

ING LA PALMA TECHNICAL NOTE NO. 126

**Maps of the standard arc-lamps for the
WHT ISIS-Red Arm**

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ING La Palma Technical Notes 84 and 98 gave identifications for lines produced by some of the calibration lamps and gratings available to ISIS on the WHT at the Roque de Los Muchachos on the island of La Palma. This note gives identification for each grating available for the red arm of ISIS with copper-argon lamp, copper-neon lamp and both lamps together.

The calibration lamp exposures were obtained on 2001 April 27th using the ISIS Red Arm with the TEK4 CCD chip. All the exposures were made with a slit width of 0.93 arcseconds. Several central wavelengths were selected for high resolution gratings.

The reduction was performed inside the IRAF environment. The arc lines were identified using the IRAF task *identify*. All lines were carefully identified with the IRAF line list, the IDS CuAr/CuNe (ING technical Note 70, 1989, by Zuiderwijk & Knapen) and the ISIS Maps (ING technical notes 84 and 98, 1992 and 1995, by Sinclair) as a reference. We used an order 4 Legendre function for fitting the wavelengths. Table 1 lists the laboratory wavelengths of lines.

The following information is given in tables for each grating and calibration lamp:

Column 1: The wavelength range in Å for each frame.

Column 2: Exposure time in seconds.

Column 3: Order-sorting filter if used; no neutral density filters were used.

Column 4: Dispersion (Å/pixel).

Column 5: Number of lines used in the IRAF fitting routine (*identify*)

Column 6: RMS values from the fitting of the wavelength.

Table 1: The Copper-Neon and Copper-Argon lines

Line (Å)	Symbol	Line (Å)	Symbol	Line (Å)	Symbol
6013.6777		6444.712		7059.108	
6025.15		6466.5526		7067.2181	
6029.9971	NeI	6483.0825	NeI	7107.478	
6032.1274	NeI(3)	6506.5279	NeI(3)	7112.2	
6043.2233		6532.8824	NeI	7125.82	
6052.7229		6538.112		7147.0416	
6059.3725	NeI	6598.9529	NeI(6)	7158.839	
6074.3377		6604.8534		7173.939	NeI(6)
6090.7848		6638.2207		7206.9804	
6096.163		6639.7403		7245.167	NeI(3)
6098.8031		6643.6976		7265.172	
6105.6351		6652.092		7272.9359	
6114.9234		6656.9386		7304.82	
6118.027	NeI(1)	6660.6761		7311.7159	
6128.46	NeI(5)	6664.051		7316.005	
6143.0623		6666.3588		7353.293	
6145.4411		6677.2817		7372.1184	
6150.384		6678.2	blend HeI6678.149&NeI6678.2764	7383.98	AI
6155.2385	NeI(5)	6684.2929		7392.98	
6163.5939		6698.875	NeI	7412.337	
6170.174		6717.0428	NeI	7425.294	
6182.146		6719.2184		7435.368	
6215.9383		6752.8335		7438.899	NeI
6217.2813	NeI(1)	6756.1631		7471.168	
6243.1201		6766.6117		7472.439	
6266.495	NeI(5)	6827.2488		7484.24	
6293.745		6861.2688		7488.872	NeI
6296.8722		6871.29	AI	7503.8691	
6304.7892	NeI	6879.5824		7514.651	AI
6307.657		6888.1742		7535.775	NeI
6313.692		6929.468	NeI(6)	7544.046	NeI
6328.165		6937.6642		7589.32	
6334.4279	NeI(1)	6951.4776		7635.106	
6369.5748		6960.25		7670.04	
6382.9914	NeI(3)	6965.43	AI(1)	7704.81	
6384.7169		7024.05		7723.7611	
6402.246	NeI(1)	7030.2514		7798.55	
6403.0128		7032.4127	NeI(1)	7868.2	AI
6416.3071	NeI(3)	7051.294		7891.075	

