines were the only lines found by YSB; we have found, in addition, a weak Si IV

$\lambda 1393$ line and Ly α (which is outside the wavelength range observed by YSB).

$z_{\text{abs}} = 1.8343$.—This is another very weak C IV doublet that is only detected because of the unusually high signal-to-noise ratio of the spectrum.

ff) Q1054–034

This QSO is a known radio and X-ray source. Its absorption spectrum was studied previously by YSB; we find, as did YSB, that there are no detectable metal lines in the spectrum. It is quite rare in this respect.

gg) Q1115 + 080

This gravitationally lensed QSO was the subject of a high-resolution study by Young, Sargent, and Boksenberg (1982*b*) (details of the observations, reductions, and results can be found there); it has been included in our sample because the observational setup was the same as for the rest of our observations, and the object would have qualified for our survey sample on the basis of its brightness.

hh) Q1138 + 040

The absorption spectrum of this QSO has not been studied previously. We find only one absorption redshift:

$z_{\text{abs}} = 1.5840$.—This redshift is certain based on the clear C IV doublet; no other lines from this system are identified.

ii) Q1148–001

The spectrum of this QSO (a Parkes radio source) has been studied previously by YSB. We find two absorption redshifts, one of which was also identified by YSB:

$z_{\text{abs}} = 1.4669$.—This redshift, identified by the strong C IV doublet, was detected by YSB. Our equivalent widths and redshifts agree well with those found by YSB.

$z_{\text{abs}} = 1.9861$.—This C IV doublet, which falls right in the C IV emission line, was not detected by YSB; their spectrum is quite noisy in this region. There is little doubt as to the reality of the redshift.

jj) Q1159 + 124

Parts of the spectrum of this very high redshift QSO were obtained previously by Hazard *et al.* (1984); the data which we present here are of much better resolution. The abrupt change of signal-to-noise ratio at 6060 Å is due to the fact that a CCD was used at the longest wavelengths. We find three absorption redshifts in the spectrum, only one of which is certainly real. Several other possibilities for absorption redshifts which do not have C IV or Mg II doublets are indicated in the line list.

$z_{\text{abs}} = 3.2256$.—This C IV doublet looks real although the redshift agreement is fairly poor.

$z_{\text{abs}} = 3.2614$.—This weak C IV doublet is regarded as only possible.

$z_{\text{abs}} = 3.5261$.—This extremely strong system is certain; doublets of C IV, Si IV, and N V are found, as well as Ly α and Ly β . The spectrum obtained by Hazard *et al.* (1984) shows that this system is also a Lyman limit absorber.

kk) Q1213 + 094

The absorption spectrum of this QSO has not been studied previously. We find four absorption redshifts:

$z_{\text{abs}} = 1.9634$.—We find only a strong, optically thin C IV doublet to identify this redshift; there is, however, little doubt as to its reality.

$z_{\text{abs}} = 2.0935$.—This C IV doublet is unambiguous. It appears that two components would be resolved with slightly higher resolution.

$z_{\text{abs}} = 2.2345$.—Strong doublets of C IV and Si IV make this system certain. There is a possible identification of C II $\lambda 1334$ in the Ly α forest.

$z_{\text{abs}} = 2.5228$.—Although the C IV doublet is somewhat affected by noise, the system is certain; the damped Ly α line, the Si IV doublet, and Si II $\lambda 1526$ confirm its reality. The identification of N V $\lambda 1238$ is unlikely to be correct because we do not find the corresponding long-wavelength component of the doublet.

ll) Q1222 + 228

This QSO, also called Ton 1530, is a known X-ray source. Its absorption spectrum has been studied previously by YSB, who found three absorption redshifts. We find six in our spectrum:

$z_{\text{abs}} = 0.6681$.—This unambiguous Mg II doublet was also found by YSB. Our measured equivalent widths are somewhat larger, particularly for the $\lambda 2803$ component.

$z_{\text{abs}} = 1.4867$.—This C IV doublet was also detected by YSB, although again there are differences in measured equivalent widths.

$z_{\text{abs}} = 1.5239$.—This C IV doublet is unambiguous in our spectrum. It was not detected by YSB because of the lower resolution and signal-to-noise ratio of their spectrum.

$z_{\text{abs}} = 1.9372$.—The very strong C IV doublet in this system was also identified by YSB; in addition, we find the corresponding Si IV doublet, together with Si II $\lambda 1526$ and C II $\lambda 1334$.

$z_{\text{abs}} = 1.9805$.—A weak C IV doublet defines this redshift; it was not detected in YSB's spectrum.

$z_{\text{abs}} = 2.0555$.—This is another unambiguous C IV doublet which was not detected in the spectrum of YSB.

mm) Q1245 + 345

We find two absorption redshifts in the spectrum of this QSO:

$z_{\text{abs}} = 1.6106$.—The C IV doublet is slightly odd looking, but the system is still regarded as certain.

$z_{\text{abs}} = 1.6778$.—This strong C IV doublet is a certain identification.

nn) Q1247 + 267

The absorption spectrum of this very bright QSO has been studied previously by YSB. We find three absorption redshifts, whereas only one was found by YSB:

$z_{\text{abs}} = 1.4063$.—This very weak C IV doublet is certain in a spectrum of such high quality.

$z_{\text{abs}} = 1.4083$.—This redshift is indicated by an unambiguous C IV doublet; there is also a possible identification of

Si IV $\lambda 1393$, although it must be considered suspect because it is found in the Ly α forest.

$z_{\text{abs}} = 1.9597$.—Although this redshift looks certain, a noise spike appears to have affected the $\lambda 1550$ component of the C IV doublet, resulting in an unphysical doublet ratio.

oo) Q1329 + 412

We find four distinct absorption redshifts in the spectrum of this QSO:

$z_{\text{abs}} = 0.5009$.—Although the lines are weak, we regard this Mg II doublet as probable.

$z_{\text{abs}} = 1.4716$.—This C IV doublet is unambiguous.

$z_{\text{abs}} = 1.6010$.—The $\lambda 1548$ component of this strong C IV doublet is almost certainly blended, probably with another C IV doublet with a slightly different redshift.

$z_{\text{abs}} = 1.8359, 1.8401$.—This is apparently a case of two C IV doublets arranged so that the $\lambda 1550$ component of one coincides with the $\lambda 1548$ component of the other.

$z_{\text{abs}} = 1.9405$.—This moderately strong C IV doublet is certainly real; there is no detectable Si IV or Si II belonging to this redshift.

pp) Q1331 + 170

The absorption spectrum of this bright QSO was studied previously by YSB and earlier workers. The QSO is both a radio and an X-ray source. We find the following absorption redshifts:

$z_{\text{abs}} = -0.0001$.—Although the redshift agreement is not perfect, we regard this identification of Galactic Ca II as probable.

$z_{\text{abs}} = 0.7443, 0.7454$.—This is a strong, certain double low-ionization system identified by strong Mg II and Fe II lines. The implied separation of the two components is $\sim 170 \text{ km s}^{-1}$.

$z_{\text{abs}} = 0.9539$.—Although the expected Mg II lines do not fall in the observed wavelength range, this redshift is suggested by two strong lines of Fe II.

$z_{\text{abs}} = 1.4462$.—We regard this weak C IV doublet as probable.

$z_{\text{abs}} = 1.7756, 1.7776$.—This strong system has two barely resolved components in the C IV doublet; the structure is not resolved in the lines of Si II and Si IV which are also identified.

qq) Q1435 + 638

This QSO is a known radio source. We identify four absorption redshifts in its spectrum:

$z_{\text{abs}} = 1.4590$.—This is a very weak C IV doublet which we regard as only possible.

$z_{\text{abs}} = 1.4792$.—This is another weak C IV doublet; we regard this one as only possible also.

$z_{\text{abs}} = 1.5925$.—This C IV doublet is slightly stronger, and is therefore regarded as probable.

$z_{\text{abs}} = 1.9235$.—There is no doubt as to the identification of this C IV doublet. We also identify the C II $\lambda 1334$ line and possibly Si IV $\lambda 1393$.

rr) Q1442 + 101

This QSO, with the second highest emission redshift in our sample, is a known radio and X-ray source and is also referred to as OQ 172. The nonuniform signal-to-noise ratio in our spectrum is due to the fact that part of the spectrum was recorded with the IPCS in a wavelength range for which the detector is not particularly sensitive, and the reddest region was recorded with the Red CCD. These spectra were obtained as part of a more extensive study of Q1442+101, which includes 1 Å resolution spectra of the Ly α forest obtained at the European Southern Observatory (Sargent, Boksenberg, and Hassler 1988). We find five possible weak C IV doublets in the spectrum discussed here:

$z_{\text{abs}} = 2.6336$.—This C IV doublet is fairly unambiguous.

$z_{\text{abs}} = 2.6705$.—This C IV doublet must be regarded as only possible.

$z_{\text{abs}} = 2.6939$.—Again, this system must be regarded as only possible, based on the tentative C IV doublet. It is possible that the $\lambda 1550$ component is blended with Si IV $\lambda 1393$ from another system, resulting in the unphysical doublet ratio.

$z_{\text{abs}} = 3.0473$.—The redshift agreement between the components is not particularly good for this possible C IV doublet.

$z_{\text{abs}} = 3.1101$.—A weak C IV doublet, this one is probably real, although by no means certain.

ss) Q1510 + 115

Another unpublished Hazard object (see § III d), this QSO has very unusual, strong absorption with $z_{\text{abs}} \approx z_{\text{em}}$, and very sharp Ly α and C IV emission lines. The exceptionally strong $z_{\text{abs}} = 2.0897$ system (see below) makes Q1510+115 resemble a BAL QSO; however, the presence of a strong Ly α absorption line in this system together with the sharpness of the emission lines, is atypical.

$z_{\text{abs}} = 0.0001$.—This redshift is based upon a very weak Ca II doublet, the long-wavelength component of which just barely qualified for the line list.

$z_{\text{abs}} = 2.0897, 2.1011$.—The first of these components is the strong broad absorption seen in C IV, Si IV, and N V. The second is a somewhat narrower component which falls just beyond the C IV and N V troughs; it is easily resolved in Si IV. The Ly α and Si IV absorption associated with these systems appears to indicate that there are probably many more sub-components in C IV which we have not been able to identify with our resolution.

tt) Q1511 + 091

This QSO, which is also an unpublished Hazard object (see § III d), has a very unusual spectrum. The emission lines are broad, shallow, and very asymmetrical with a pronounced blue wing. There is a very strong complex absorption system at $z_{\text{abs}} \sim 2.85$ which falls approximately at the peak of the emission lines. Nevertheless, the character of the absorption is highly unusual for a BAL QSO, which in some respects it resembles. For example, in addition to the broken character of the complex, Ly α absorption is strong. In addition to the complex, there are two more "standard" systems:

$z_{\text{abs}} = 2.5596$.—This is a weak C IV doublet which we regard as probable.

$z_{\text{abs}} = 2.6702$.—This is an unambiguous, moderately strong C IV doublet.

$z_{\text{abs}} = 2.8352, 2.8389, 2.8469, 2.8503, 2.8529, 2.8570, 2.8606, 2.8634, 2.8668, 2.8853$.—Our decomposition of the $z_{\text{abs}} \sim 2.85$ complex into 10 discrete redshift systems is based primarily on the C IV lines, although several of the components are also supported by Si IV, N V, and Ly α absorption. The first nine systems are redshifted by up to 3300 km s⁻¹ relative to the redshift defined by the peaks of the emission lines; $z_{\text{abs}} = 2.8853$ displays a blueshift of 570 km s⁻¹. All are high-ionization systems judging from the absence of Si II and C II. It is almost certain that higher resolution spectra would reveal even greater complexity in this system.

uu) Q1517 + 239

Also known as LB 9612, this QSO was studied previously by YSB. Although we find no C IV absorption systems in our spectrum, YSB found an unambiguous C IV doublet with $z_{\text{abs}} = 1.4147$, just beyond our observed wavelength range. We do find one low-redshift absorption system:

$z_{\text{abs}} = 0.7382$.—This certain redshift is indicated by a fairly clear Mg II doublet.

vv) Q1548 + 092

This is one of a few QSOs in our sample for which the spectrum near the C IV emission line was not observed. We find four absorption redshifts:

$z_{\text{abs}} = 0.7708$.—Although fairly weak, this Mg II doublet is unambiguous.

$z_{\text{abs}} = 2.2484$.—This identification is only tentative; the C IV $\lambda 1550$ line is too weak, although it may have been affected by noise. The lines identified as the Si IV doublet are probably misidentifications.

$z_{\text{abs}} = 2.3195$.—This relatively weak system is certain because of the redshift agreement between the C IV doublet and the line identified as Si II $\lambda 1526$. We also identify a possible Si IV $\lambda 1393$ line.

$z_{\text{abs}} = 2.4915$.—In addition to the C IV doublet, there are also two lines which may be identified as the N V doublet, although this is uncertain because the lines fall in the Ly α forest. The reality of the redshift is not doubtful.

ww) Q1623 + 269

This QSO, also known as KP 77, was the subject of a detailed study by Sargent, Young, and Schneider (1982). Our new data were obtained partly in order to make a more detailed study of this QSO. Thus, they have superior resolution and signal-to-noise ratios and also cover a wider wavelength range than the Sargent, Young, and Schneider spectra. We find 10 absorption redshifts in the spectrum:

$z_{\text{abs}} = 0.3292$.—This system must be regarded as only tentative because all of the lines are found in the Ly α forest.

$z_{\text{abs}} = 0.8875, 0.8885$.—This double Mg II system also has lines of Mg I, Fe II, and the Al III doublet (in the Ly α forest). The implied separation of the two components of this system is ~ 160 km s⁻¹.

$z_{\text{abs}} = 1.0397$.—Although the Mg II doublet expected for this system is outside of our observed wavelength range, several Fe II lines make the redshift quite certain.

$z_{\text{abs}} = 1.8802$.—A relatively weak C IV doublet defines this probable redshift.

$z_{\text{abs}} = 1.9729$.—This is another weak C IV doublet defining a probable redshift.

$z_{\text{abs}} = 2.0502, 2.0527$.—This is a double C IV complex; the lower redshift component is much weaker than the higher redshift component. A Si IV doublet is found corresponding to the higher redshift, as well as C II $\lambda 1334$ and Si II $\lambda 1260$. Si III $\lambda 1206$ lines are found for both components.

$z_{\text{abs}} = 2.1615$.—This is another relatively weak C IV doublet, with no other lines identified.

$z_{\text{abs}} = 2.5287$.—In addition to the C IV doublet, the Ly α line and Ly β lines are identified for this redshift.

xx) Q1715 + 535

We find three absorption redshifts in the spectrum of this QSO and also possibly Galactic Ca II $\lambda 3935$:

$z_{\text{abs}} = 0.3673$.—This redshift is a bit uncertain because of the noise near the long wavelength component of the Mg II doublet.

$z_{\text{abs}} = 1.6330$.—This certain redshift has a clear C IV doublet and Si II $\lambda 1526$.

$z_{\text{abs}} = 1.7587$.—This is a relatively weak, but unambiguous, C IV doublet.

yy) Q2126–158

This QSO is a Parkes radio source as well as a known X-ray source. Its absorption spectrum has been studied in detail at high resolution by Young *et al.* (1979). Our spectrum is of somewhat lower resolution, but has a higher signal-to-noise ratio, particularly longward of Ly α emission. We find the following absorption redshifts:

$z_{\text{abs}} = 2.3936$.—The $\lambda 1548$ line of the C IV doublet in this system is blended with Si IV $\lambda 1393$ from another system. In addition to the C IV doublet, we find Si II $\lambda 1526$ for this system. These identifications are in good agreement with those suggested by Young *et al.* (1979).

$z_{\text{abs}} = 2.4597$.—This weak C IV doublet was not found by Young *et al.*, presumably because of their much lower signal-to-noise ratio in this region.

$z_{\text{abs}} = 2.6380$.—In addition to a strong C IV doublet, we identify Si II $\lambda 1526$, the Si IV doublet, C II $\lambda 1334$, Al II $\lambda 1670$, and Fe II $\lambda 1608$ for this system. These agree well with the identifications suggested by Young *et al.* for the wavelength range covered by our spectrum (they found several other lines from this system in the Ly α forest).

$z_{\text{abs}} = 2.6791$.—This C IV doublet was not identified by Young *et al.*, again because of the relatively low signal-to-noise ratio of their spectrum in this region.

$z_{\text{abs}} = 2.7690$.—For this system, we identify the C IV doublet, Si II $\lambda 1526$, the Si IV doublet, C II $\lambda 1334$, O I $\lambda 1302$, and possibly Si II $\lambda 1304$ and Al II $\lambda 1670$. These identifications agree well with those of Young *et al.*

zz) Q2206–199

The absorption spectrum of this QSO has been studied in some detail by Robertson, Shaver, and Carswell (1983). It is highly unusual in that it has two damped Ly α lines in its spectrum (the lower redshift one cannot be seen completely in

our spectrum, as it is at the blue edge of our observed wavelength range). The focus of the study by Robertson, Shaver, and Carswell was to determine the metal abundances of the two high-H I column density systems. They found that the lower redshift system has the strong metal lines that would be expected for abundances of 0.1–1 solar, but the higher redshift system ($z_{\text{abs}} \sim 2.077$) may have abundances as low as 0.002 solar. Our spectrum has about the same resolution, but extends slightly farther into the red region of the spectrum, while it does not quite go so far into the blue. The signal-to-noise ratio of our spectrum appears to be somewhat higher. We did not identify any metal lines corresponding to the $z_{\text{abs}} \sim 2.077$ system longward of Ly α emission; however, like Robertson *et al.*, we did detect a line with equivalent width of 0.5 Å at the expected position of C IV $\lambda 1548$ from that system; the $\lambda 1550$ component was not detected in either spectrum. We have identified the following systems based on lines observed longward of Ly α emission:

$z_{\text{abs}} = 0.7520$.—This is a certain low-ionization system, with all of the expected lines of Mg II, Mg I, and Fe II detected.

$z_{\text{abs}} = 1.0169$.—This too is a certain system, with lines of Mg II and Fe II identified.

$z_{\text{abs}} = 1.9208$.—This is the system which corresponds to the lower redshift damped Ly α line; we find all of the metal lines which occur in the wavelength range we observed that were identified by Robertson *et al.*; the equivalent width and redshift agreement is quite good.

$z_{\text{abs}} = 2.0144$.—This weak C IV doublet defines a probable redshift. We have also identified Ly α , and possibly Si II $\lambda 1260$, $\lambda 1304$, and $\lambda 1808$ from this redshift.

aaa) Q2342 + 089

This is a previously unpublished Hazard QSO (see § III*d*); we find 10 absorption redshifts in the spectrum:

$z_{\text{abs}} = 0.7233$.—This is a strong, unambiguous Mg II doublet; no corresponding Mg I is found.

$z_{\text{abs}} = 0.9489$.—This Mg II doublet must be regarded as only possible; the $\lambda 2803$ component falls at 5463 Å, close to the strong Hg I night-sky line at $\lambda 5460$.

$z_{\text{abs}} = 2.1884$.—This is a very weak C IV doublet, but is probably real based on the good redshift agreement between the components.

$z_{\text{abs}} = 2.3466, 2.3483$.—The splitting of these systems is just resolved in the C IV doublets; the splitting is not seen in the Si II $\lambda 1526$ line, which is also identified.

$z_{\text{abs}} = 2.4442$.—This system is based only on a weak but certain C IV doublet.

$z_{\text{abs}} = 2.5888$.—This system is certain—both the C IV and Si IV doublets are identified, as well as C II $\lambda 1334$.

$z_{\text{abs}} = 2.6241, 2.6270, 2.6300$.—There is a certain complex at $z_{\text{abs}} \sim 2.627$. Our decomposition into three redshifts is based on the C IV doublets. In addition, there are Si IV doublets identified corresponding to the two higher redshift components. C II $\lambda 1334$, Si II $\lambda 1526$, and Fe II $\lambda 1608$ are also identified—their redshifts indicate that they probably consist of components from the two higher redshifts.

bbb) Q2343 + 125

This is another previously unpublished Hazard QSO (see § III*d*). We identify seven absorption redshifts in the

spectrum; however, there is one unquestionably real, fairly broad, shallow feature near 5020 Å that we have been unable to identify. It may be C IV absorption similar to that found in the spectra of BAL QSOs. If so, the redshift would be $z_{\text{abs}} \sim 2.24$ as compared with the emission redshift of 2.515. The implied ejection velocity of $\sim 23,000 \text{ km s}^{-1}$ is unusual considering that there is no broad absorption at smaller velocities. We note that the emission lines in the spectrum of Q2343+125 are broad and shallow, like those in BAL QSOs generally.

$z_{\text{abs}} = 0.7313$.—This strong Mg II doublet is unambiguous.

$z_{\text{abs}} = 2.1143$.—The redshift agreement for the two components of this C IV doublet is quite good.

$z_{\text{abs}} = 2.1693, 2.1714$.—This double C IV redshift is fairly well resolved at the resolution of our spectrum. We have a possible identification of Si II $\lambda 1526$ at $z_{\text{abs}} = 2.1711$, but the line, if present, is blended with a strong Mg II line from another system.

$z_{\text{abs}} = 2.4285, 2.4308$.—This double system is not quite so well resolved in the C IV doublets, but there is little doubt about its reality. The double structure is also seen in Al II $\lambda 1670$, Fe II $\lambda 1608$, and Si II $\lambda 1526$. The Si IV doublet is identified as corresponding to the lower redshift component.

$z_{\text{abs}} = 2.5696$.—Although no lines other than the C IV doublet are identified for this system, the redshift agreement between the doublets and the reasonable doublet ratio make this system certain.

ccc) Q2344+125

This QSO, another Hazard object (see § III d), is only $\sim 5'$ away from Q2343+125 on the plane of the sky. Interestingly, there is an absorption system in this object ($z_{\text{abs}} = 2.4292$) which corresponds to within $\sim 70 \text{ km s}^{-1}$ of a system in the spectrum of Q2343+125 ($z_{\text{abs}} = 2.4285$). The separation of the two lines of sight at $z = 2.43$ is of order 1 Mpc, so that this constitutes another possible case of common absorption over very large scales. New spectra of the two QSOs have been obtained over a wider wavelength range, and a complete discussion of coincidences in the spectra will be presented in a separate paper (Sargent and Boksenberg 1988a). In the present work, we find the following absorption redshifts:

$z_{\text{abs}} = 1.0465$.—This system is certain and is based on identified lines of Mg II and Fe II. The Mg II doublet may be involved in a blend with two C IV doublets, however. This possibility will be discussed below.

$z_{\text{abs}} = 2.2754$.—This weak C IV doublet must be regarded as only possible.

$z_{\text{abs}} = 2.4265, 2.4292, 2.4371$.—The first two components of the triple C IV complex seem to be fairly unambiguous, although the $\lambda 1548$ line of the first component may be blended with a weak Si IV $\lambda 1402$ line from another system. The third redshift component is slightly less certain. Based on the strength of the $\lambda 1550$ component of the C IV doublet, which is unblended, the line identified as C IV $\lambda 1548$ is dominated by an Fe II line from another redshift system. The second component, as mentioned above, is very close in redshift to a system identified in the spectrum of Q2343+125.

$z_{\text{abs}} = 2.6964, 2.7017$.—These systems are only possible, but the second component is more likely to be real. Although

the redshift agreement is very good for the $z_{\text{abs}} = 2.6964$ component, the $\lambda 1548$ line is also identified as Mg II $\lambda 2796$ from another system; even if the C IV is present, the Mg II line is most likely dominating. The evidence in support of the reality of the second redshift component is that the Mg II $\lambda 2803$ line is stronger than Mg II $\lambda 2796$, indicating that it is blended; moreover, there is noticeable asymmetry in the profile of the line. We suggest that C IV $\lambda 1550$ is causing this asymmetry, and that the line which falls in between the two Mg II lines is C IV $\lambda 1548$. Also, we may have detected a weak Si IV $\lambda 1393$ line corresponding to this redshift.

$z_{\text{abs}} = 2.7817$.—This system is fairly certain, with both the C IV and Si IV doublets identified (although the Si IV $\lambda 1402$ line, which is expected to be weak, is involved in a blend).

IV. DERIVATION OF COMPLETE SAMPLES

Table 4 contains a list of 229 C IV absorption redshifts found in the spectra of the 55 QSOs. Successive columns of Table 4 list the name of the QSO, its emission redshift, the minimum absorption redshift z_{min} at which the C IV doublet could have been detected, and the corresponding maximum redshift z_{max} ; no entry in this column means that $z_{\text{max}} = z_{\text{em}}$. The next column lists the difference between each absorption redshift and the emission redshift of the QSO expressed as a fraction β of the velocity of light. This is calculated using the expression

$$\beta = \frac{(1 + z_{\text{em}})^2 - (1 + z_{\text{abs}})^2}{(1 + z_{\text{em}})^2 + (1 + z_{\text{abs}})^2}. \quad (1)$$

The last two columns of Table 4 give the rest equivalent widths of the two C IV lines. When one of the components of the C IV doublet was clearly involved in a blend with a line from another system, the line was assigned the minimum physically acceptable equivalent width based on the equivalent width of the unblended component. That is, when the $\lambda 1548$ component was involved in a blend, the line was assigned the equivalent width of the $\lambda 1550$ line, and when the $\lambda 1550$ line was blended, it was assigned an equivalent width which was one-half that of the unblended $\lambda 1548$ line. When both lines are likely to be involved in a blend, the equivalent widths were adjusted only when the measured values were physically unacceptable (i.e., when the doublet ratio was not between 1 and 2 within the errors). Although every attempt was made to produce spectra of uniform signal-to-noise ratio, practical considerations, such as variations in sensitivity of the overall system with wavelength, made this impossible to achieve. Consequently, the signal-to-noise ratios of the spectra are not completely uniform either in wavelength in a particular QSO or from object to object. For this reason we have generated complete samples of redshifts which could have been discovered in any of the spectra. The first such sample contains the 140 redshifts in Table 4 for which the rest equivalent widths of both C IV lines in a given doublet exceed 0.15 Å . It has also been observed that in some QSO samples, notably ones consisting largely of radio QSOs, there is a preferential tendency for absorption to occur close to the

TABLE 4
C IV $\lambda\lambda 1548, 1550$ ABSORPTION LINES

QSO	z_{em}	z_{min}	z_{max}	z_{abs}	β	$W_0(1548)$	$W_0(1550)$
Q0013-004	2.086	1.50	...	1.5617	0.1843	1.28	0.64
				1.7137	0.1281	0.58	0.72
				1.7536	0.1137	0.15	0.23
				1.9675	0.0394	0.70	0.77
				1.9706	0.0384	0.83	0.83
				1.9758	0.0366	0.66	0.33
				1.9917	0.0313	0.24	0.18
				2.0290	0.0189	0.63	0.56
				2.4933	0.2218	0.13	0.09
				2.7980	0.1409	0.11	0.13
Q0014+813	3.377	2.44	...	2.8002	0.1404	0.53	0.26
				3.2265	0.0350	0.21	0.12
Q0058+019	1.959	1.32	...	1.4636	0.1812	0.51	0.55
Q0112+030	2.810	2.07	...	2.1507	0.1880	0.12	0.15
				2.4234	0.1069	0.28	0.13
Q0114-089	3.199	2.29	2.87	2.2995	0.2365	0.36	0.29
				2.5394	0.1692	0.17	0.14
Q0119-046	1.937	1.29	...	1.6512	0.1020	0.14	0.09
				1.7403	0.0692	0.17	0.11
				1.9647	-0.0094	1.68	1.52
				1.9726	-0.0120	0.82	0.84
				1.9751	-0.0129	0.35	0.39
Q0142-100	2.727	1.92	...	1.9405	0.2327	0.41	0.31
				1.9416	0.2323	0.21	0.12
				1.9444	0.2314	0.19	0.14
				2.3245	0.1138	0.08	0.05
				2.3561	0.1044	0.83	0.51
Q0150-203	2.147	1.50	...	1.7666	0.1281	0.17	0.10
				1.9287	0.0718	0.09	0.08
				2.0083	0.0450	0.14	0.08
				2.0097	0.0446	0.11	0.09
Q0151+048	1.904	1.32	...	1.4680	0.1613	0.29	0.12
				1.5612	0.1250	0.22	0.14
				1.6189	0.1030	0.66	0.60
				1.6534	0.0900	0.16	0.16
				1.6557	0.0891	0.36	0.26
				1.6581	0.0882	0.48	0.39
				1.6601	0.0875	0.21	0.11
				1.8266	0.0270	0.11	0.09
				1.9342	-0.0103	0.35	0.27
				2.5231	0.0885	0.58	0.48
Q0207-003	2.849	2.07	...	2.5744	0.0741	0.22	0.17
				2.5915	0.0694	0.20	0.11
				2.2821	0.1929	0.18	0.09
Q0216+080	2.990	2.13	2.89	2.2931	0.1896	1.40	0.81
				2.3361	0.1771	0.09	0.09
				2.7204	0.0698	0.18	0.14
				2.0435	0.0064	0.28	0.20
Q0226-038	2.063	1.43	...	1.4698	0.2132	0.13	0.09
Q0229+131	2.067	1.45	...	1.8605	0.0696	0.27	0.21
				1.8622	0.0690	0.31	0.29
				1.9024	0.0551	0.76	0.40
				1.5959	0.2128	0.39	0.42
Q0237-233	2.222	1.53	...	1.5972	0.2123	0.49	0.36
				1.6109	0.2073	0.20	0.12
				1.6563	0.1907	0.33	0.33
				1.6576	0.1902	0.62	0.46
				1.6588	0.1898	0.08	0.04
				1.6604	0.1892	0.11	0.05
				1.6711	0.1853	0.31	0.31
				1.6724	0.1849	0.58	0.52
				1.6740	0.1843	0.32	0.22
				1.6753	0.1838	0.42	0.22
				1.8996	0.1050	0.16	0.12
				2.0422	0.0574	0.07	0.08
				2.2028	0.0060	0.48	0.19

TABLE 4—*Continued*

QSO	z_{em}	z_{min}	z_{max}	z_{abs}	β	$W_0(1548)$	$W_0(1550)$
Q0329–255	2.689	2.07	...	2.4550	0.0657	0.32	0.14
Q0348+061	2.060	1.50	...	1.7975	0.0894	0.51	0.45
				1.8409	0.0742	0.39	0.36
				1.9681	0.0305	0.49	0.33
				2.0237	0.0119	0.82	0.71
				2.0330	0.0089	0.57	0.38
Q0421+019	2.051	1.39	...	1.4555	0.2138	0.15	0.14
				1.5379	0.1821	0.13	0.19
				1.5977	0.1595	0.18	0.12
				1.6368	0.1449	0.53	0.44
				1.6379	0.1445	0.46	0.44
				1.6389	0.1441	0.15	0.19
				1.9996	0.0170	0.19	0.18
Q0424–131	2.166	1.49	...	1.5519	0.2123	0.11	0.06
				1.5527	0.2120	0.20	0.11
				1.5615	0.2088	1.05	0.96
				1.7161	0.1521	0.36	0.22
				1.7886	0.1263	0.25	0.15
				2.1332	0.0001	0.24	0.24
				2.1731	–0.0022	0.13	0.15
Q0440–168	2.679	2.07	...	2.2142	0.1342	0.30	0.17
				2.2290	0.1297	0.31	0.15
Q0449–135	3.097	2.23	2.87	2.3132	0.2095	0.46	0.25
Q0450–132	2.253	1.61	...	2.0669	0.0588	1.07	0.82
				2.1063	0.0461	0.82	0.75
				2.2315	0.0066	1.14	0.96
Q0528–250	2.765	2.07	...	2.1408	0.1793	0.59	0.49
				2.2057	0.1600	1.14	0.94
				2.2081	0.1588	1.13	0.82
				2.5382	0.0620	0.25	0.19
				2.6736	0.0246	0.13	0.08
				2.8052	–0.0106	0.37	0.18
				2.8118	–0.0124	1.02	1.02
Q0831+128	2.734	2.07	...	2.0844	0.1888	0.93	0.86
Q0837+109	3.326	2.40	...	2.4165	0.2325	0.18	0.10
				2.9558	0.0900	0.14	0.13
				3.1430	0.0437	0.27	0.16
Q0848+163	1.925	1.30	...	1.4575	0.1724	0.08	0.07
				1.4686	0.1680	0.08	0.08
				1.4704	0.1673	0.72	0.53
				1.9158	0.0032	0.25	0.14
				1.9176	0.0025	0.55	0.34
Q0848+155	2.009	1.42	...	...	...	...	...
Q0852+197	2.221	1.54	...	1.9399	0.0911	0.31	0.31
				2.1716	0.0155	0.66	0.35
Q0854+191	1.896	1.27	...	1.2954	0.2283	0.44	0.44
				1.2973	0.2275	0.34	0.34
				1.3019	0.2256	0.67	0.33
				1.3522	0.2050	0.55	0.55
				1.3543	0.2042	0.79	0.79
				1.3558	0.2036	0.73	0.73
				1.4754	0.1556	0.16	0.18
				1.6916	0.0731	0.27	0.21
				1.7323	0.0581	0.53	0.53
				1.7367	0.0565	0.61	0.26
				1.8424	0.0187	0.52	0.24
				1.8550	0.0143	0.28	0.32
Q0913+072	2.785	1.96	2.29	2.0002	0.2285	0.19	0.15
				2.0440	0.2147	0.19	0.06
				2.0637	0.2086	0.21	0.22
				2.1460	0.1831	0.14	0.22
Q0958+551	1.751	1.23	...	1.2726	0.1887	0.44	0.44
				1.2768	0.1870	0.58	0.37
				1.3563	0.1536	0.21	0.11
				1.3771	0.1451	0.14	0.15
				1.7310	0.0073	0.49	0.29
				1.7330	0.0066	0.52	0.40

TABLE 4—*Continued*

QSO	z_{em}	z_{min}	z_{max}	z_{abs}	β	$W_0(1548)$	$W_0(1550)$
Q1017+280	1.928	1.30	...	1.5368	0.2125	0.13	0.17
				1.5951	0.1201	0.14	0.11
				1.6081	0.1152	0.37	0.25
				1.7667	0.0566	0.06	0.03
				1.7984	0.0453	0.41	0.29
				1.8343	0.0325	0.10	0.05
Q1054-034	2.114	1.45	...	...	...	...	...
Q1115+080	1.725	1.14	...	1.6997	0.0093	0.12	0.11
				1.7321	-0.0026	0.37	0.32
				1.7352	-0.0037	0.26	0.14
Q1138+040	1.877	1.43	...	1.5840	0.1070	0.34	0.33
Q1148-001	1.980	1.43	...	1.4669	0.1867	0.84	0.61
				1.9861	-0.0020	0.27	0.18
Q1159+124	3.502	2.53	...	3.2256	0.0628	0.12	0.12
				3.2614	0.0544	0.14	0.08
				3.5261	-0.0058	0.89	0.78
				1.9634	0.2233	0.64	0.37
Q1213+093	2.719	1.92	2.55	2.0935	0.1821	0.18	0.19
				2.2345	0.1387	0.88	0.63
				2.5228	0.0541	0.47	0.31
				1.4867	0.1982	0.33	0.31
				1.5239	0.1839	0.25	0.24
Q1222+228	2.040	1.43	...	1.9372	0.0344	1.18	0.92
				1.9805	0.0198	0.17	0.09
				2.0555	-0.0051	0.25	0.18
				1.6106	0.1601	0.38	0.23
				1.6778	0.1352	0.59	0.53
Q1245+345	2.068	1.43	...	1.4063	0.2296	0.09	0.07
				1.4083	0.2288	0.63	0.42
				1.9597	0.0264	0.13	0.17
Q1247+267	2.039	1.39	...	1.4716	0.1702	0.52	0.32
				1.6010	0.1202	1.38	0.83
				1.8359	0.0343	0.13	0.13
				1.8401	0.0329	0.45	0.13
				1.9405	-0.0019	0.44	0.36
Q1329+412	1.935	1.43	...	1.4462	0.2276	0.20	0.15
				1.7756	0.1050	1.03	0.77
				1.7776	0.1043	0.60	0.62
Q1331+170	2.084	1.43	...	1.4590	0.2177	0.08	0.10
				1.4792	0.2099	0.17	0.10
				1.5925	0.1668	0.27	0.12
				1.9235	0.0482	0.46	0.39
				2.6336	0.2191	0.20	0.13
Q1435+638	2.068	1.43	...	2.6705	0.2095	0.20	0.14
				2.6939	0.2034	0.16	0.21
				3.0473	0.1144	0.18	0.14
				3.1101	0.0992	0.11	0.08
				2.0897	0.0062	7.00	...
Q1442+101	3.540	2.58	...	2.1011	0.0016	0.29	0.29
Q1510+115	2.106	1.43	...	2.5596	0.0855	0.11	0.06
				2.6702	0.0550	0.28	0.19
				2.8352	0.0111	0.14	0.25
				2.8389	0.0101	0.68	0.47
				2.8469	0.0081	0.27	0.27
				2.8503	0.0072	0.48	0.44
				2.8529	0.0065	0.44	0.31
				2.8570	0.0054	0.44	0.44
				2.8606	0.0045	0.55	0.39
				2.8634	0.0038	0.89	1.02
				2.8668	0.0029	0.39	0.47
				2.8853	-0.0019	0.72	0.72
Q1511+091	2.878	2.12	...	...	...	...	...
				...	...	...	...
				...	...	...	...

TABLE 4—*Continued*

QSO	z_{em}	z_{min}	z_{max}	z_{abs}	β	$W_0(1548)$	$W_0(1550)$
Q1517+239	1.898	1.43	...	...	...	...	...
Q1548+093	2.749	1.94	2.55	2.2484	0.1426	0.23	0.08
				2.3195	0.1213	0.20	0.13
				2.4915	0.0713	0.30	0.27
				1.8802	0.1996	0.14	0.11
Q1623+269	2.526	1.76	...	1.9729	0.1690	0.14	0.07
				2.0502	0.1440	0.29	0.20
				2.0527	0.1431	0.93	0.67
				2.1615	0.1087	0.18	0.10
				2.5287	-0.0008	0.14	0.08
				1.6330	0.1061	0.63	0.50
Q1715+535	1.929	1.43	...	1.7587	0.0598	0.17	0.13
Q2126-158	3.266	2.36	...	2.3936	0.2249	0.55	0.28
				2.4597	0.2065	0.08	0.06
				2.6380	0.1579	1.00	0.67
				2.6791	0.1469	0.19	0.15
				2.7690	0.1232	0.68	0.51
Q2206-199	2.559	1.78	...	1.9208	0.1951	1.12	1.15
				2.0144	0.1646	0.25	0.14
Q2342+089	2.784	2.07	...	2.1884	0.1696	0.12	0.09
				2.3466	0.1222	0.33	0.26
				2.3483	0.1217	0.38	0.30
				2.4442	0.0938	0.31	0.25
				2.5888	0.0529	0.58	0.41
				2.6241	0.0431	0.18	0.18
				2.6270	0.0424	0.67	0.41
				2.6300	0.0415	0.35	0.17
				2.1143	0.1204	0.24	0.18
				2.1693	0.1032	0.14	0.14
Q2343+125	2.515	2.07	...	2.1714	0.1025	0.32	0.19
				2.4285	0.0249	0.48	0.30
				2.4308	0.0242	0.63	0.36
				2.5696	-0.0154	0.30	0.24
				2.2754	0.1379	0.14	0.07
				2.4265	0.0934	0.53	0.29
				2.4292	0.0926	0.19	0.09
				2.4371	0.0903	0.19	0.09
				2.6964	0.0179	0.43	0.23
				2.7017	-0.0050	0.23	0.15

emission redshift of a QSO. Moreover, it is likely that the QSO itself has a strong influence on the ionization state of galaxies in its immediate vicinity. Accordingly, for many purposes we have employed only redshifts for which $\beta c \geq 5000$ km s⁻¹. Foltz *et al.* (1986) found that, even for a sample consisting of mostly radio-loud QSOs, the distribution of C IV doublets with $\beta c \geq 5000$ km s⁻¹ is entirely consistent with the hypothesis that the absorbers are intervening. In addition, it is useful to derive a sample that can be compared (and combined) with previously published samples (particularly YSB and Foltz *et al.* 1986). For this reason we will also make use of samples for which the two components of the C IV doublet must exceed 0.3 Å in rest equivalent width. The first two columns in Table 5 outline the various samples and the criteria used for their selection.