Line (Å)	Symbol	Line (Å)	Symbol	Line (Å)	Symbol
7933.13		8408.2096		8771.885	
7943.181		8418.		8780.622	NeI(27)
7948.175	AI(6)	8424.6475		8783.755	NeI(38)
8006.1567		8463.357	NeI(18)	8799.082	
8014.7857		8484.444	AI(8)	8849.97	
8053.308		8495.36		8853.867	
8082.458	NeI(6)	8521.4422		8865.755	
8092.634		8544.695		8905.65	
8103.692	AI(3)	8571.353		8919.5	
8115.311	AI(1)	8582.91		8931.326	
8118.549		8591.258	NeI(23)	8962.19	
8128.908		8605.779		8970.98	
8136.406		8620.46		8988.58	
8178.96		8634.648		9066.77	
8248.681		8647.04	NeI(33)	9073.34	
8259.379		8654.383	AI(6)	9075.394	
8264.5225		8667.9442		9075.394	
8266.		8679.492		9122.9674	
8300.326	NeI(12)	8681.922		9148.68	
8365.746		8704.113		9194.638	
8377.607	NeI(12)	8761.691		9201.76	
8384.73					

R158R Grating

Table 1: Copper-Argon Lamp with R158R

Range (\AA)	Exp. (s)	Filter	Disp ($\text{\AA}/\text{pixel}$)	Lines	RMS (\AA)
4631-7447	10	GG495	2.8947	17	0.1502
7566-10401	1	GG495	2.9131	17	0.0800

Table 2: Copper-Neon Lamp with R158R

Range (\AA)	Exp. (s)	Filter	Disp ($\text{\AA}/\text{pixel}$)	Lines	RMS (\AA)
4631-7447	2	GG495	2.8929	30	0.072
7566-10401	10	GG495	2.9170	21	0.134

Table 3: Copper-Argon and Copper-Neon Lamps with R158R

Range (\AA)	Exp. (s)	Filter	Disp ($\text{\AA}/\text{pixel}$)	Lines	RMS (\AA)
4631-7447	2	GG495	2.9003	31	0.1082
7566-10401	1	GG495	2.9135	21	0.1316

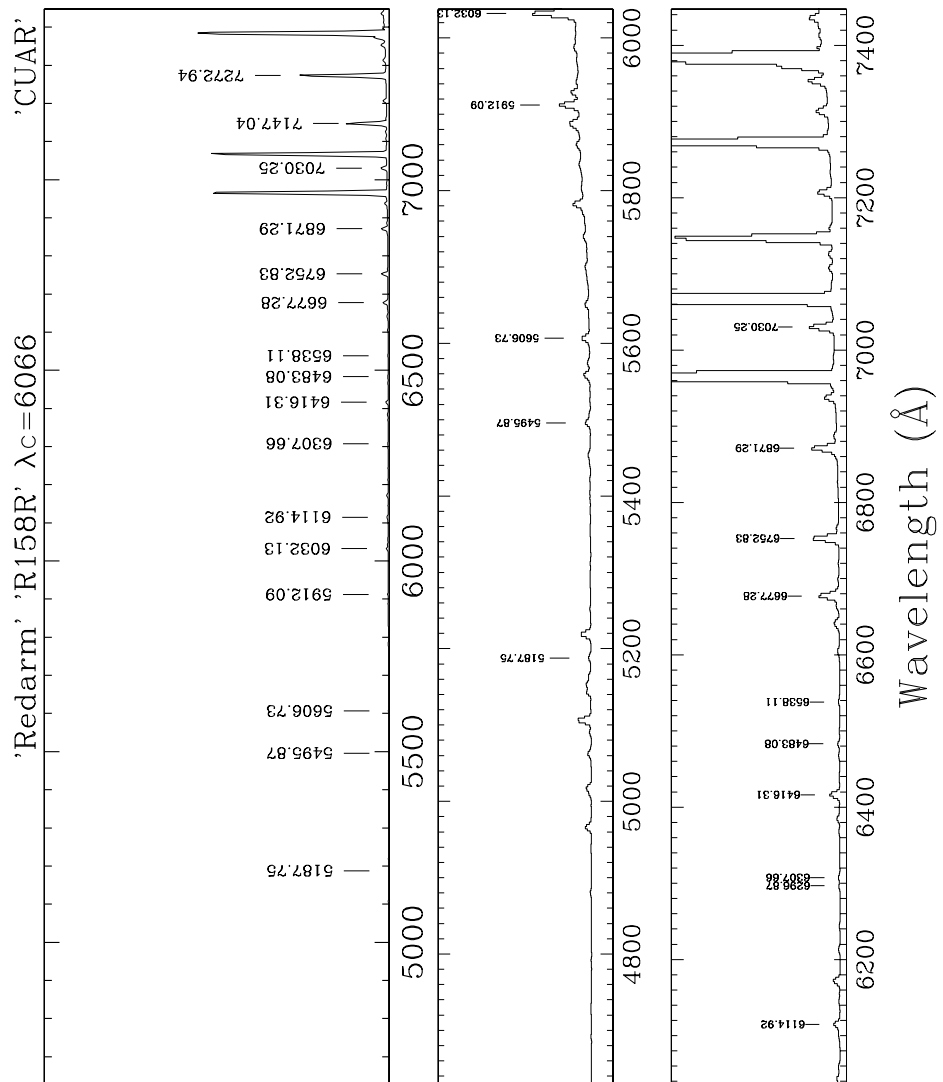


Figure 1: Copper-Argon Lamp with R158R. Central wavelength = 6000 \AA . Brighter lines were saturated.