An examination of Table 4 reveals that the redshifts sometimes occur in clumps which are clearly not independent. For some purposes, for example the “Bahcall-Peebles tests” described in § V, it is desirable to count each clump as one redshift. Consequently, samples which we have called the “Poisson samples” were isolated by counting clumps containing redshifts separated by less than 1000 km s⁻¹ as one

TABLE 5
THE ABSORPTION SYSTEM SAMPLES

Criteria	Sample Number	W_*	$\sigma(W_*)$	N_*	$\sigma(N_*)$
All included	A1	229	0.41	0.02	5.92 0.59
$\beta c > 5000$	A2	186	0.37	0.02	5.75 0.64
$W_0 > 0.15$	A3	140	0.49	0.04	5.05 0.70
$W_0 > 0.15, \beta c > 5000$	A4	111	0.46	0.04	4.60 0.74
$W_0 > 0.30$	A5	86	0.55	0.07	3.93 0.69
$W_0 > 0.30, \beta c > 5000$	A6	66	0.52	0.07	3.51 0.70
$W_0 > 0.30, \beta c > 5000^a$	A7	90	0.55	0.07	3.03 0.46

^aIncludes the data of Foltz *et al.* 1986 and YSB.

system. The adopted redshift of each “clump” is based on the equivalent-width-weighted mean redshift of the systems involved. It is using these “Poisson samples” that we will examine the possible cosmological evolution of the number density of absorbers in § VI. The first two columns of Table 6 summarize selection criteria for the different Poisson samples. The value N for each of the samples in Table 6 is the mean number of absorption systems per unit redshift interval. Our

TABLE 6
THE "POISSON" SAMPLES

Criteria	Sample	Number	$\langle z_{\text{abs}} \rangle$	N^a	$\sigma(N)$	γ^b	$\sigma(\gamma)$
$W_0 > 0.15$	S1	109	2.037	2.81	0.32	-0.90	0.63
$W_0 > 0.15, \beta_c > 5000$	S2	86	1.957	2.57	0.34	-1.18	0.72
$W_0 > 0.30$	S3	64	1.970	1.69	0.24	-2.20	0.85
$W_0 > 0.30, \beta_c > 5000$	S4	52	1.887	1.56	0.24	-2.77	0.98
$W_0 > 0.30, \beta_c > 5000^c$	S5	76	1.798	1.48	0.18	-1.56	0.79

^aMean number density of absorption systems per unit redshift interval.

^bMaximum likelihood estimation assuming the form $N(z) \propto (1+z)^\gamma$.

^cIncludes the data of Foltz *et al.* 1986 and YSB.

sample S3 uses the same selection criterion as was used by YSB; for this sample we find that $N = 1.69 \pm 0.24$ with $\langle z_{\text{abs}} \rangle = 1.97$, which is in good agreement with YSB's result of $N = 1.49 \pm 0.29$ for their sample with $\langle z_{\text{abs}} \rangle = 1.71$. For the sample in which we have combined our data with those of YSB and Foltz (sample S5), we find $N = 1.48 \pm 0.18$.

The number of absorption systems in the various samples listed in Tables 5 and 6 are considerably larger than existing published samples of heavy-element absorption redshifts (e.g., YSB found only 26 C IV doublets in 30 QSOs in their main sample C1). Both tables contain other statistical information about the samples which will be referred to in §§ V and VI.

In addition to the C IV redshifts, we found 40 other absorption redshifts based on the Mg II $\lambda\lambda 2796, 2803$ doublet. The properties of this sample will be discussed in a further paper (Sargent, Steidel, and Boksenberg 1988).

V. TESTS FOR UNIFORMITY

The distribution of the C IV absorbers has been shown to be consistent with that expected for cosmologically intervening systems by YSB. At the time, this finding was in contrast to earlier work (Weymann *et al.* 1979) in which it was found that there was a strong tendency for the absorption to occur near the emission redshift of the QSO. Foltz *et al.* (1986) reobserved the same sample as Weymann *et al.* using a photon-counting detector (the original data were photographic), and found that the earlier results were largely upheld. Foltz *et al.* suggest that the marked difference between their result and that of YSB has to do with the radio properties of the sample; the great majority of the Weymann *et al.* sample were radio sources, because at the time there were few high-redshift QSOs which were discovered using optical methods. In contrast, most of the sample observed by YSB were optically selected and were not known radio sources. Foltz *et al.* find a statistically significant difference between the radio-selected and optically-selected QSOs, but, as mentioned above, if the absorption systems within 5000 km s^{-1} of the emission redshift are excluded, their sample and YSB's sample are statistically identical. Following YSB, we have performed various statistical tests on our new, much larger sample of absorption redshifts. For all of the tests described below, we have made use of the Poisson samples which are discussed above.

a) Distribution in Velocity

The distribution of the apparent velocity β_c for the Poisson sample with $W_0 > 0.15 \text{ \AA}$ (sample S1) is shown in Figure 2a.

As in YSB, there is obviously no strong tendency for the absorption redshifts to cluster around the emission redshift. As in other samples of this kind, a significant number of the absorption redshifts have large negative values of β_c , in this case ranging up to $\beta_c = -3700 \text{ km s}^{-1}$. The origin of these large apparent infall velocities is still not clear. The velocities are a little too large to be comfortably accounted for by peculiar motions in dense clusters of galaxies. Gaskell (1983) has made the plausible suggestion that perhaps the emission redshift does not represent the motion of the center of gravity of the object; in any case, the presence of absorption close to the emission redshift renders it even more difficult to define the centers of the broad emission lines. The uncertainties involved in defining the emission redshifts may be as large as several thousand km s^{-1} .

The distribution of apparent velocities in Figure 2a is remarkably flat out to the largest velocities plotted. This figure has been corrected for differences in the number of QSOs in which a particular velocity could have been observed due to the finite range of the spectra, including cases where the C IV emission line was not in the observed spectral range. For this reason, the numbers are not always integers at large values of β_c . A χ^2 test on the binned data in Figure 2a confirms the visual impression that the data are consistent with a flat distribution. The calculated χ^2 for 65 bins is 73.14; drawing from the null distribution, the probability of obtaining a value of χ^2 larger than the measured value is $P(\chi^2 > \chi_{\text{obs}}^2) = 0.21$. A Kolmogorov-Smirnov (K-S) test on the same data set, this time unbinned, gives essentially the same result ($P[D > D_{\text{max}}] = 0.21$, where D_{max} is the calculated maximum deviation of the observed distribution from the null hypothesis of a flat distribution).

Figure 2a confirms the evidence presented in YSB that the absorption redshifts are produced by cosmologically distributed intervening objects unrelated to the QSO.

The majority of the QSOs in our sample are not known radio sources. Therefore, the continued disagreement between our results and those of Foltz *et al.* might at first sight be understood on this basis. However, in Figure 2b we show the distribution of apparent ejection velocity for the 17 known radio QSOs in our sample. We see that the distribution appears flat. This impression is confirmed by a K-S test ($P[D > D_{\text{max}}] = 0.30$). (The one object in the sample which shows at least 10 components of C IV absorption in the C IV emission line, Q1511+091, is known to be radio quiet. Barthel [1987] found an upper limit for the flux at 15 GHz of 1 mJy in

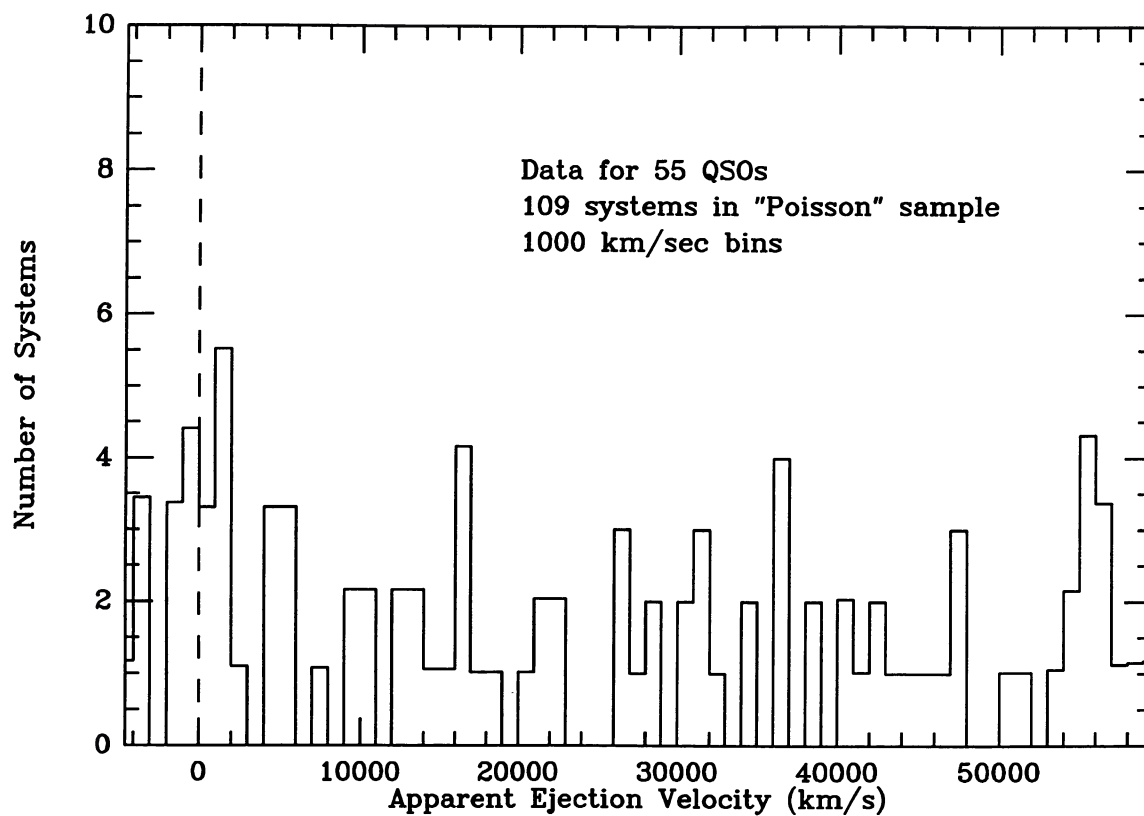


FIG. 2a

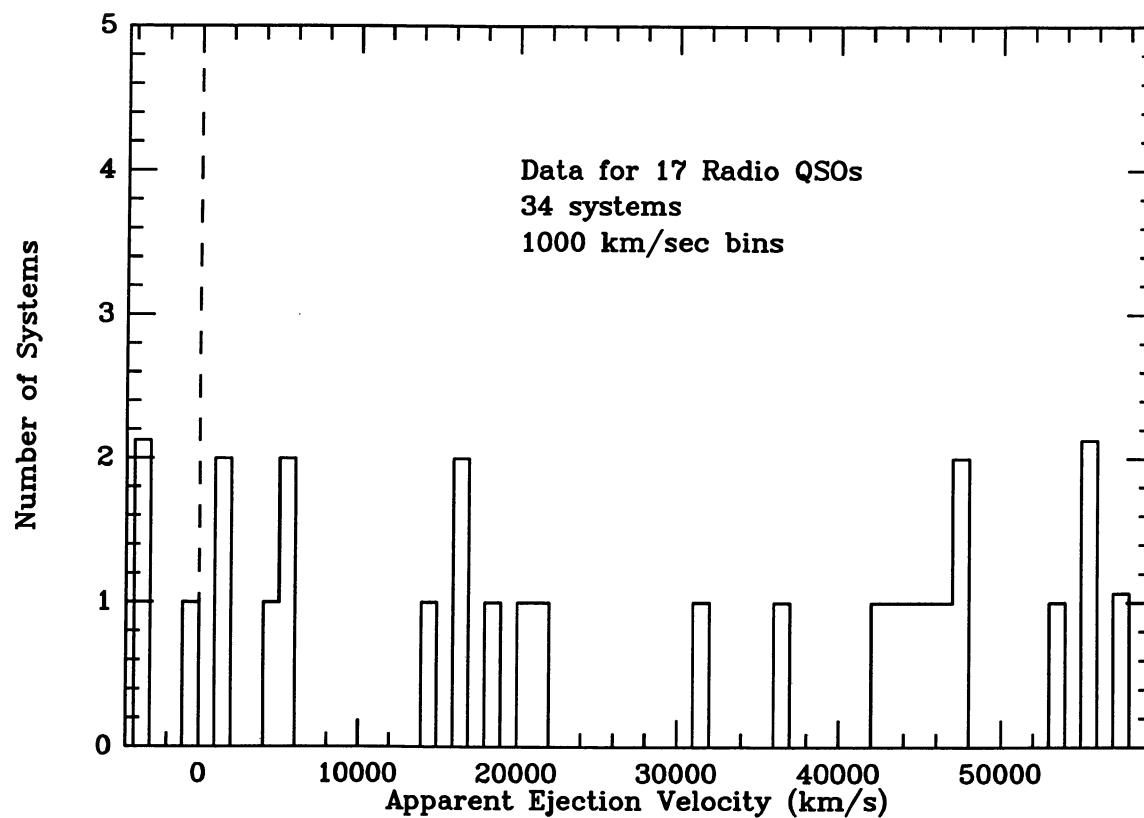


FIG. 2b

FIG. 2.—(a) Histogram of apparent ejection velocity βc for the absorption systems in sample S1 (see Table 6). (b) Same as (a), for the subset of sample S1 which appears in the spectra of the 17 known radio QSOs in the sample.

a measurement made at the VLA on 1987 January 12.) It seems that the precise reason why some samples give an excess of absorption redshifts close to the emission redshift is still not understood. Moller and Jakobsen (1988) have proposed that the incidence of absorption redshifts close to the emission redshift is really a function of the absolute magnitude of the QSO, rather than its radio properties. They point out that most of the radio-selected QSOs in which Foltz *et al.* found a high proportion of absorption systems close to z_{em} are relatively faint. We find that, for our sample, the proportion of QSOs with $z_{\text{abs}} \approx z_{\text{em}}$ ($\beta c < 5000 \text{ km s}^{-1}$) is 22 of 55. A χ^2 test shows that the distribution in absolute luminosity for the 22 QSOs with $z_{\text{abs}} \approx z_{\text{em}}$ is statistically indistinguishable from that of the total sample. (Note, however, that because of the way in which our QSOs were selected for observation, they tend to be significantly brighter than the QSOs for which the trend was found.)

b) The Bahcall-Peebles Tests

A strong prediction of the intervening hypothesis is that the distribution of the number of independent absorption redshifts per QSO is a Poisson distribution. This was found to be the case in the YSB sample C1. In carrying out the test, we must allow for the fact that there is a variation in the observed Δz from object to object. A convenient procedure is to calculate the likelihood function

$$\ln f = \sum_{j=1}^{N_Q} \ln P(N_i^{\text{abs}}, \lambda_i), \quad (2)$$

where N_Q is the number of QSOs in the sample, N_i^{abs} is the number of absorption systems in the i th QSO, and $\lambda_i = N\Delta z_i$ is the Poisson parameter. Here $N = 2.57 \pm 0.34$ is the mean density of absorption redshifts per unit redshift interval in sample S2. Expressions for $\langle \ln f \rangle$ and $\sigma^2(\ln f)$ are given in equations (17) and (18) of YSB. For sample S2, we find

$$\ln f = -90.44, \quad (3)$$

$$\langle \ln f \rangle = -85.32, \quad (4)$$

$$\sigma(\ln f) = 11.44, \quad (5)$$

and, therefore, according to this test, the observed deviation from a Poisson distribution is not significant. A more perspicuous test is to restrict the data so as to cover the same value of Δz in all of the QSOs. We found that a value $\Delta z = 0.5$ maximized the total available redshift range $N_{\Delta z}^Q \Delta z$, where $N_{\Delta z}^Q = 48$ is the number of QSOs which have at least $\Delta z = 0.5$ in which C IV doublets could have been found. The distribution of N^{abs} is now expected to be exactly a Poisson distribution, neglecting any evolution in line density with redshift. (We show in § VI that this latter assumption is justified.) The disposition of a fixed $\Delta z = 0.5$ within the generally larger observed range of Δz is to some extent arbitrary; we chose to place it at the center of the observed interval in each QSO. Table 7 compares the observed distribution with the expected Poisson distribution. A χ^2 test indicates that the Poisson distribution may be rejected at the 89% confidence level, or

TABLE 7

BAHCALL-PEEBLES TEST 1 ($\Delta z = 0.5$)^a

Number of Systems	Expected QSOs	Observed QSOs	χ^2
0	13.2	14	0.1
1	17.0	19	0.2
2	11.1	8	0.8
3	4.7	4	0.1
4	1.5	1	0.2
5	0.4	1	0.9
6	0.1	1	8.1
Total	48.0	48	10.4

^a QSOs were rejected for this test if the observed redshift range $\Delta z < 0.5$; otherwise, systems were included only if they fell in a redshift range $\Delta z = 0.5$ centered in the original observed redshift range for the QSO.

$P(\chi^2 > \chi_{\text{obs}}^2) = 0.11$. Thus there is marginal evidence for an excess of QSOs with large numbers of absorption redshifts over what would be expected if the absorbers were distributed according to a Poisson distribution. The implications of this possible excess will be discussed in § VII g.