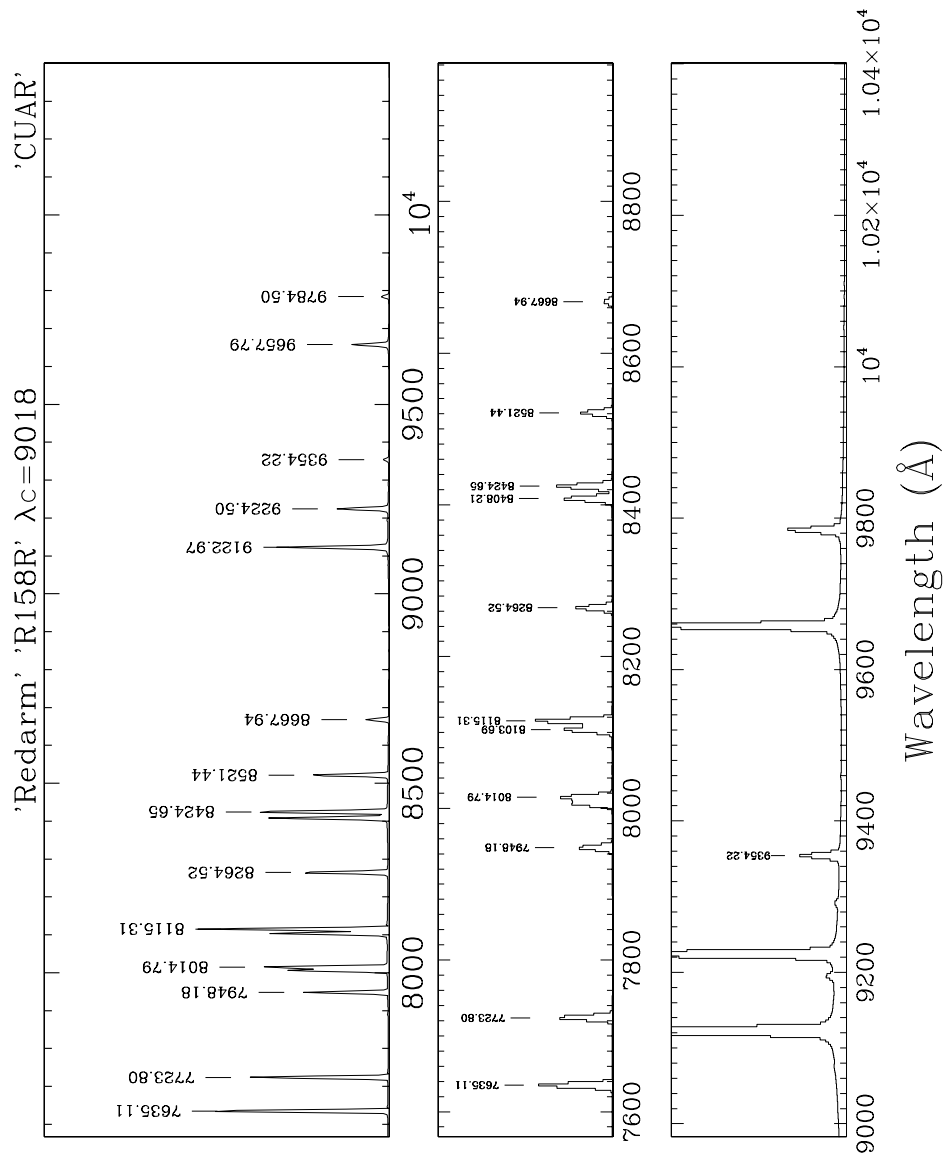


Figure 2: Copper-Argon Lamp with R158R. Central wavelength = 9020 \AA .

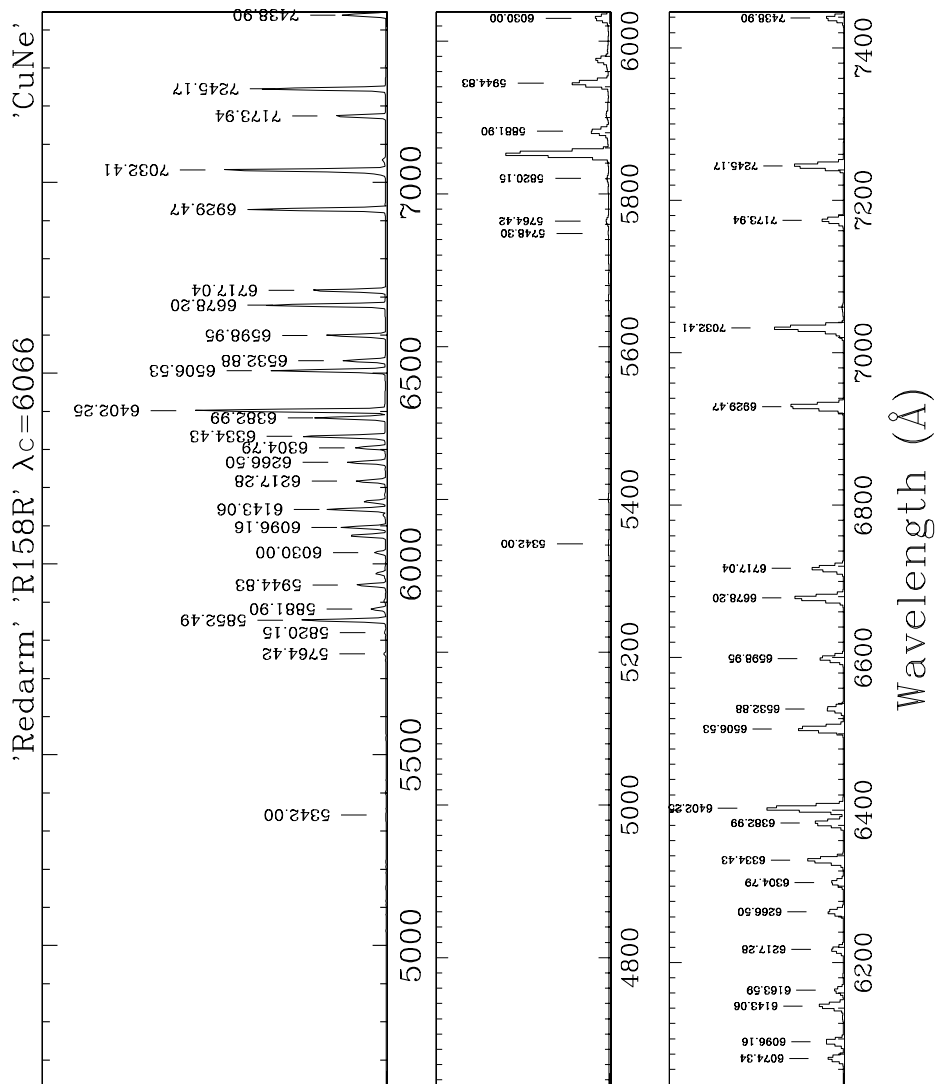


Figure 3: Copper-Neon Lamp with R158R. Central wavelength = 6000 Å.