For cosmologically distributed intervening absorbers, the number density per unit redshift range is expected to vary with redshift according to the expression

$$N(z) = N_0(1+z)(1+2q_0z)^{-1/2} \quad (6)$$

if the properties of the absorbers do not vary with redshift. (Derivations of this formula are given by Wagoner 1967, Peterson 1978, and by SYBT.) The second test of Bahcall and Peebles (1969) looks for deviations in the observed $N(z)$ from the expected form (eq. [6]). As Bahcall and Peebles showed, it is convenient to introduce a new variable

$$X(z) = \int_0^z (1+z)(1+2q_0z)^{-1/2} dz. \quad (7)$$

Explicit expressions for $X(z)$ are given in equation (23) of YSB. The random variable

$$Y = \frac{[X(z_{\text{abs}}) - X(z_{\text{min}})]}{[X(z_{\text{max}}) - X(z_{\text{min}})]} \quad (8)$$

should be uniformly distributed in the interval [0,1]. Here z_{min} and z_{max} are the minimum and maximum redshifts at which a C IV absorption z_{abs} could be observed in a given QSO. We follow YSB in using the K-S test to compare the observed and expected distributions. We have performed the test for both $q_0 = 0$ and $q_0 = 1/2$. Explicit expressions for the expected distribution function of Y and for calculating the observed distribution are given in equation (25) of YSB. The observed distribution of Y for $q_0 = 1/2$ is shown in Figure 3. For this test we used the Poisson sample S1 which included the 109 redshifts having $W_0 > 0.15 \text{ \AA}$ (i.e., redshifts within 5000 km s^{-1} of the emission redshift were not automat-

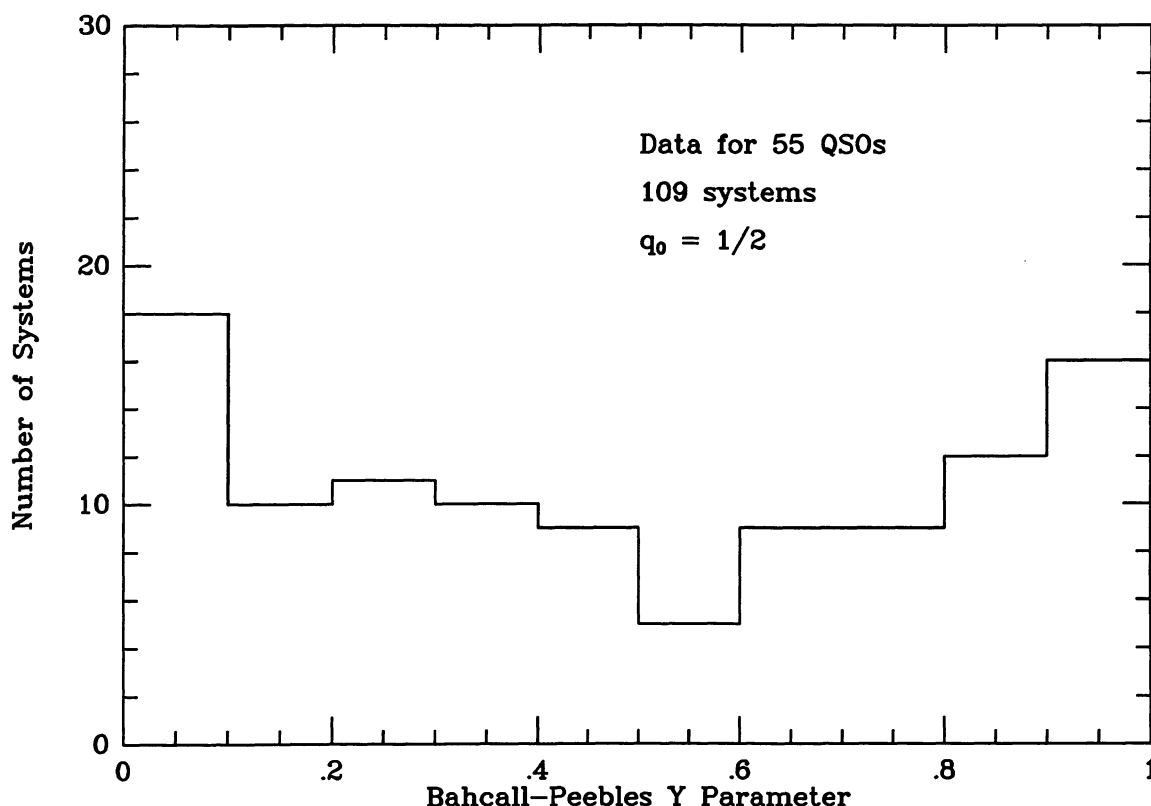


FIG. 3.—Histogram of the Bahcall-Peebles “Y-parameter,” for sample S1 with $q_0 = 1/2$. The distribution is consistent with what would be expected for randomly distributed intervening absorbers.

ically excluded). The resulting test statistics are

$$D_{\max} = 0.099, P(D > D_{\max}) = 0.24 (q_0 = 0); \quad (9)$$

$$D_{\max} = 0.085, P(D > D_{\max}) = 0.41 (q_0 = 1/2). \quad (10)$$

Clearly the data are consistent with the hypothesis that the absorption redshifts are produced by cosmologically distributed intervening objects.

VI. EVOLUTION IN REDSHIFT

a) Evolution in Number Density

Because the universe is expanding, the number of absorbers intercepted per unit redshift range along a given line of sight is expected to increase with redshift. If the cosmological constant $\Lambda = 0$, the expected behavior for absorbers of constant cross section πr_0^2 and constant comoving number density Φ_0 is given by equation (6), where the local value of $N(z)$ is $N_0 = \pi r_0^2 \Phi_0 c / H_0$. If the absorbers evolve in cosmic time, then $N_0 = N_0(z)$. It is convenient to compare the observed data with a power law of the form $N(z) = A(1+z)^\gamma$, where A is a constant. It is easy to show that the general expression for the exponent γ is

$$\gamma = \left(\frac{1 + q_0 z - q_0}{1 + 2q_0 z} \right). \quad (11)$$

Particular values are $\gamma = 1$ for $q_0 = 0$ and $\gamma = 1/2$ for $q_0 = 1/2$. As emphasized by SYBT, this test could be used to determine q_0 if one had evidence that N_0 did not evolve in time for a particular class of absorbers. Otherwise the test has the same problems with evolutionary corrections as the more familiar redshift–apparent magnitude and redshift–angular diameter tests. However, the density of absorbers test has, in principle, the advantage that it is maximally sensitive at $z = 0$ where there is the best chance of understanding evolutionary effects.

Since the absorption redshifts which contain lines of the heavy elements are much less common than the Ly α cloud redshifts, it is much harder to obtain statistical samples large enough to study their evolution. The situation has been summarized recently by Tytler *et al.* (1987) for the various classes of absorption systems. Data on the C IV absorbers show some, probably insignificant, evidence for evolution over the redshift range $1.2 \leq z_{\text{abs}} \leq 2.2$ (Bergeron and Boissé 1984). The analysis was based primarily upon the data presented by YSB, with a small extension. The unbiased sample consisted of only 38 absorption systems along 39 lines of sight, subject to the criteria $W_0(1548) > 0.3 \text{ \AA}$ and $W_0(1550) > 0.2 \text{ \AA}$. Bergeron and Boissé found that the best fit to the power-law form has $\gamma = 1.8 \pm 1.5$; this result is therefore consistent with “no evolution” for $q_0 = 0$, and shows very marginal evidence for evolution with $q_0 = 1/2$.

The extensive catalog of C IV redshifts described in § III covers the redshift range $1.3 \leq z_{\text{abs}} \leq 3.4$. Figure 4 shows a plot of the number of absorption systems identified (sample

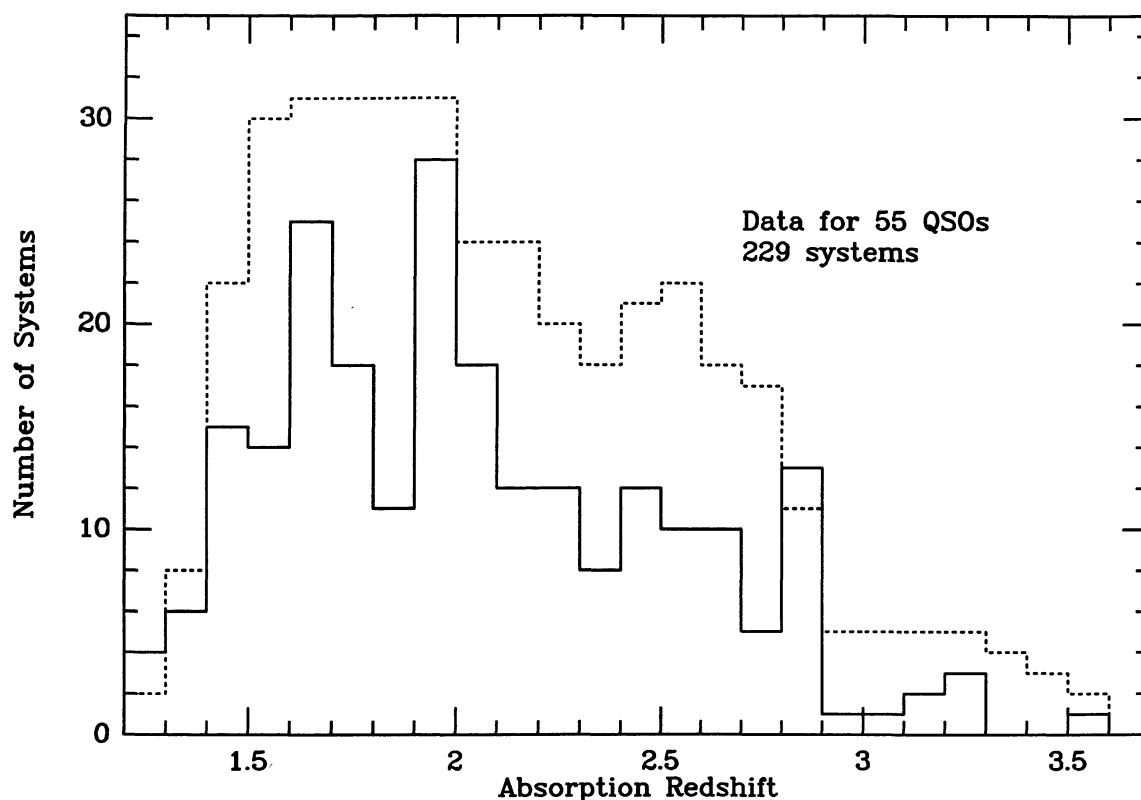


FIG. 4.—The solid histogram represents the number of absorption systems in sample A1 as a function of redshift. The dotted histogram is the number of QSOs (out of 55 total) in which an absorption redshift z_{abs} could have been detected.

A1) as a function of redshift. The dotted histogram in Figure 4 is the number of QSOs in the sample for which a redshift z_{abs} could have been detected. In Figure 5 we have plotted the density of absorption redshifts in sample A1 against redshift. It is arbitrarily broken into five bins for display purposes. Surprisingly, this plot shows a clear tendency for $N(z)$ to decrease with increasing redshift. The visual impression is confirmed by a maximum likelihood estimation of γ , which for sample A1 is $\gamma = -0.91 \pm 0.43$. However, for statistical purposes, it is more appropriate to consider an unbiased sample in which “clumps” of absorption redshifts on scales less than 1000 km s^{-1} count as only one system. Our primary sample for this application is sample S2 (see Table 6); a maximum likelihood estimation of γ leads to the relation $N(z) \propto (1+z)^{-1.20 \pm 0.71}$. In Figure 6 we have plotted the binned data from sample S2. The dotted curve is the maximum likelihood estimation. Table 6 contains a summary of maximum likelihood estimations of γ for all of the Poisson samples; clearly the same qualitative trend of a decreasing $N(z)$ with increasing z holds for all of the samples. Sample S5 contains all of the C IV redshifts from our sample with $W_0 \geq 0.3 \text{ \AA}$, in addition to the less extensive samples published by YSB and Foltz *et al.* (1986). For sample S5 we find $\gamma = -1.56 \pm 0.79$; Figure 7 shows a plot of the observed $N(z)$ along with the fitted curve based on the maximum likelihood estimation for γ . Taken together, all of these results give strong evidence that the C IV absorbers are evolving in cosmic time. No evolution with $q_0 = 0$ is certainly excluded, while

$q_0 = 1/2$, and no evolution of the absorbers is excluded at about the 2.3σ level for sample S2. Figures 5 and 6 give a tantalizing impression that there may be an abrupt discontinuity in $N(z)$ at $z \sim 3$ rather than the gradual trend implied by the power law. Unfortunately, considerably more data will be required to investigate this possibility.

b) The Distribution of Line Strength

Previous work has shown that the distribution of equivalent width for both the Ly α lines and for the C IV absorption lines can be represented by an exponential function of the form

$$n(W) = \left(\frac{N_*}{W_*} \right) \exp \left(\frac{-W}{W_*} \right). \quad (12)$$

YSB found that, for a sample of lines in which $W_0(1548) + W_0(1550) > 0.6 \text{ \AA}$, $W_* = 0.87 \pm 0.15$ and $N_* = 3.55 \pm 0.64$. The corresponding values for our samples A1 through A6 are given in Table 5. (In comparing our results with those of YSB it should be remembered that, while our selection criteria were based on both lines of the C IV doublet, the exponential function was fitted using only $W_0[1548]$.) In Figure 8 we have plotted the binned equivalent width distribution for sample A4, along with the exponential curve calculated using the value of $W_* = 0.46$ obtained from a maximum likelihood estimation (see Table 5). Clearly the exponential curve gives a reasonably good fit to the binned data except for the lowest

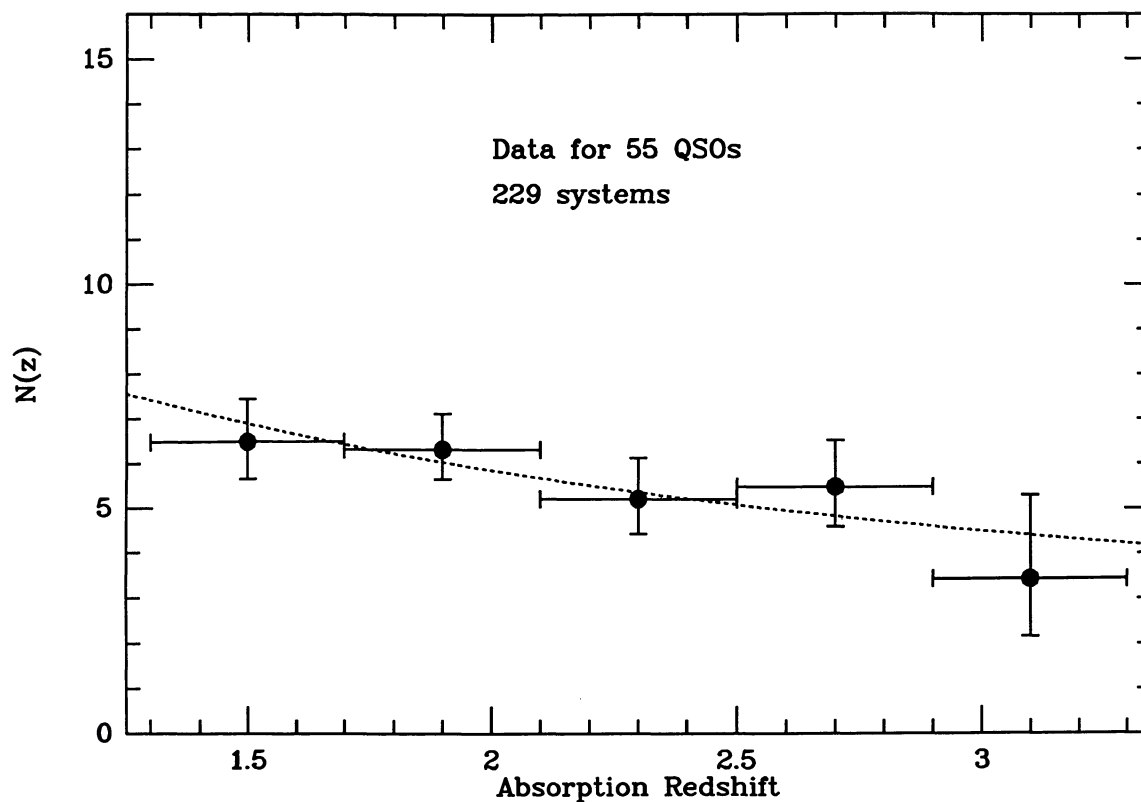


FIG. 5.—The binned distribution of the number of absorption systems per unit redshift range as a function of redshift for the systems in sample A1. The dotted curve is the result of a maximum likelihood estimation for a power-law form, $N(z) \propto (1+z)^{-0.90}$.

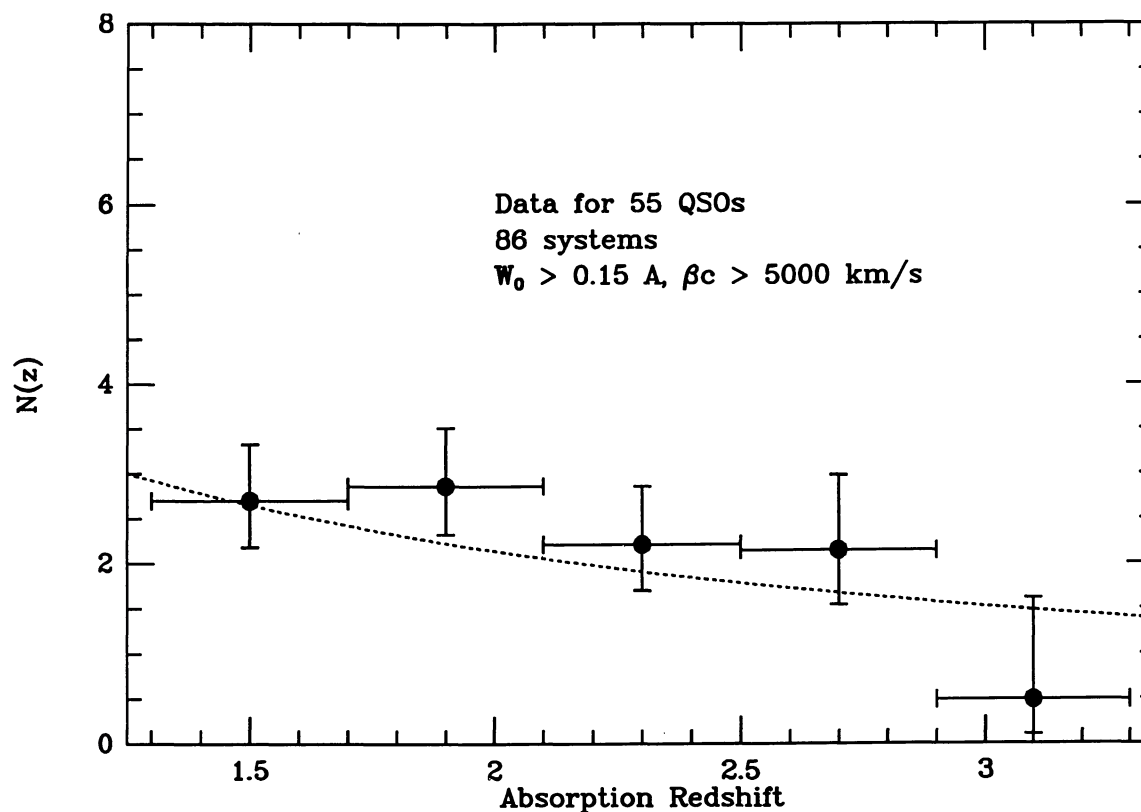


FIG. 6.—Same as Fig. 5, for the absorption systems in sample S2 (our primary unbiased sample). The dotted curve is the result of a maximum-likelihood estimation for a power-law form, $N(z) \propto (1+z)^{-1.18}$.

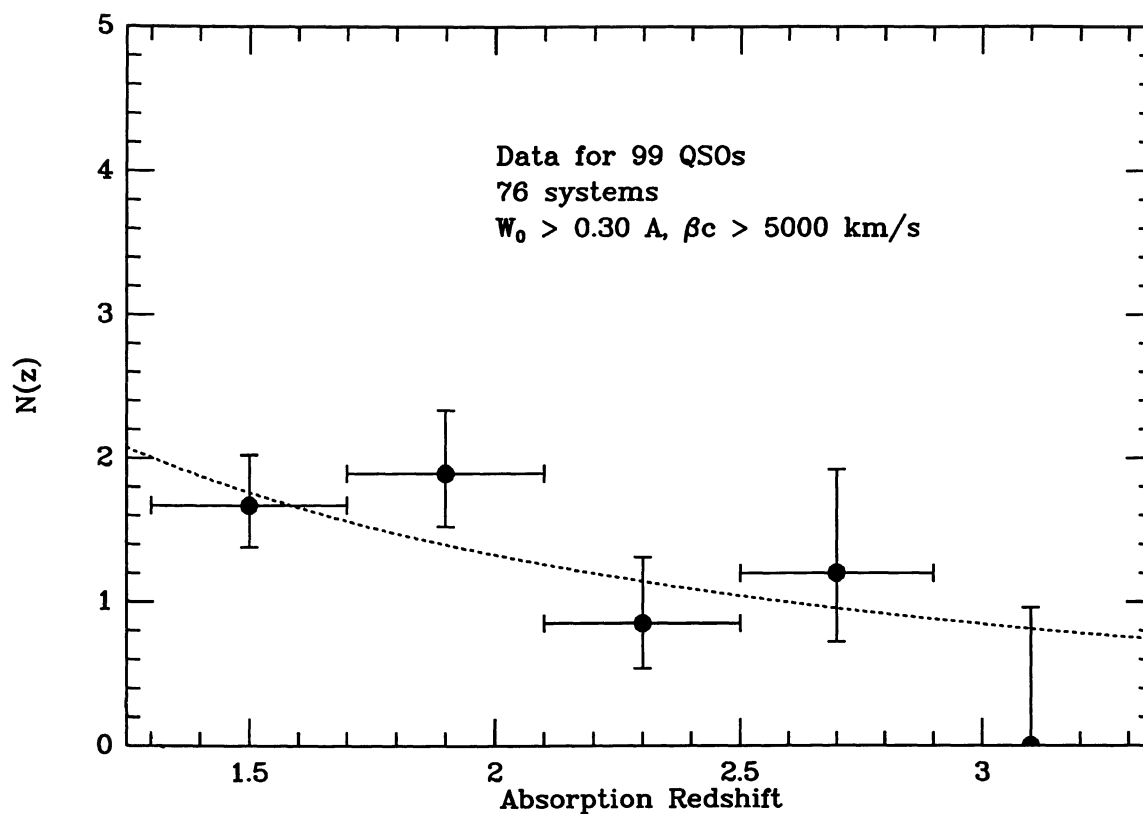


FIG. 7.—Same as Fig. 5, for the absorption redshifts in sample S5, which include data from the homogeneous samples of YSB and of Foltz *et al.* (1986). The dotted curve is again the result of a maximum-likelihood estimation for a power-law form, $N(z) \propto (1+z)^{-1.56}$.

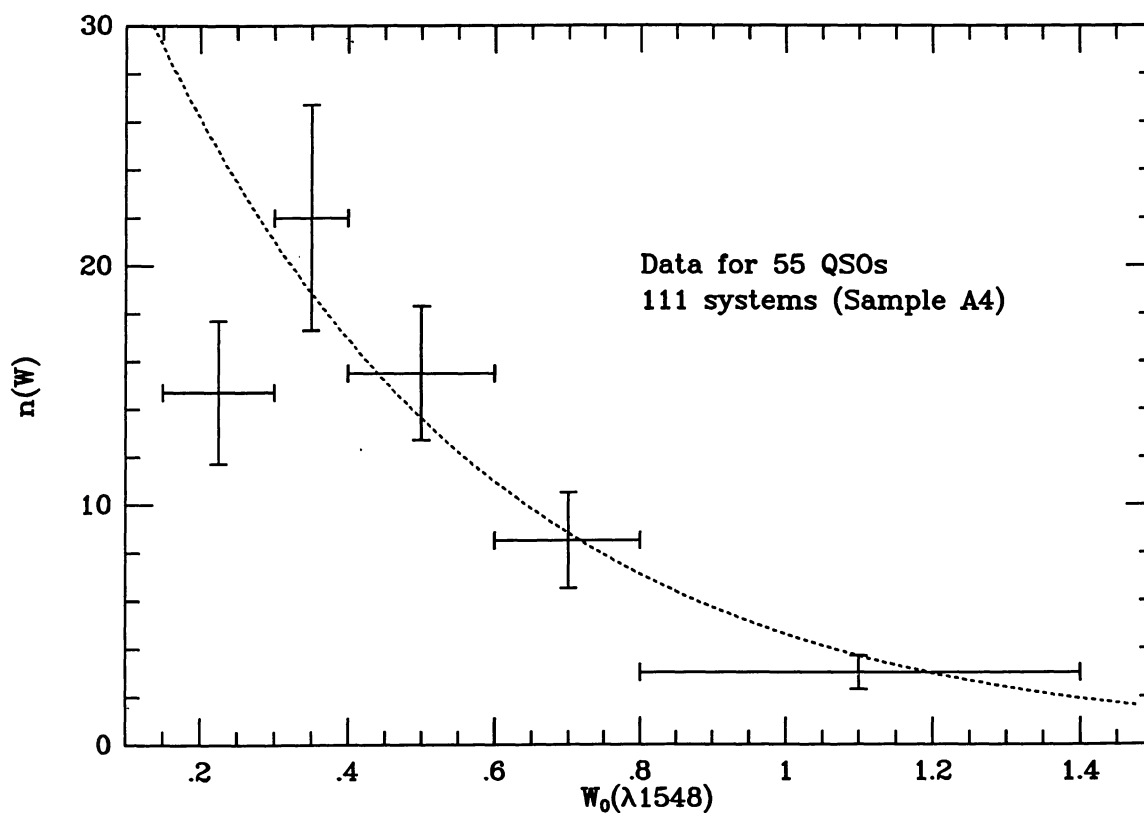


FIG. 8.—The binned equivalent width spectrum for the C IV $\lambda 1548$ lines in sample A4. The dotted curve represents the maximum-likelihood estimation for an assumed exponential distribution of the form $n(W) \propto \exp(-W/W_*)$, where $W_* = 0.46$ (see Table 5).

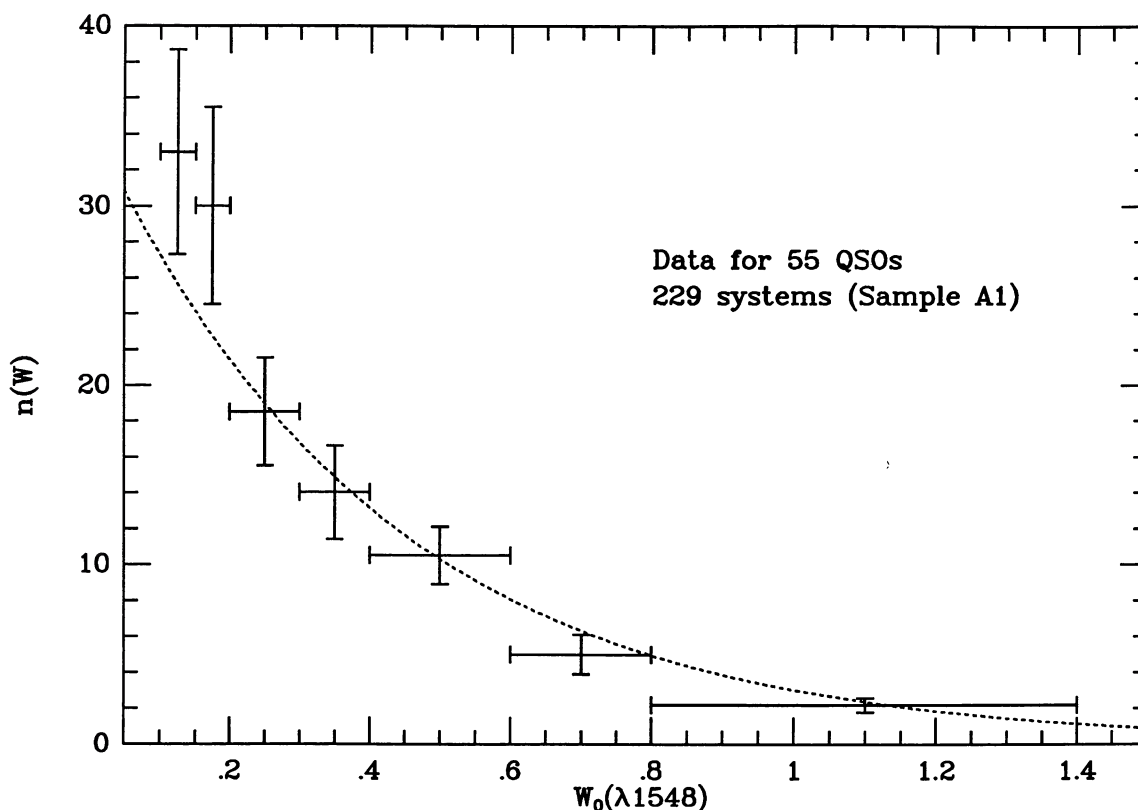


FIG. 9.—Same as Fig. 8, for sample A1. The dotted curve represents the maximum-likelihood estimation for the assumed exponential distribution ($W_* = 0.41$).

equivalent width bin. This bin is incomplete because the equivalent width threshold for sample A4 requires that both components of the C IV doublet be greater than $0.15 \text{ \AA}$, so that for weak lines only doublets with $W_0(1550) \approx W_0(1548)$ will be included. In order to examine the true behavior of the equivalent width distribution for lines weaker than $0.30 \text{ \AA}$, we have plotted in Figure 9 the observed distribution of equivalent width for sample A1, which contains all 229 C IV redshifts. The exponential curve obtained from a maximum likelihood estimation of W_* appears to fit the data extremely well down to $W_0(1548) \approx 0.2 \text{ \AA}$; however, for smaller equivalent widths there are more lines than would be predicted by assuming an exponential distribution of the form given in equation (12). This qualitative result is similar to that found for Ly α forest lines (e.g., Murdoch *et al.* 1986; Atwood, Baldwin, and Carswell 1985; Carswell *et al.* 1984).

Unlike the case of the Ly α forest, previous studies of heavy-element absorption have contained too few redshifts to permit a serious consideration of any possible evolution of line strength. With our enhanced samples, we have examined the correlation between rest equivalent width of the C IV $\lambda 1548$ line $W_0(1548)$ and redshift z using both the Spearman rank test and the Kendall tau test. (The use of these nonparametric tests in a similar context is described in SYBT.) In order for this test not to be biased against weaker doublets for which the $\lambda 1548$ line would be accepted in the equivalent width cutoff criterion, but for which the $\lambda 1550$ would be too weak, we define a new sample L1. A doublet is accepted to

sample L1 if $W_0(1548) \geq 0.30$ (and $\beta_c > 5000 \text{ km s}^{-1}$), with no specific requirement for $W_0(1550)$. This way the sample will be complete regardless of the relative strength of the two lines of the C IV doublet. We find that, for the 90 doublets in sample L1, there is no significant correlation of $W_0(1548)$ with redshift. The results of the two rank correlation tests are presented in Table 8.

c) Evolution of the Doublet Ratio

The doublet ratio $DR = W_0(1548)/W_0(1550)$ is critical for the physical interpretation of the equivalent widths. It varies from $DR = 2$ for unsaturated lines to $DR \approx 1$ for lines on the saturated part of the curve of growth. YSB found $\langle DR \rangle = 1.33 \pm 0.06$ with a standard deviation $\sigma(DR) = 0.30$, although the distribution shown in their Figure 6 is not Gaussian. We have examined the doublet ratio distribution for a subset of sample L1 constructed by removing doublets which appear to be involved in blends. The resulting sample D1 contains 49 doublets. We have used the Spearman and Kendall rank correlation tests to examine possible correlations between DR and redshift z . The null hypothesis that the two quantities are uncorrelated can be rejected at the 93% level for the Spearman test and at the 95% level for the Kendall test. The complete results of these tests are summarized in Table 8. The apparent correlation is in the sense that DR is systematically larger at higher redshifts. A plot of the binned data which shows this trend clearly is given in Figure 10. We have carried

TABLE 8
RESULTS OF RANK CORRELATION TESTS

Test Variables	Sample	ρ_s^a	$(\rho_s/\sigma)^b$	S_s^c	ρ_k^d	$(\rho_k/\sigma)^e$	S_k^f
$W_0(1548), z_{\text{abs}}$	L1	0.020	0.185	0.855	0.016	0.220	0.826
DR, z_{abs}	D1	0.256	1.780	0.073	0.191	1.934	0.053
DR, $W_0(1548)$	D1	0.036	0.249	0.809	0.014	0.138	0.890
M_V , Number of absorbers.....	S2	-0.120	0.449	0.251	0.042	0.451	0.652

^aSpearman rank correlation coefficient.

^bNumber of standard deviations from the null hypothesis (no correlation) for the Spearman test.

^cSignificance level of the deviation for the Spearman test.

^dKendall rank correlation coefficient.

^eNumber of standard deviations from the null hypothesis (no correlation) for the Kendall test.

^fSignificance level of the deviation for the Kendall test.

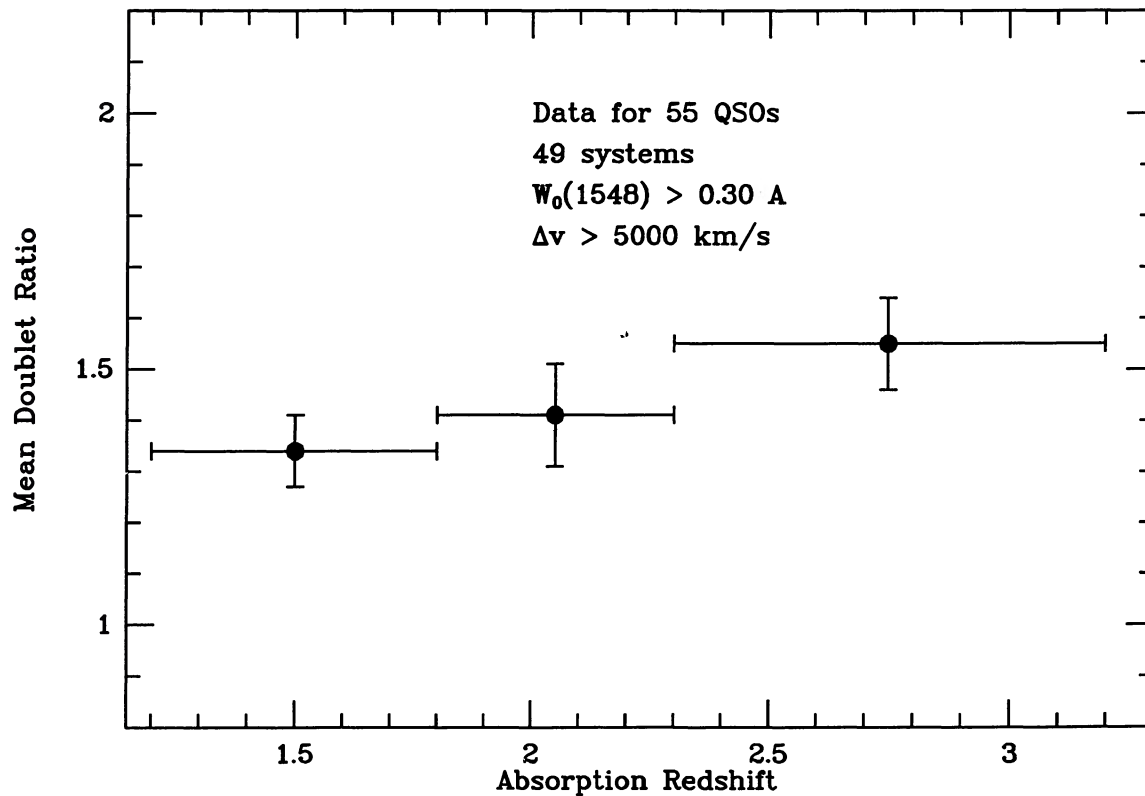


FIG. 10.—The mean doublet ratio for C IV, $W_0(\lambda 1548)/W_0(\lambda 1550)$

out an additional test on sample L1 for a correlation between DR and $W_0(1548)$, and we find no significant correlation. The results of the Spearman and Kendall rank correlation tests are summarized in Table 8.

d) Summary

The discussions in the earlier parts of this section have led to four distinct qualitative trends with increasing redshift:

1. The C IV line density decreases.
2. The mean equivalent width stays constant.
3. The doublet ratio increases.

4. The doublet ratio is not strongly correlated (or anticorrelated) with line strength.

The fact that DR is uncorrelated with $W_0(1548)$ implies that there are saturated lines with a wide variation in equivalent width. This is presumably caused by variations in the velocity dispersion b of the gas. The first result implies that the product $\pi n_0^2 \Phi_0$ is a decreasing function of z . The increase in DR is probably due to a systematic decrease in mean column density with increasing redshift.

Overall, the most likely explanation of these facts is that we are observing the effects of the initial enrichment in heavy elements of the interstellar gas in galaxies. This may be combined with a systematic change in the ionization state of