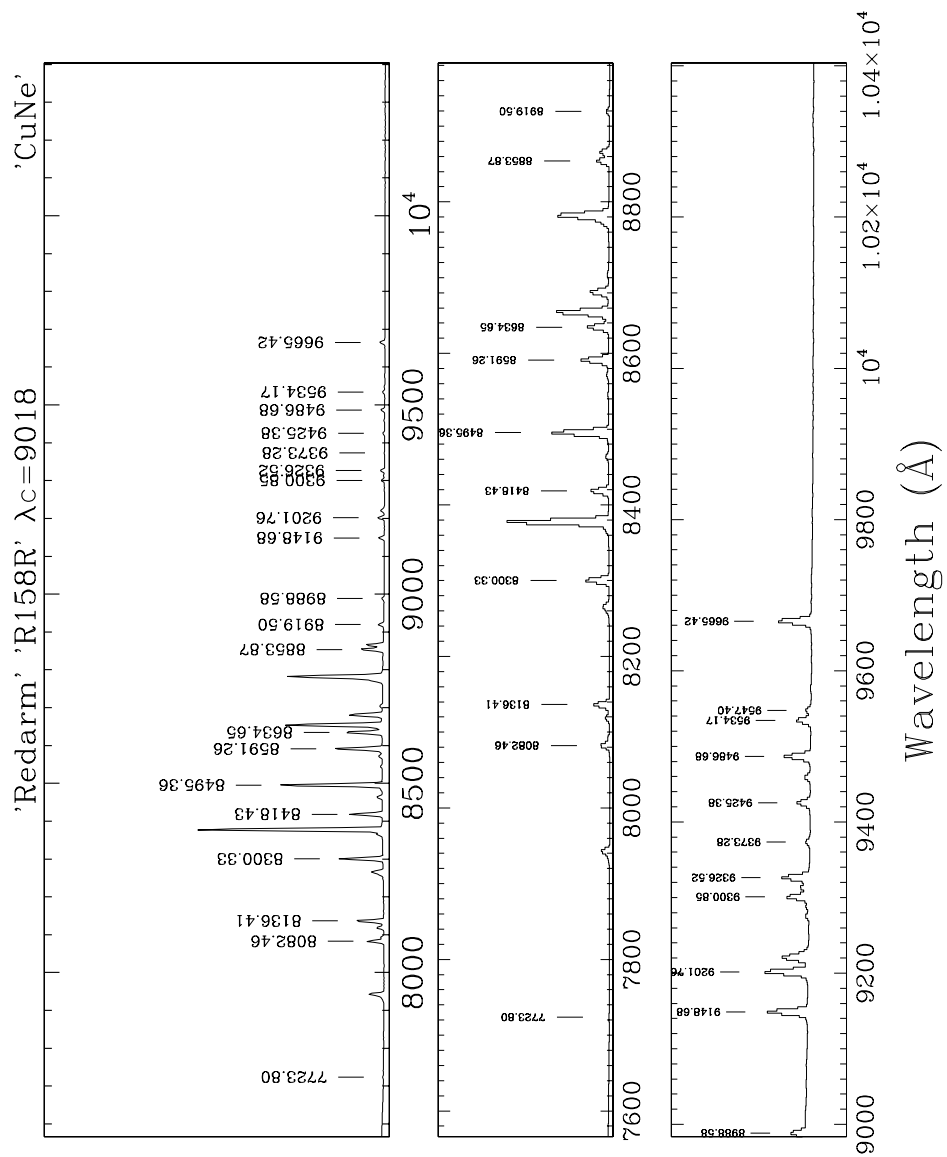


Figure 4: Copper-Neon Lamp with R158R. Central wavelength = 9020 Å.