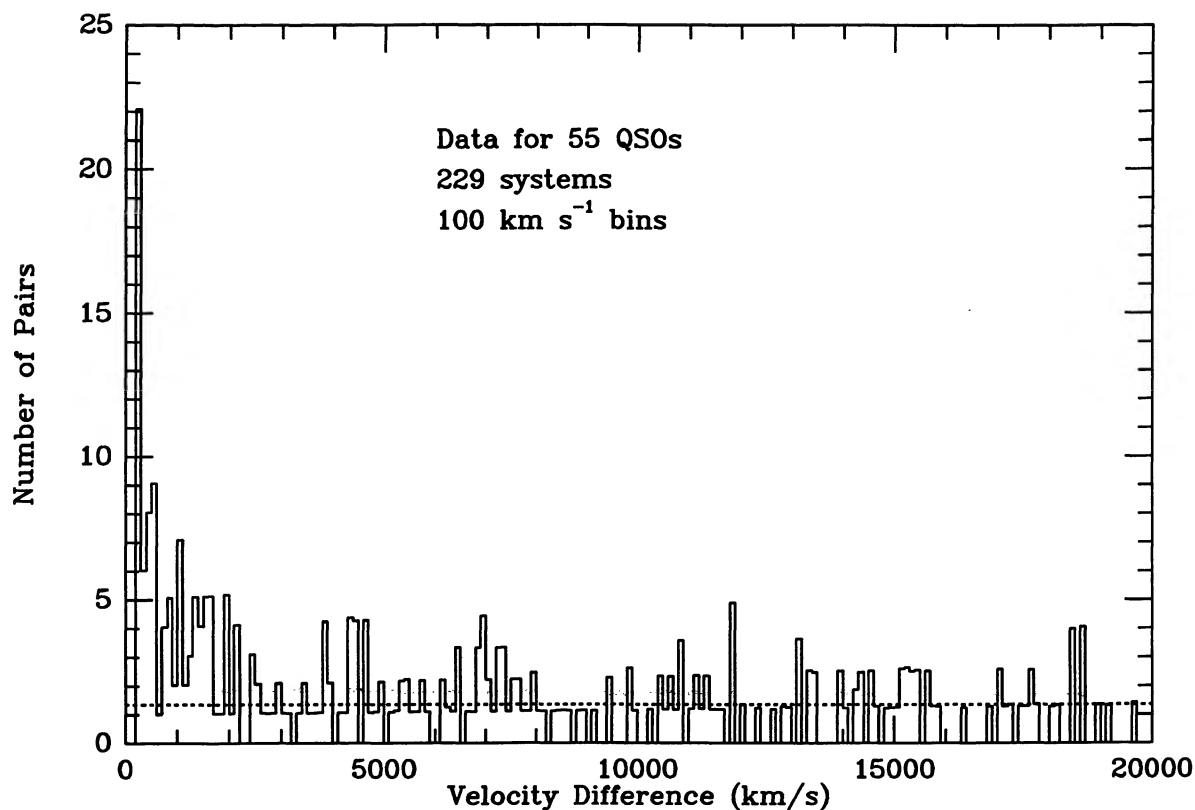


FIG. 11a

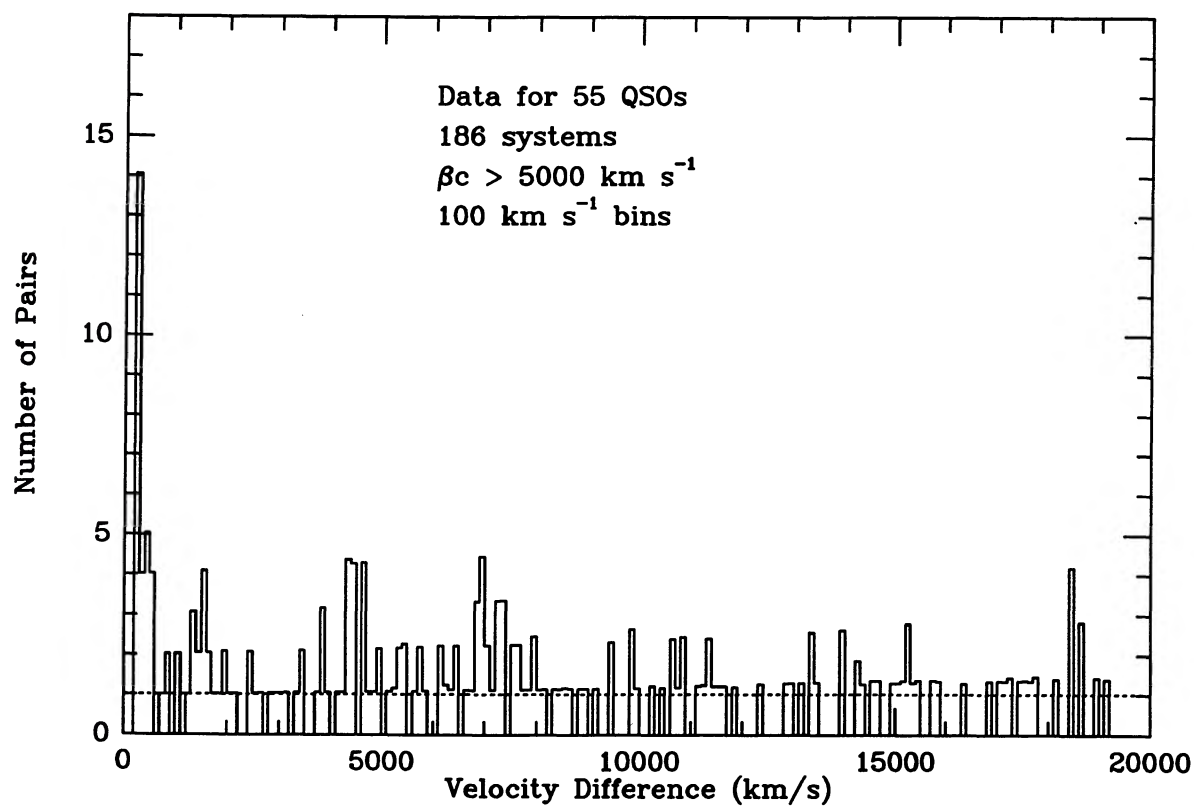


FIG. 11b

FIG. 11.—(a) The two-point correlation function for C IV redshifts in sample A1. The dotted line represents the adopted background level or the mean number of pairs per bin $\langle N_p \rangle$ (excluding velocity scales less than 1000). The correlation amplitude for each bin is then $\xi = (N_p / \langle N_p \rangle) - 1$. (b) Same as (a), for sample A2. (c) Same as (a), for sample A3. (d) Same as (a), for sample A4.

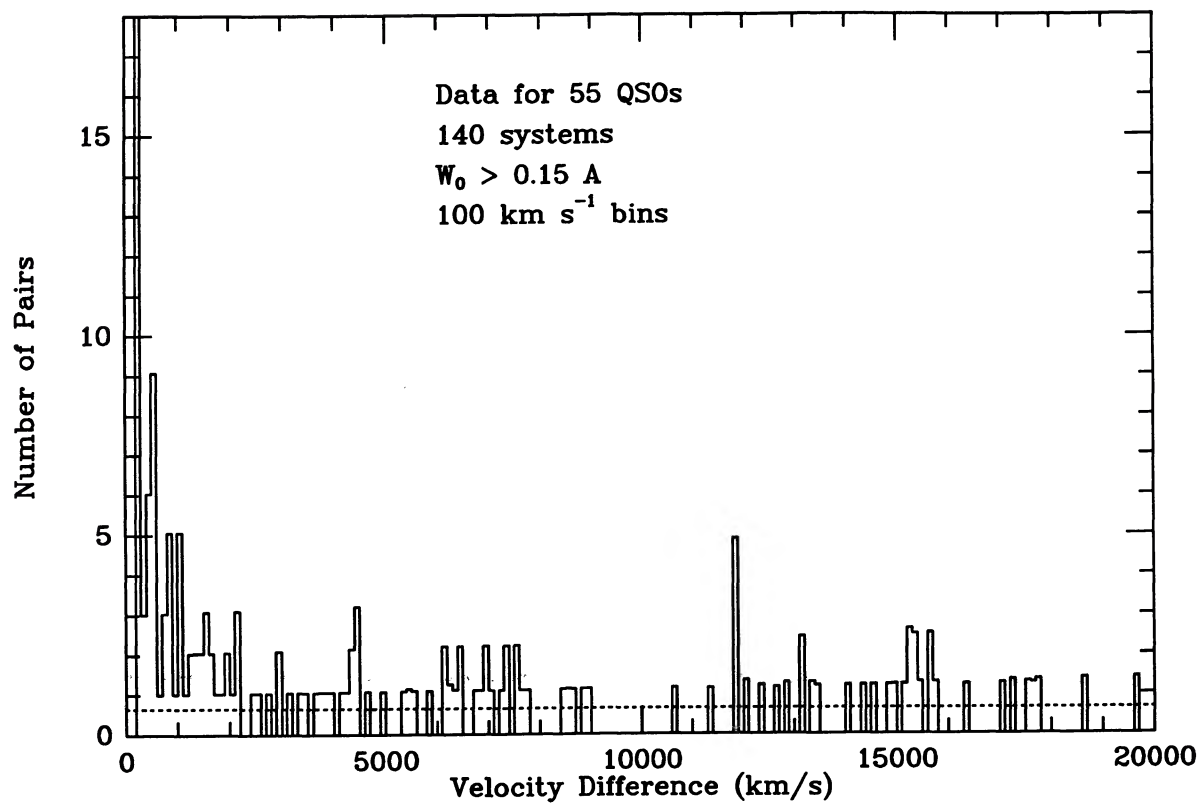


FIG. 11c

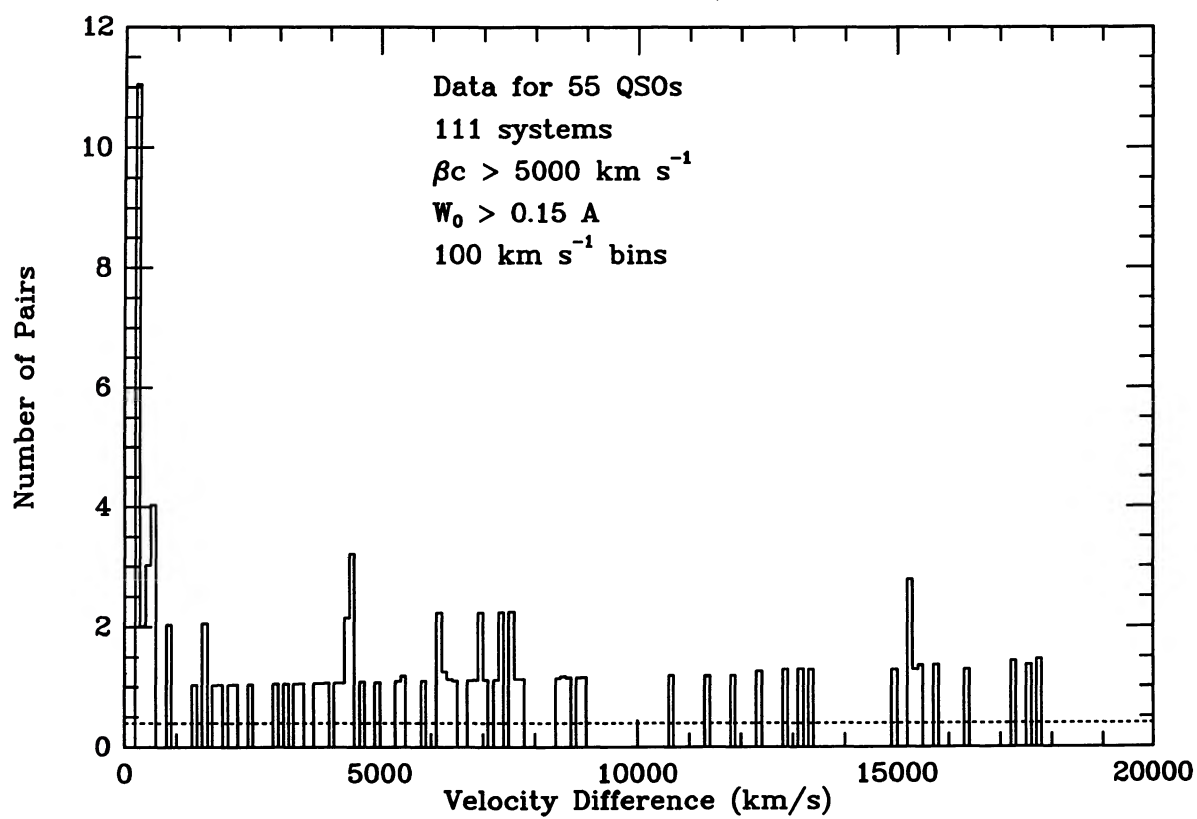


FIG. 11d

the halo gas with time.¹ These possibilities are both open to direct test through detailed observation of the physical state and the composition of the absorbers using the absorption lines themselves.

VII. CLUSTERING

a) Definitions

We quantify the clustering tendency of the absorbers from the degree to which the corresponding absorption systems clump in redshift in each QSO in the given sample. In measuring the clustering from such one-dimensional information it is very convenient to make use of the two-point correlation function, used primarily for the description of local galaxy clustering. Thus, the probability of finding a galaxy in volume dV at distance r from a given galaxy is written in the form

$$dP = \Phi_0 dV [1 + \xi(r)]. \quad (13)$$

Here Φ_0 is the local space density of galaxies and $\xi(r)$ is the excess probability due to clustering. The correlation function for local galaxies is found empirically to have the power-law form $\xi(r) = (r/r_c)^{-1.77}$ (Peebles 1973), where $r_c = 5(H_0/100)^{-1}$ Mpc.

In our case we evaluate the correlation function from the splittings between the measured absorption redshifts. For large redshift differences we have to take into account the fact that the light traverses different absorbing objects at different cosmic epochs. For this reason we use the differences in *comoving* coordinate $S_0(q_0, z)$ between the pairs of absorbers (SYBT). For $q_0 = 1/2$ we have

$$S_0(1/2, z) = \frac{2c}{H_0} [1 - (1+z)^{-1/2}]. \quad (14)$$

The comoving separation between a pair of absorbers with redshifts z_1 and z_2 is then given by

$$s_0 = |S_0(1/2, z_1) - S_0(1/2, z_2)|. \quad (15)$$

The unit of distance is the Hubble radius at the present epoch—or $3000/h^{-1}$ Mpc for $H_0 = 100h$ km s⁻¹ Mpc⁻¹. For small redshift differences $\Delta z = z_2 - z_1$ it is convenient to express splittings in terms of the velocity difference due to the Hubble flow:

$$\Delta v = c \Delta z / (1+z) = cs_0(1+2q_0z)^{1/2}, \quad (16)$$

where $z = (z_1 + z_2)/2$. This is the velocity which would be deduced by an observer on one absorber observing the redshift of a second absorber in the case where the redshift

difference is small. A summary of the various measures of the correlation function in redshift and of their interpretations is given in SYBT.

b) Previous Work

It was shown by Bokseberg and Sargent (1975) that the heavy-element redshifts in QSO spectra are strongly clustered on a scale of ~ 150 km s⁻¹. This was interpreted by Bahcall and Spitzer (1969) as being due to the motions of clouds within galactic halos. SYBT then discovered from a study of the two-point correlation function that the lines of the Ly α forest are not perceptibly clustered. This result was quantified by Sargent, Young, and Schneider (1982), who showed that the clustering length $r_c \leq 0.2$ Mpc at $z = 2.5$. On the simplest hierarchical clustering model (which is approximated in the currently popular “cold dark matter” scenario) the power law retains the same slope as clustering proceeds in the nonlinear regime, while $r_c(z) = r_c(0)(1+z)^{-5/3}$. Thus the expected value at $z = 2.5$ is $r_c = 1.0(H_0/100)^{-1}$ Mpc, a factor of 5 higher than the observed limit. Recent work by Webb, which has not been fully reported in the literature, indicates a small tendency for clustering on scales less than 300 km s⁻¹ in the Ly α forest lines at $z \sim 2$ but not at $z \sim 3.5$ (Webb 1987).

No departure has been found from a Poisson distribution on large scales (out to $\Delta v \approx 30,000$ km s⁻¹) in the two-point correlation function of the Ly α clouds. Carswell and Rees (1987) have shown that voids of the kind found in the local galaxy distribution are not present in the Ly α cloud distribution at redshifts $z \geq 2$.

Some marginal evidence for clustering of the heavy element redshifts on scales between 500 and 2000 km s⁻¹ was found by YSB both in their own data and in an expanded data set. A primary reason for the present investigation was to clarify the properties of the C IV correlation function on scales between 200 and 2000 km s⁻¹, since on these scales any effects are unlikely to be due to the relative motions of clouds within galaxies.

c) Determination of the Correlation Function

We have used the procedures outlined in § VIIa to calculate the two-point correlation function for various samples of C IV redshift systems outlined in § IV and Table 5. The results are shown in Figures 11a–d. We recall that the abscissa is the comoving velocity splitting between any pair of absorbers in the spectrum of the same object as calculated from equation (16). The horizontal dotted line in each of the figures is the average background Poisson contribution. This was estimated in each case by calculating the mean value of the two-point correlation function after subtracting values on scales less than 1000 km s⁻¹, where most of the correlation is expected to be seen. In constructing the two-point correlation function for each sample, we have also excluded all splittings on scales less than 200 km s⁻¹. This way we do not give too much weight to the QSOs which were observed at the higher (0.7 Å) resolution, and we exclude velocity scales over which the distribution of splittings may be incomplete because of the finite resolution of the spectra. The largest data set, shown in Figure 11a, is the correlation function for all 229 absorp-

¹We thank Dr. J. Bergeron for pointing out that, for systems in which both C IV $\lambda\lambda 1548, 1550$ and Si IV $\lambda\lambda 1393, 1402$ are observed longward of Ly α emission, there is a tendency for the ratio $W(\text{Si IV})/W(\text{C IV})$ to increase with increasing redshift. Such a trend might be interpreted as evidence for a systematic decrease in the ionization state of the gas with increasing redshift; however, we find on statistical analysis that the trend is not significant.

tion systems (sample A1) obtained by summing the individual correlation functions for each of the 55 QSOs. Thus we have ignored the fact that the sensitivity for finding absorption systems varies slightly from object to object and also with wavelength in any given QSO. Clearly the first effect results in different QSOs having unequal weights. The second effect will only be serious on large velocity scales; in particular, it should not distort any structure in the correlation function within, for example, 2000 km s^{-1} of the origin. (This corresponds to $\sim 20 \text{ \AA}$ in a typical spectrum.) Figure 11a shows that the C IV correlation function is generally flat on scales above $\sim 2000 \text{ km s}^{-1}$, as is expected for randomly distributed intervening absorbers. (We note that this test for the origin of the absorption lines is independent of the tests involving the distribution of β_c discussed in §§ Va and Vb.) There is possible structure on scales of tens of thousands of km s^{-1} which we shall return to shortly. The most pronounced feature in Figure 11 is the strong clustering observed on scales $\Delta v \leq 600 \text{ km s}^{-1}$; as found by YSB, this apparently extends out to $\sim 2000 \text{ km s}^{-1}$. However, we recall that there is a tendency for QSOs to show clumps of absorption near the emission redshift. This behavior is exhibited particularly by Q1511+091 in our sample. In order to remove any possible contamination by ejected matter, we have also calculated the correlation function for the 186 absorption systems which result when all absorption systems for which $\beta_c \leq 5000 \text{ km s}^{-1}$ are excluded (sample A2). The resulting plot is shown in Figure 11b. As expected, Figures 11a and 11b differ qualitatively only near the origin. The peak in the correlation function no longer extends out continuously beyond $\Delta v \sim 600 \text{ km s}^{-1}$; however, there are possibly significant isolated peaks on scales of ~ 1500 and $\sim 7000 \text{ km s}^{-1}$. In order to weight the QSOs equally, and to be more certain of any features in the correlation function on large scales, we show in Figures 11c and 11d similar plots to those in Figures 11a and 11b, respectively, this time using samples A3 and A4. These plots exhibit the same qualitative behavior as Figures 11a and 11b. An examination of the four figures leads to the following conclusions:

1. There is a peak in the correlation function at the origin which appears to cut off sharply at $\Delta v \approx 600 \text{ km s}^{-1}$. The finite resolution of the spectra strongly influences the first 100 km s^{-1} bin, and possibly influences the bin $100\text{--}200 \text{ km s}^{-1}$, so that we have excluded splittings on these scales. Beyond that, the mean amplitude of the correlation function between 200 and 600 km s^{-1} is well determined to be 5.7 ± 0.6 for sample A2, and 11.5 ± 1.3 for sample A4.

2. Overall, the Poisson background appears sensibly flat in all of the plots; however, there are hints of structure on large velocity scales. For example, for velocity scales between 1000 and $10,000 \text{ km s}^{-1}$, there appears to be a 2.0σ excess, while on velocity scales from $10,000$ to $20,000 \text{ km s}^{-1}$ there is a 2.4σ deficiency. These values were calculated by determining the two-point correlation function using the Poisson sample S2 (Table 6), where all velocity splitting on scales less than 1000 km s^{-1} has been removed (this is done so that the correlation function on large scales is uncontaminated by "multiplicity" effects that would arise when the splittings are calculated between all the members of a "clump" and an isolated redshift separated from the clump by a large velocity).

This effect and the other apparent smaller scale peaks in the figures could only be confirmed with more data.

d) Expected Contribution of Cloud Motions

The Fisher-Tully and Faber-Jackson relations show that rotational amplitudes of up to 600 km s^{-1} and random motions of up to 400 km s^{-1} can occur in luminous galaxies. Thus, much of the power in the correlation function that we have found on scales extending up to 600 km s^{-1} could, in principle, be due to relative motions of independent clouds within intervening galaxies. We estimate the expected contribution of such motions to the two-point correlation function as follows. Assume that the galaxian luminosity function may be represented by Schechter's (1976) expression:

$$\Phi(L) dL = \Phi_*(L_*)(L/L_*)^{-5/4} \exp(-L/L_*) dL. \quad (17)$$

Next, assume that the effective cross section for C IV absorption scales with luminosity like the Holmberg radius:

$$R(L) = R_*(L/L_*)^{5/12}. \quad (18)$$

Finally, assume that typical cloud velocities within a galaxy scale like the Faber-Jackson (Faber and Jackson 1976) or Tully-Fisher (Tully and Fisher 1977) relations:

$$v(L) = v_*(L/L_*)^{1/4}. \quad (19)$$

With these assumptions it is easy to calculate that galaxies with luminosity $L \leq L_*$ contribute 81% of the total absorption cross section, while galaxies with $L \leq 3L_*$ contribute 98%. However, the total cross section is not dominated by very faint galaxies, since galaxies with $L > 0.3L_*$ contribute $\sim 84\%$ of the total cross section.

The area-weighted mean velocity spread in a galaxy is given by

$$\langle v \rangle = \frac{\int_0^\infty \Phi(L) L^{1/4} R^2 dL}{\int_0^\infty \Phi(L) R^2 dL}. \quad (20)$$

This gives $\langle v \rangle = 0.74 v_*$, where $v_* \approx 200 \text{ km s}^{-1}$ is the typical velocity spread in a galaxy of luminosity L_* . Therefore, with the above assumptions, we expect the mean velocity splitting for QSO absorption lines produced by motions in galaxies to be $\sim 150 \text{ km s}^{-1}$. Moreover, our sight lines through galaxies typically must occur at large radii where the rotation curves of spirals are observed to be flat. Thus, the sampled *differential* rotational velocity is expected to be small and the expected mean velocity splitting would be less than the 150 km s^{-1} derived above. It is therefore unlikely that the observed C IV splittings which go up to 600 km s^{-1} are due to motions within galaxies; it is more likely that we are observing the tip of the galaxian two-point correlation function.

On the other hand, two completely different and more direct lines of evidence suggest that the absorbers may in fact be abnormally large objects. However, as we shall see, this does not alter the conclusion that the velocity splittings above

$\Delta v \sim 200 \text{ km s}^{-1}$ are for the most part *not* due to relative motions *within* galaxies.

First, Bergeron (1988) has demonstrated that visible galaxies at a similar redshift may be found associated with a large fraction (15 out of 19 cases examined) of Mg II absorption systems with $z \leq 0.7$. As emphasized by Bergeron, in order to be detected the galaxies producing the absorption have to be unusually luminous; their mean luminosity turns out to be $\langle L \rangle = 1.5L_*$ and the range is from $0.4L_*$ to $3L_*$. Moreover, since 80% of the absorbers are actually detected, low-luminosity galaxies cannot possibly dominate the total cross section. This result, at least for the Mg II absorbers, is somewhat at variance with the assumptions made earlier. The detection limit for the Mg II galaxies is 2 mag fainter than the faintest of the positive detections, indicating that there may be a cutoff in the luminosity function of galaxies which give rise to Mg II absorption.

Related evidence for the existence of a population of very large absorbers comes from the rare cases of correlated absorption in the spectra of closely spaced QSOs on the plane of the sky. A particular important example is the pair UM 680 ($z_{\text{em}} = 2.144$) and UM 681 ($z_{\text{em}} = 2.122$), which are separated by $58''$. This corresponds to a linear dimension for a range of redshifts near $z = 2$ of $240h^{-1} \text{ kpc}$ ($q_0 = 1/2$) or $370h^{-1} \text{ kpc}$ ($q_0 = 0$). Despite the large separation of the light beams, Shaver and Robertson (1982) discovered two common absorption systems at $z_{\text{abs}} = 2.12$ and $z_{\text{abs}} = 2.03$. Later, Sargent and Boksenberg (1988b) found a third common system at $z_{\text{abs}} = 1.70$. All three systems contain C IV doublets. The velocity differences of the common systems are small, namely $\Delta v_{\text{rms}} = 190 \text{ km s}^{-1}$. Using the value for the incidence of C IV absorptions per unit redshift obtained in the present paper, we have estimated the probability that the adjacent lines of sight intercept a pair of correlated but independent objects as we observe in UM 680 and UM 681. With the observed values of the equivalent widths of a typical pair of correlated C IV doublets, this probability comes out to be only $\sim 2 \times 10^{-3}$. Thus we may conclude that the three coincidences observed in UM 680 and UM 681 must be due to the fact that most of the absorption cross section is contributed by coherent objects with diameters of order 200–400 kpc. This is in accord with Bergeron's more direct discovery that most of the cross section for Mg II absorption is contributed by large and luminous galaxies. (Of course, nothing is known about the *luminosities* of the inferred large absorbers in UM 680 and UM 681.) The fact that the observed Δv_{rms} is only $\sim 190 \text{ km s}^{-1}$ in the three lines of sight nevertheless implies that the correlation observed on scales above 200 km s^{-1} in our C IV sample is primarily due to the galaxy-galaxy correlation function.

e) Correlations Due to Galaxy Clustering: Simple Theory

We now wish to calculate the amplitude of the correlation function of the absorbers in order to compare the results with the values obtained in § VIIc. We have just seen that it is likely that most of the absorption cross section is contributed by galaxies with luminosities above $0.3L_*$ which have large cross sections. However, for reasons of clarity, we shall first

calculate the expected galaxy-galaxy correlation function at a redshift $z \sim 2$ using the assumption that the effective cross section scales with luminosity as in equation (18). We then find that the mean effective radius for absorption for an L_* galaxy is given in terms of the number density of absorption systems $N(z) \equiv dN/dz$ by the expression

$$R_* = 59h^{-1} \left[\frac{N(z)}{(1+z)} \right]^{1/2} (1+2q_0z)^{1/4} \text{ kpc.} \quad (21)$$

On substituting $\langle N(z) \rangle = 2.57$ and $\langle z_{\text{abs}} \rangle = 1.957$ for sample S2, we find

$$R_* = 72h^{-1} \text{ kpc} \quad (q_0 = 1/2), \quad (22)$$

$$R_* = 55h^{-1} \text{ kpc} \quad (q_0 = 0). \quad (23)$$

Note that in deriving this equation we have assumed that the local luminosity function of galaxies also obtains at a redshift of $z \sim 2$. It is highly unlikely that this assumption is correct, but we have no alternative. If we adopt the assumptions summarized in §§ VIIa and VIIb regarding the form of the local galaxian correlation function and its evolution in cosmic time, we find for the number of *correlated* galaxies per fiducial galaxy with radius between R and $R + dR$ along the line of sight

$$n_c(R) dR = \int_0^R 4\pi s ds \int_0^\infty dl \Phi r_c^\alpha (s^2 + l^2)^{-\alpha/2} \\ - \int_0^R 4\pi s ds \int_0^{(D_{\text{min}}^2 - s^2)^{1/2}} dl \Phi r_c^\alpha (s^2 + l^2)^{-\alpha/2} \quad (24)$$

Here l is the distance along the line of sight and s is the distance perpendicular to the line of sight. The last term is added to prevent galaxies being closer than D_{min} to any fiducial galaxy. This equation is similar to the one derived in YSB's equation (44). They were interested in calculating the expected number of absorptions associated with the QSO and considered a hemispherical volume of radius R centered on the QSO. Our modified treatment considers a cylindrical volume of radius R with the QSO at one end of the cylinder and the observer at the other. As in YSB, the expression in equation (24) must be integrated over the luminosity function in order to obtain the total number of correlated absorbers n_c . The value of n_c is quite sensitive to the choice of D_{min} ; in order to exclude velocity splittings on scales $\Delta v < 200 \text{ km s}^{-1}$, which might be due to motions within galaxies, we choose D_{min} to be the Hubble flow distance corresponding to 200 km s^{-1} at $z \sim 2$, that is, $D_{\text{min}} \approx 6 R_*$ (for $q_0 = 1/2$). On integrating over the luminosity function and substituting, we find that, for $q_0 = 1/2$, $n_c/N = 0.062$, where N is the mean number of independent absorption systems per unit redshift as presented for the *Poisson* samples in Table 6. For the comparison with the observations, we will use the correlation function generated from sample A4 (Fig. 11d) because N is well determined by sample S2 (which is the *Poisson* sample with identical selection criteria). The mean number of absorption systems per unit redshift range in sample S2 is $N = 2.57$. Thus, the number of excess splittings per absorption system

TABLE 9
EXPECTED NUMBER OF EXCESS SPLITTINGS

Luminosity Function	$q_0 = 1/2$	$q_0 = 0$
$L/L_* > 0$	13.7	4.6
$L/L_* > 0.5$	6.0	2.2

over the mean Poisson level is $n_c = 0.062 \times 2.57 = 0.16$. With 86 absorption systems in sample S2, we therefore expect $0.16 \times 86 \approx 14$ excess splittings, strikingly close to the observed value of ~ 18 . Because the Hubble flow distance corresponding to the lower velocity cutoff of 200 km s^{-1} depends on q_0 (there is no H_0 dependence because we have expressed $D_{\min}$ in units of R_*), we have repeated the above calculation for $q_0 = 0$. The expected number of excess splittings in this case is significantly smaller than observed. The results for both values of q_0 are summarized in the first line of Table 9. It appears that the pronounced peak in the two-point correlation function of the C IV doublets is consistent with the most naive theory of the evolution of the local galaxian correlation function for $q_0 = 1/2$, but perhaps not for $q_0 = 0$. Nevertheless, this result gives some confidence that we are actually observing the effects of the correlation function in the clustering of the C IV absorption lines.

We have seen in § VII d that there is good reason to believe that most of the absorption cross section is contributed by luminous galaxies. We shall therefore repeat the comparison outlined above, this time assuming that only galaxies more luminous than $L_{\min} = 0.5 L_*$ contribute to the cross section. We shall continue to assume that the cross section scales with luminosity as in equation (18) and that the local Schechter luminosity function applies at a redshift of $z \sim 2$. Clearly there is little justification for either of these assumptions. The new equation for the effective radius of an L_* galaxy is

$$R_* = 97h^{-1} \left[\frac{N}{(1+z)} \right]^{1/2} (1 + 2q_0 z)^{1/4}. \quad (25)$$

Substituting $\langle N(z) \rangle = 2.57$, $\langle z_{\text{abs}} \rangle = 1.957$ from sample S2, we find

$$R_* = 119h^{-1} \text{ kpc} \quad (q_0 = 1/2), \quad (26)$$

$$R_* = 91h^{-1} \text{ kpc} \quad (q_0 = 0). \quad (27)$$

We note that these values of R_* , while large, are still smaller than all three intervening absorbers along the lines of sight to UM 680 and UM 681. This may mean that the luminosity cutoff $L_{\min}$ is even higher than the value inferred from the statistics of the Mg II absorbers.

In order to examine the effect of having only large absorbers on the predicted correlation function, we have repeated the calculation of the predicted excess splittings for different values of q_0 . The results are shown in the second line of Table 9. Keeping in mind all of the assumptions we have made in this calculation, it appears on the basis of this simple calculation that the expected number of excess splittings for

both $q_0 = 1/2$ and $q_0 = 0$ is very much less than the observed number.

f) Comparison with Simulations

We have so far compared our observed C IV two-point correlation functions with the simplest theory of the evolution of hierarchical clustering and we have seen that the model is in tolerable agreement with the observations. However, a perhaps more realistic approach is to compare the clustering observed in the C IV doublets with the predictions obtained from simulations.

Salmon and Hogan (1986) have computed the correlations in redshift space expected on the currently popular cosmological model in which the mass-density is dominated by "cold dark matter." In these simulations the velocity correlation function between particles close to a chosen line of sight in N -body simulations are calculated at epochs which correspond to mean redshifts z of 0.0, 1.25, and 3.0, respectively. In all cases the initial conditions were adjusted so that the distribution of particles is similar to the observed galaxy distribution at $z = 0$. The quantity calculated is

$$w(v) = \frac{n_{\text{pairs}}}{\langle n_{\text{pairs}} \rangle}, \quad (28)$$

where $\langle n_{\text{pairs}} \rangle$ is the background level (expected to be constant on scales greater than a few tens of Mpc and much less than the Hubble radius at any given epoch) and n_{pairs} is the number of splittings in excess of the background.

The resulting correlation function $w(v)$ is found to depend strongly on the cosmological parameters z and Ω_0 , but hardly at all on the adopted number density, size, or mass of the clouds. The observed correlations are found to evolve rapidly with epoch. The main trends revealed by the calculations may be summarized as follows:

The clouds are more strongly correlated in the $\Omega_0 = 0.2$ models than in the $\Omega_0 = 1.0$ models. For example, Salmon and Hogan found $w = 10 \pm 5$ at $z = 3$ for velocity separations in the range $100\text{--}150 \text{ km s}^{-1}$, growing to $w = 15 \pm 5$ at $z = 1.25$. These values agree tolerably well with the data for C IV redshifts in six QSOs published by SYBT and suggested to Salmon and Hogan that the C IV redshifts must be associated with galaxies. (However, the six QSOs in SYBT may not constitute an unbiased sample as far as the heavy-element lines are concerned. At that time, the few detailed QSO studies carried out had tended to concentrate on objects such as Q0237–233 with abnormally complex absorption spectra.) If this interpretation is correct the Ly α clouds must then for some reason avoid the galaxy concentrations.

The correlations in $\Omega_0 = 1$ models evolve very rapidly in time and less rapidly in $\Omega_0 = 0.2$ models. Overall the correlations are much weaker in the $\Omega_0 = 1$ simulations; at $z = 3$ no correlation can be reliably discerned in these models. Salmon and Hogan suggest therefore that the Ly α clouds, which show little or no correlation on any scale (SYBT; Webb 1987), may be represented by these simulations. Thus, a second possibility is that the Ly α cloud distribution traces the true mass distribution in a "cold dark matter" universe, while the

heavy-element systems, presumed to be galaxies, are more clustered than the overall mass distribution. As Salmon and Hogan point out, various schemes have been proposed by which the "biasing" in the galaxy distribution might be brought about.

The observations obtained in the present work have led to the first reliable information on the correlation function for the heavy-element redshifts on velocity scales in the range 200–600 km s⁻¹, which are too large to be due to motions of clouds within galaxies. We earlier found the mean amplitude of the correlation function over this range to be 11.5 ± 1.3 . Salmon and Hogan give the range of amplitudes w as a function of velocity splitting for each of the three redshifts. We have interpolated their calculations to obtain w at $z \sim 2$. Thus we find that in Salmon and Hogan's $\Omega_0 = 0.2$ simulation the expected w is in the range $1.4 < w < 5.1$ for $H_0 = 50$ km s⁻¹ Mpc⁻¹. For the $\Omega_0 = 1.0$ simulation, the corresponding values are $1.6 < w < 4.0$. For both simulations, there is negligible power on the velocity scales of interest if $H_0 = 100$ km s⁻¹ Mpc⁻¹. We thus find that the observed strong clustering at $z \sim 2$ cannot be reconciled with the predictions of cold dark matter models with any reasonable value of Ω_0 . In contrast, Salmon and Hogan found that the amplitude of the correlation function on scales $\Delta v < 150$ km s⁻¹ (which, as we have seen, is not necessarily a reflection of galaxy clustering) could be reconciled with their $\Omega_0 = 0.2$ simulation. Thus, we must suppose that the heavy-element absorbers are much more clustered than the overall matter distribution for either value of Ω_0 . Our conclusion is made stronger by the better data sample in the present paper and by the fact that we have measured the amplitude of the correlation function on large velocity scales. The need for "biasing" in cold dark matter cosmologies arises essentially from the contrast between voids and superclusters at $z = 0$. We have shown using the clustering of C IV absorption lines that the same difficulty exists at $z \sim 2$. As Salmon and Hogan pointed out, the lack of clustering observed in the Ly α clouds could reflect the overall matter distribution in a cold dark matter-dominated universe with either $\Omega_0 = 1$ or $\Omega_0 = 0.2$.

g) Large-Scale Structure

Recent extensive redshift surveys (e.g., Davis *et al.* 1982; de Lapparent, Geller, and Huchra 1986; Giovanelli *et al.* 1986) have shown that the local universe has very large scale structures in the galaxy distribution. For example, the Bootes void has a diameter of $\sim 50h^{-1}$ Mpc (Kirshner *et al.* 1981). The existence of such large structures at high redshifts is indicated by at least three distinct types of observations using the QSO absorption lines:

1. The possible departure of the number of absorbers per unit line of sight from a Poisson distribution (§ Vb).
2. The apparent departure of the two-point correlation function from a flat distribution on large velocity scales (§ VIIe).
3. The rare existence of regions in the sky where QSOs separated by several minutes of arc show an enhanced density of absorption redshifts over the same sizable range in Δz .

In general, correlated absorption features have only been found in the spectra of QSOs separated by less than 1' on the

plane of the sky (Shaver and Robertson 1982; Sargent 1987). In particular, the QSOs which are thought to be gravitationally lensed and in which the images are separated by a few arcseconds show common absorption features. Thus, until recently, cases of common absorption had been limited to separations of the order of the largest dimensions associated with galactic halos. It therefore came as a surprise when Jakobsen *et al.* (1986) found an unusually high density of C IV absorption doublets in the spectra of two QSOs, Tol 1038–2712 ($z_{\text{em}} = 2.331$) and Tol 1037–2704 ($z_{\text{em}} = 2.193$), which are separated by 17' on the sky. According to Jakobsen *et al.*, and confirmed by Sargent and Steidel (1987), there are at least five absorption redshifts or clumps of redshifts in the range $1.85 \leq z_{\text{abs}} \leq 2.14$ in the spectra of both of these QSOs, a density unequaled in the C IV survey of 55 QSOs described in this paper. Even more remarkably, two fainter QSOs in the same field, Q1038–2707 ($z_{\text{em}} = 1.937$) and Q1035–2737 ($z_{\text{em}} = 2.168$) also have strong absorption redshifts at $z_{\text{abs}} = 1.89$ and $z_{\text{abs}} = 2.13$, respectively. The picture which emerges is that there is a supercluster in this region of the sky, extending from $z \sim 1.85$ to $z \sim 2.14$. The corresponding comoving size in the radial direction (assuming $q_0 = 1/2$) is ~ 100 Mpc. The projected extent of the supercluster on the plane of the sky is at least 5 Mpc by 15 Mpc. Further observations of the absorption spectra of other QSOs discovered by Bohuski and Weedman (1979) in this region of the sky are currently underway to more closely define the boundaries. Since the density of absorption features is so high in the spectra of QSOs thought to be on the far side of the supercluster, it is likely that we are observing along a filament of galaxies or along the plane of a sheet. The existence of such large, unsymmetrical structures would lead to a complication in the statistics of the expected number of absorbers per QSO, which would only be Poissonian for observed redshift intervals Δz that were large compared with the sizes of the largest structures. Since the typical redshift range for the C IV survey is only $\Delta z \approx 0.6$, as compared with $\Delta z \approx 0.2$ for the hypothetical supercluster discussed above, the possible existence of the tail on the Poisson distribution of the number of absorbers per QSO then has a natural explanation. Clearly the existence of large-scale structure of the kind revealed by the absorption spectra of Tol 1037–2704 and Tol 1038–2712 would also lead to structure on large velocity scales in the two-point correlation function. Indications of such an effect were pointed out in § VIIe, but, as we have stated, more data are required for a definitive discussion.

h) Gravitational Lensing

One alternative explanation of the possible non-Poissonian behavior of the number of absorbers per unit line of sight and the two-point correlation function on large velocity scales is observational bias. It has been suggested (Webster 1987) that the observed larger-than-expected incidence of absorption systems in the spectra of QSOs may be caused by an observational selection effect involving gravitational lensing. The idea is that the QSOs whose absorption spectra are studied tend to be the brightest of the ones available. If, as some believe, the QSO luminosity function at the bright end is strongly influenced by amplification due to gravitational lensing one would