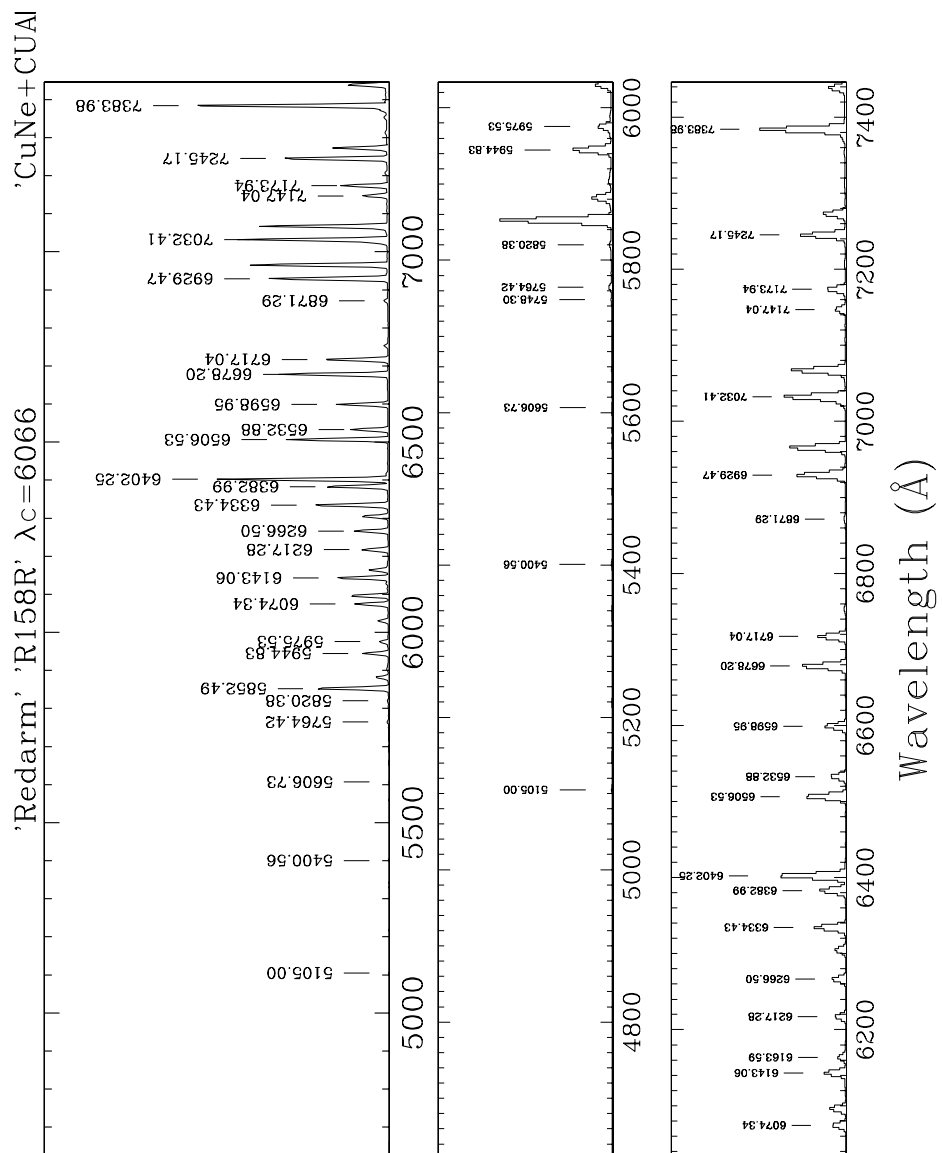


Figure 5: Copper-Neon & Copper-Argon Lamps with R158R. Central wavelength = 6000 Å.

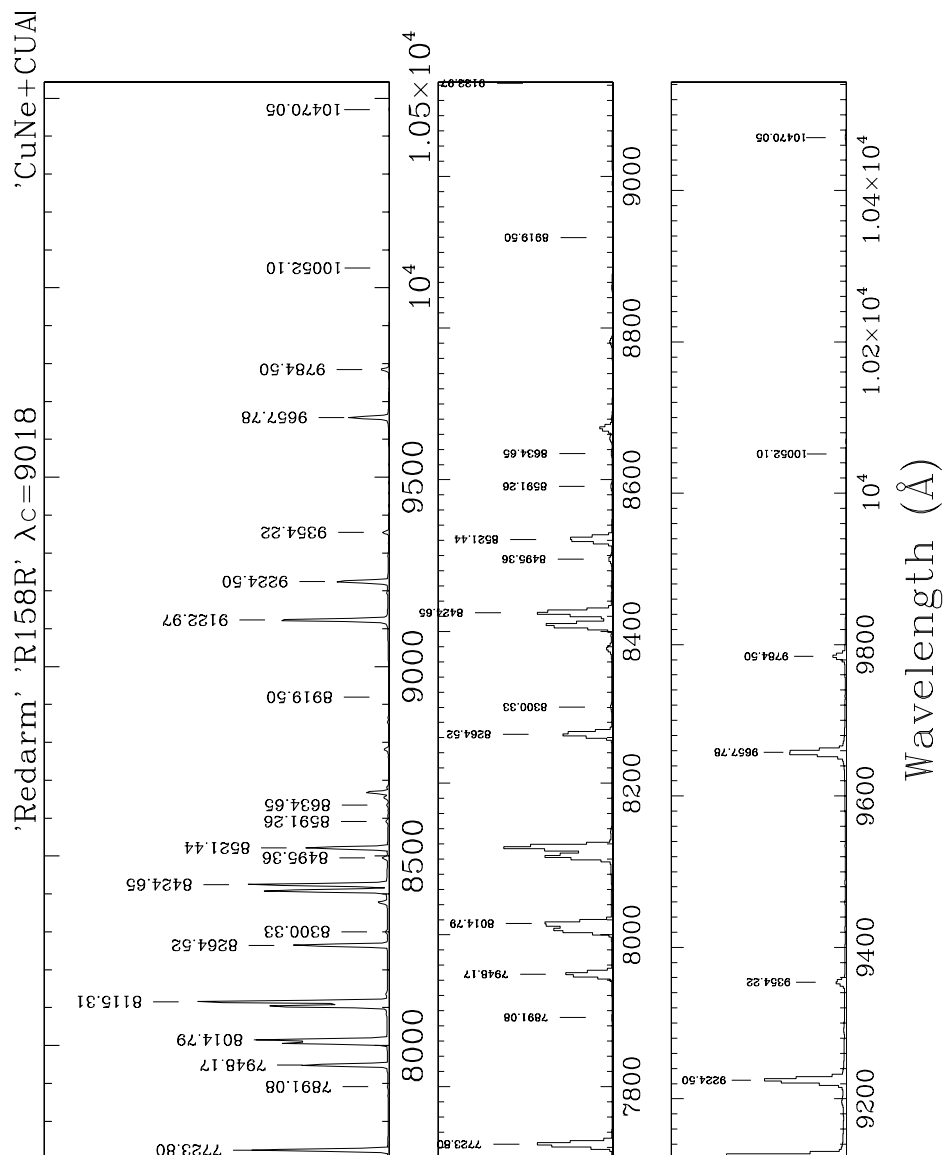


Figure 6: Copper-Neon & Copper-Argon Lamp with R158R. Central wavelength = 9020 Å.