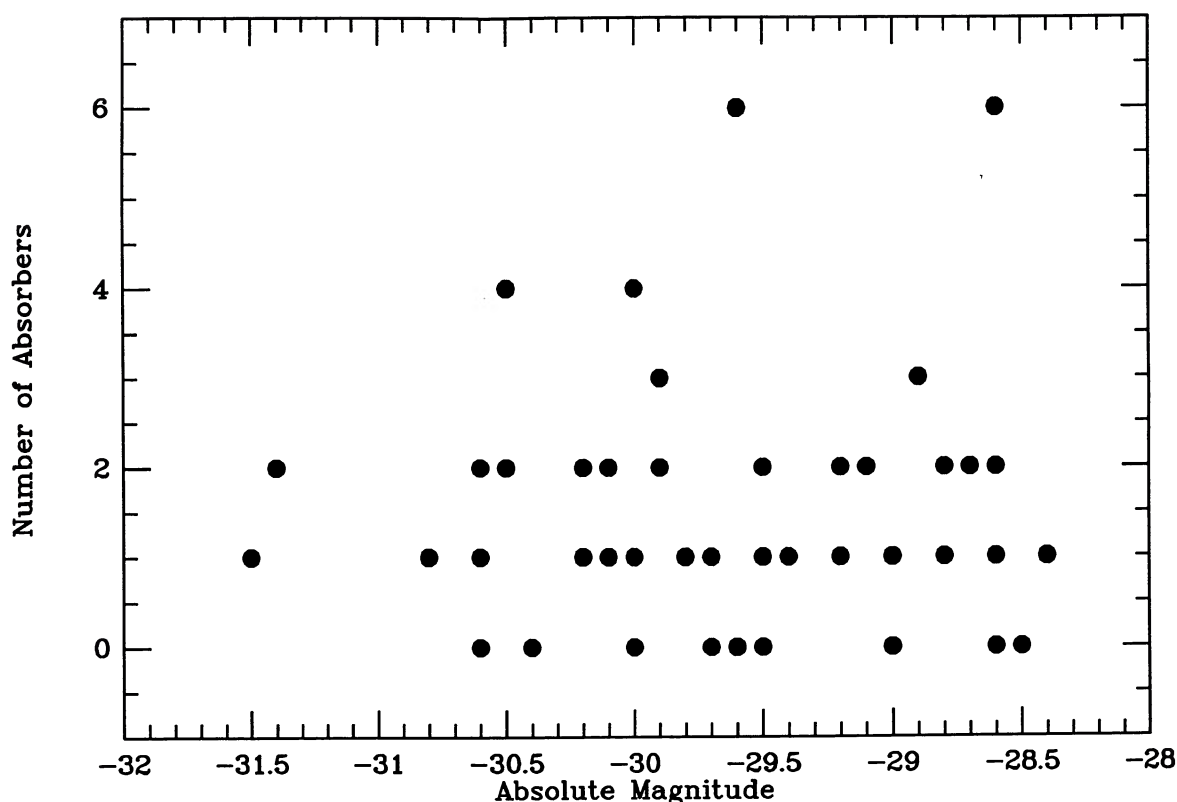


FIG. 12.—The number of absorption redshifts (in sample S2) vs. the QSO absolute magnitude for the 55 QSOs in the sample. There is no significant correlation between the two quantities.

therefore be observing along lines of sight which are not representative of the overall cosmological distribution of material.² If this were the case, then a survey such as the one we have carried out might be expected not to conform to a Poisson distribution for the number of absorbers per unit redshift range. Following Webster (1987), to look for this effect we have tested for a correlation between the QSO absolute magnitude (as defined by Véron-Cetty and Véron 1987) and the number of absorption systems (in sample S2) present in the QSO spectrum. The results of both the Spearman and Kendall rank correlation tests, shown in Table 8, indicate that there is no significant correlation between the two quantities. Figure 12 shows a plot of the number of absorbers per QSO against absolute magnitude; clearly there is no obvious trend. While we find no evidence for the effects of gravitational lensing on our sample, it would be important to obtain spectra of a significantly fainter sample of QSOs in order to compare the absorption line statistics with those obtained from the existing bright samples.

²In this connection, it is interesting that one of the brightest QSOs in our sample, Q0142–100, was recently discovered by Surdej *et al.* (1987) to be gravitationally lensed. We observed the bright component UM 673A which Surdej *et al.* measure to have $B = 17.0 \pm 0.2$ mag. A second image, UM 673B, with $B = 19.1 \pm 0.2$, was found $2''.22$ from UM 673A. According to Surdej *et al.*, UM 673A is highly amplified, and it would almost certainly not have been included in our sample had it not been lensed.

VIII. LINE LOCKING AND SPECIAL REDSHIFTS

The extensive list of C IV absorption redshifts found in the present survey constitute an independent sample on which to test for the existence of various peculiar features of the distribution in redshift which have been proposed in the past.

For example, it has been asserted (Burbidge 1967) that a redshift $z = 1.955$ occurs more commonly both in emission and in absorption than would be expected from statistical fluctuations about a smooth underlying distribution. In Figure 13 we show the distribution of number of absorption redshifts $N(z)$ versus z_{abs} with smaller bins in Δz than that shown in § V. We see that this data sample, which for the most part contains objects which have been observed at this resolution for the first time, shows no significant peak at $z = 1.955$. In fact, in the sample of 229 mostly new redshifts, only one lies between 1.950 and 1.960. This is $z_{\text{abs}} = 1.9597$ in the spectrum of Q1247+267.

“Line locking,” or the preferred existence of coincidences between particular different features in emission and absorption, has also been proposed (Burbidge 1971). Emission-absorption line locking would show up as a peak in Figure 2a. Two particular forms of such line locking have been advocated on both observational and theoretical grounds. The first is a coincidence between the Ly α emission line and the Lyman limit; this leads to an apparent ejection velocity of $\beta c = 78,000 \text{ km s}^{-1}$. The limited wavelength coverage of most

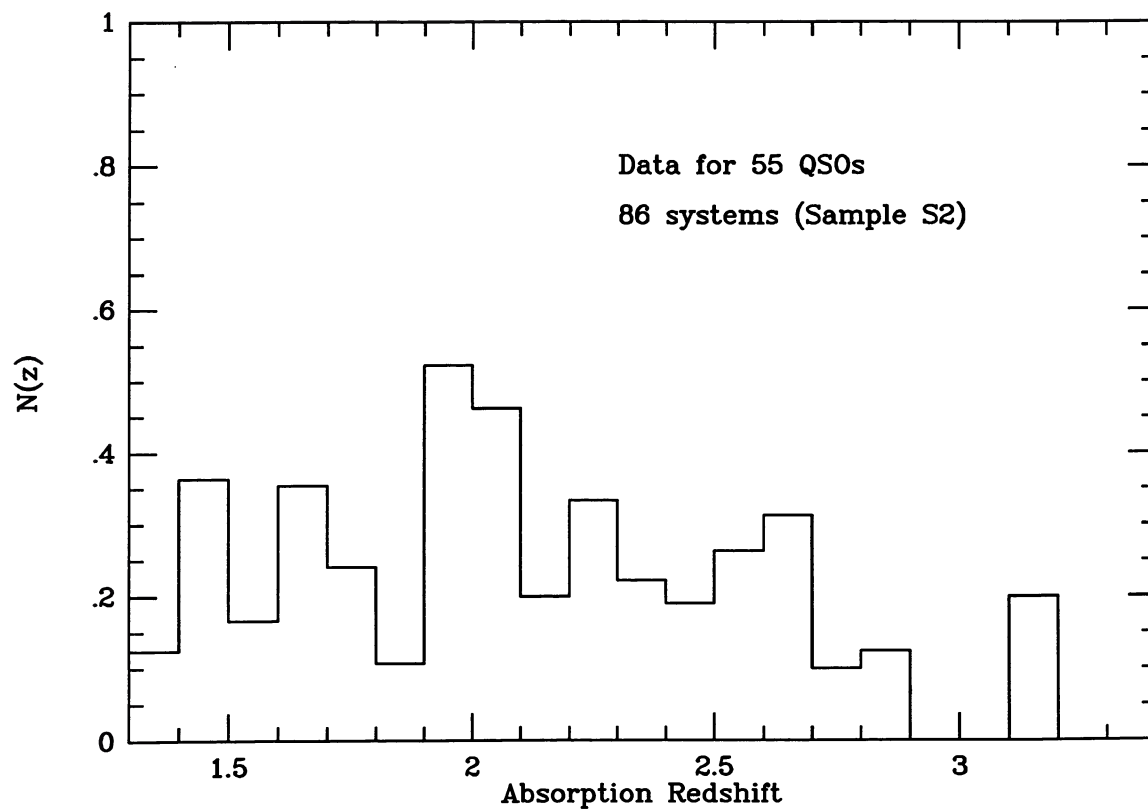


FIG. 13.—The number of absorption systems per unit redshift range $N(z)$ (from sample S2) vs. redshift. Except for the size of the bins, this plot is essentially identical to Fig. 6.

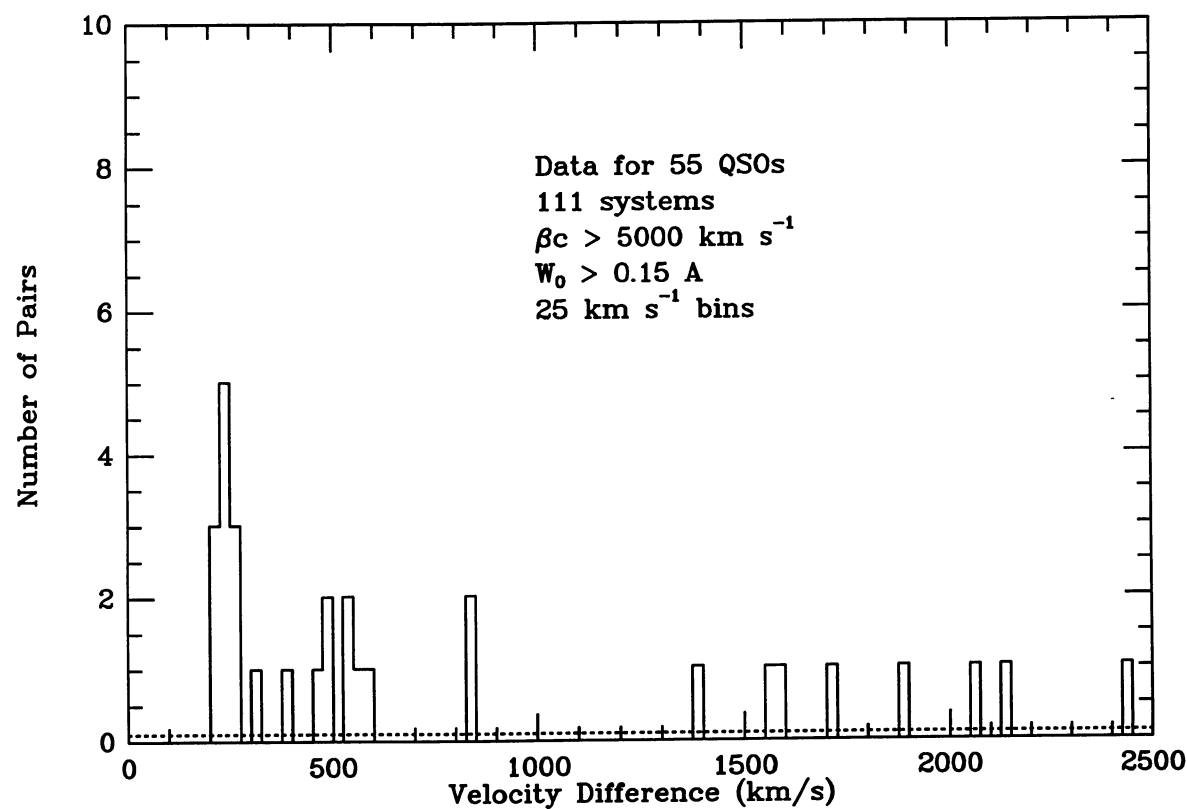


FIG. 14.—The two-point correlation function for redshifts in sample A4, on small velocity scales. Except for the size of the bins, this histogram is identical to the one shown in Fig. 11*d*.

of our spectra does not allow us to extend Figure 2 beyond 60,000 km s⁻¹. The second proposed coincidence is a tendency to find C IV absorption in the blue wing of the Si IV λ 1400 emission line. This occurs at an apparent ejection velocity $\beta c \sim 28,000$ km s⁻¹. We see that there is no significant peak at this velocity in Figure 2a. Absorption-absorption line locking occurs when pairs of redshifts z_{abs}^a and z_{abs}^b have the property that the long-wavelength component of z_{abs}^a coincides with the short wavelength component of z_{abs}^b . Particular examples of this effect have been proposed involving the C IV $\lambda\lambda$ 1548, 1550 doublet. In this case, the apparent velocity between the two redshifts comes out to be $\Delta v = 498$ km s⁻¹. In Figure 14, we show an expanded plot of the two-point correlation function near the origin. We observe that there is no significant peak at $\Delta v = 498$ km s⁻¹, particularly taking into account the fact that our resolution for separating components in a blend is about 150 km s⁻¹.

Thus we find no evidence for line locking of either kind, or for the existence of special redshifts such as $z = 1.955$.

IX. CONCLUSIONS AND DISCUSSION

We have obtained spectra of 52 QSOs in a uniform manner and have used additional data in the literature to prepare a homogeneous sample of 55 QSOs with $1.8 \leq z_{\text{em}} \leq 3.54$ in order to study the statistics of the C IV $\lambda\lambda$ 1548, 1550 absorption redshifts.

1. Most of the 55 QSOs have not been studied at comparable resolution before. There are several interesting individual spectra, for example those of Q0013-004 and Q1511+091, which would repay study at even higher resolution. In general, it was possible to identify all of the strong absorption lines longward of the Ly α emission line using standard line lists and procedures.

2. Extensive new data on the redshifts and equivalent widths of the emission lines are given in Table 2.

3. We found a total of 229 C IV absorption redshifts with $1.2 < z_{\text{abs}} < 3.53$ in the 55 QSOs (sample A1 of Table 5). Of these, 186 (sample A2) have apparent ejection velocities $\beta c > 5000$ km s⁻¹ and are therefore very unlikely to be associated with the QSO. A sample A3 contains 140 redshifts with rest equivalent widths W_0 of both lines of the C IV doublet satisfying the condition $W_0 > 0.15$ Å. The redshifts in this and succeeding samples could have been found in any of the QSO spectra. A more restrictive sample A4 contains 111 redshifts with $W_0 > 0.15$ Å and $\beta c > 5000$ km s⁻¹. Three other samples (A5, A6, and A7) are listed in Table 5. They have equivalent width limits $W_0 > 0.3$ Å; sample A7 is enhanced by the inclusion of uniform data from other sources.

4. We found 40 absorption redshifts based on the Mg II $\lambda\lambda$ 2796, 2803 doublet, confirming previous impressions that Mg II absorption is much rarer than C IV absorption. The Mg II redshifts will be discussed elsewhere.

5. In Table 6 we list the samples which we have called the "Poisson" samples; these were constructed by counting pairs and clumps of absorption redshifts separated by less than 1000 km s⁻¹ as one system (samples S1, S2, S3, S4, and S5). With the exception of this criterion, these samples are identical to samples A3, A4, A5, A6, and A7, respectively.

6. The distribution of the apparent ejection velocity βc for our sample S1 (Fig. 2a) is consistent with a flat distribution.

We find no significant excess of absorption redshifts with $z_{\text{abs}} \approx z_{\text{em}}$. The corresponding distribution (Fig. 2b) for the 17 known radio QSOs also shows no peak. Thus, we are in accord with the earlier results of YSB, and the disagreement with the samples of Weymann *et al.* (1979) and Foltz *et al.* (1986) remains a problem.

7. The number of redshifts per QSO, taken from sample S2 of Table 6, varies from 0 to 6. The distribution does not conform to the expected Poisson distribution on the basis of a χ^2 test (Table 7), but appears to be consistent on the basis of a maximum-likelihood estimation. The existence of QSOs with six absorption systems is the discrepant feature of the observed distribution. Otherwise, the agreement with a Poisson distribution is good. We advanced at least two reasons why the intervening hypothesis should not demand an exact Poisson distribution in the number of absorbers per unit redshift (§§ VIIg and VIIh).

8. We used the second Bahcall-Peebles test on sample S1 to confirm that the absorbers are uniformly distributed along the line of sight, as is indicated crudely by the flat distribution of βc .

9. Overall, the statistical tests confirm the conclusion of YSB that the C IV absorption systems are produced by randomly distributed intervening objects. Based on our samples, there is no reason to believe that even the systems with $\beta c < 5000$ km s⁻¹ are ejected from the QSO.

10. Various analyses all lead to the result that the comoving density of absorbers is decreasing with increasing redshift and that the C IV absorbers are evolving in cosmic time. Further data will be required to determine whether there is a uniform trend or whether there is a sudden drop at $z \sim 3$.

11. The distribution of number of absorption systems as a function of equivalent width is well fitted by an exponential distribution, except that there is an excess of lines with the smallest equivalent widths. We find no significant correlation of $W_0(1548)$ with redshift for sample L1.

12. Two different statistical tests show a significant correlation between $DR = W_0(1548)/W_0(1550)$ and redshift.

13. The preceding two results are interpreted to be a consequence of a systematic decrease in heavy-element composition with increasing redshift. This can be checked by more detailed observations of high-redshift absorption systems.

14. We have calculated the two-point correlation function for various samples of C IV redshift systems (Figs. 11a-11d). There is a sharp peak in the correlation function at the origin which extends out to $\Delta v \sim 600$ km s⁻¹. The mean amplitude of the correlation function between 200 and 600 km s⁻¹ is determined to be 11.3 ± 1.3 (sample A4). Between 600 and 20,000 km s⁻¹, the correlation function appears flat, although there are hints of structure on large velocity scales, which are not significant with the presently available data.

15. Arguments were given that most of the absorption cross section is contributed by luminous galaxies. It was also concluded that velocity splittings due to relative motions in galaxies are unlikely to contaminate the two-point correlation function on velocity scales above $\Delta v \sim 200$ km s⁻¹.

16. A simple theory for the evolution of the two-point correlation function in cosmic time, based on the hierarchical clustering model, only gives good agreement with the observed amplitude at $z \sim 2$ if $q_0 = 1/2$ and if galaxies with

$L < 0.5 L_*$ are assumed to contribute to the total cross section for absorption. The simple theory fails if, in fact, only the most luminous galaxies contribute to the total cross section.

17. Comparing our data with the results of simulations by Salmon and Hogan (1986), we find that the observed strong clustering of the C IV doublets at $z \sim 2$ cannot be reconciled with the prediction of cold dark matter models for any reasonable value of Ω_0 . Thus the need for "biasing" in order to understand galaxy clustering in cold dark matter cosmologies at $z \sim 0$ also obtains at $z \sim 2$.

18. We find no evidence for line locking or for $z = 1.955$ being a special redshift.

Two of the strongest results of the present work are the strong clustering of the C IV absorption systems and the flat or even declining variation of number density with increasing redshift. Both characteristics are in marked contrast to the behavior of the Ly α forest lines. As we saw in § VIIb, the Ly α forest lines only show signs of clustering on scales less than 300 km s^{-1} , and even here the amplitude is only marginally significant. On the other hand, the line density evolves very steeply, with $N(z) \propto (1+z)^{2.3}$ (Hunstead 1988). Thus we have clear evidence for two populations of absorbers which appear to evolve differently in cosmic time and which are distributed differently on large scales. The most natural interpretation of the observed facts remains that the heavy-element redshifts are produced by galaxies and the Ly α forest lines by intergalactic clouds. Tytler (1987) has recently challenged the received view by concluding that the same power-law distribution of column density encompasses both the Ly α forest lines and the heavy-element Ly α lines over the enormous range $12 \leq \log N(\text{H I}) \leq 21$. This discovery caused Tytler

to conclude that, since there is no break at $\log N(\text{H I}) \sim 17$ (at which point roughly spherical objects become optically thick), then it is likely that the absorbers are neutral at all values of the column density. Thus, Tytler arrived at a model in which the Ly α forest and heavy-element absorbers are small, dense objects with diameters of only $\sim 3 \text{ pc}$. The existence of Tytler's single power-law distribution has been challenged by Bechtold (1988), who supports earlier work in finding a flatter distribution of H I column density for the heavy-element redshifts than for the Ly α forest lines. Thus, taken as a whole, the evidence still seems in favor of two populations of absorbers which are of galactic dimensions, which are highly ionized, and which are distributed differently in the universe.

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