R316R Grating

Table 1: Copper-Argon Lamp with R316R

Range (Å)	Exp. (s)	Filter	Disp (Å/pixel)	Lines	RMS (Å)
5987-7513	3	GG495	1.4716	21	0.0692
7502-9028	1	GG495	1.4805	17	0.0704
8797-10323	2	RG630	1.4795	8	0.1003

Table 2: Copper-Neon Lamp with R316R

Range (Å)	Exp. (s)	Filter	Disp (Å/pixel)	Lines	RMS (Å)
5987-7513	1	GG495	1.4717	27	0.0417
7502-9028	10	GG495	1.4797	23	0.0526
8797-10323	20	RG630	1.4824	14	0.0634

Table 3: Copper-Argon and Copper-Neon Lamps with R316R

Range (Å)	Exp. (s)	Filter	Disp (Å/pixel)	Lines	RMS (Å)
5987-7513	1	GG495	1.4717	41	0.0799
7502-9028	1	GG495	1.4797	27	0.1041
8797-10323	2	RG630	1.4824	17	0.1130

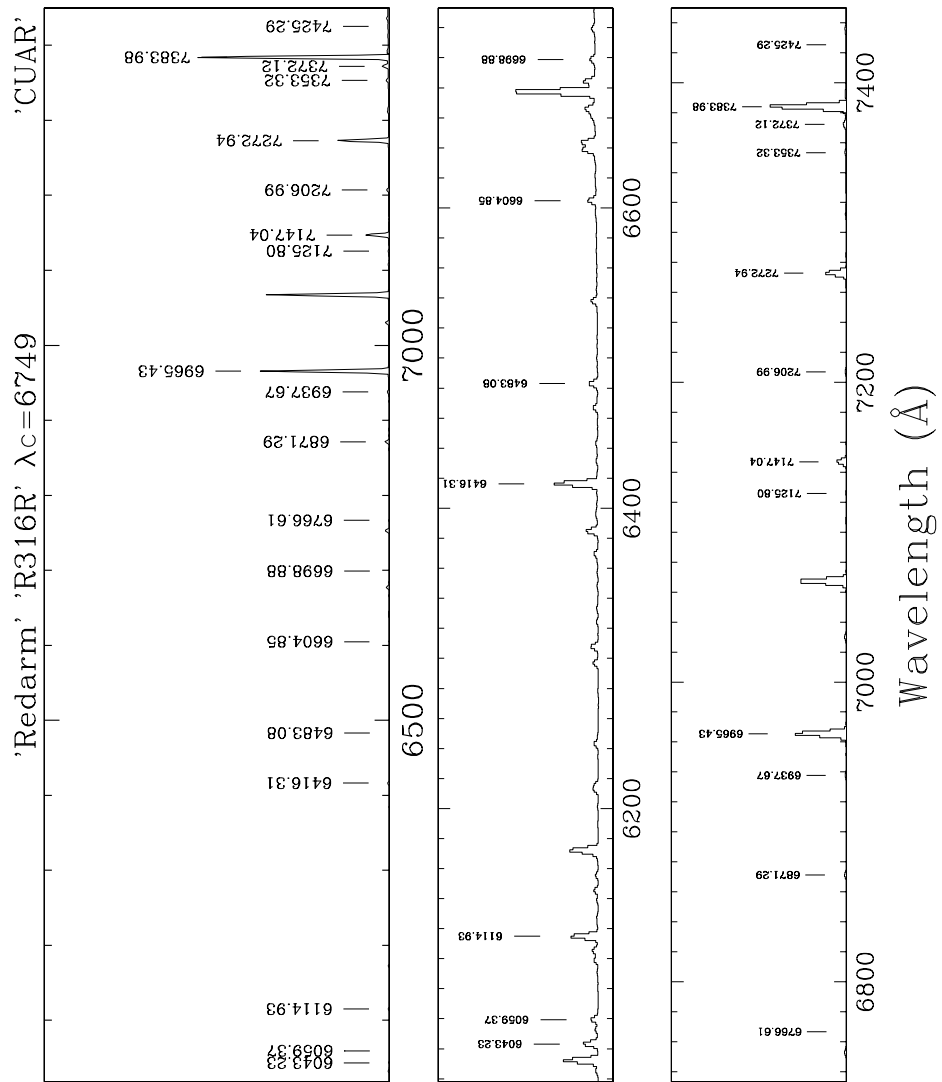


Figure 1: Copper-Argon Lamp with R316R. Central wavelength = 6750 Å.

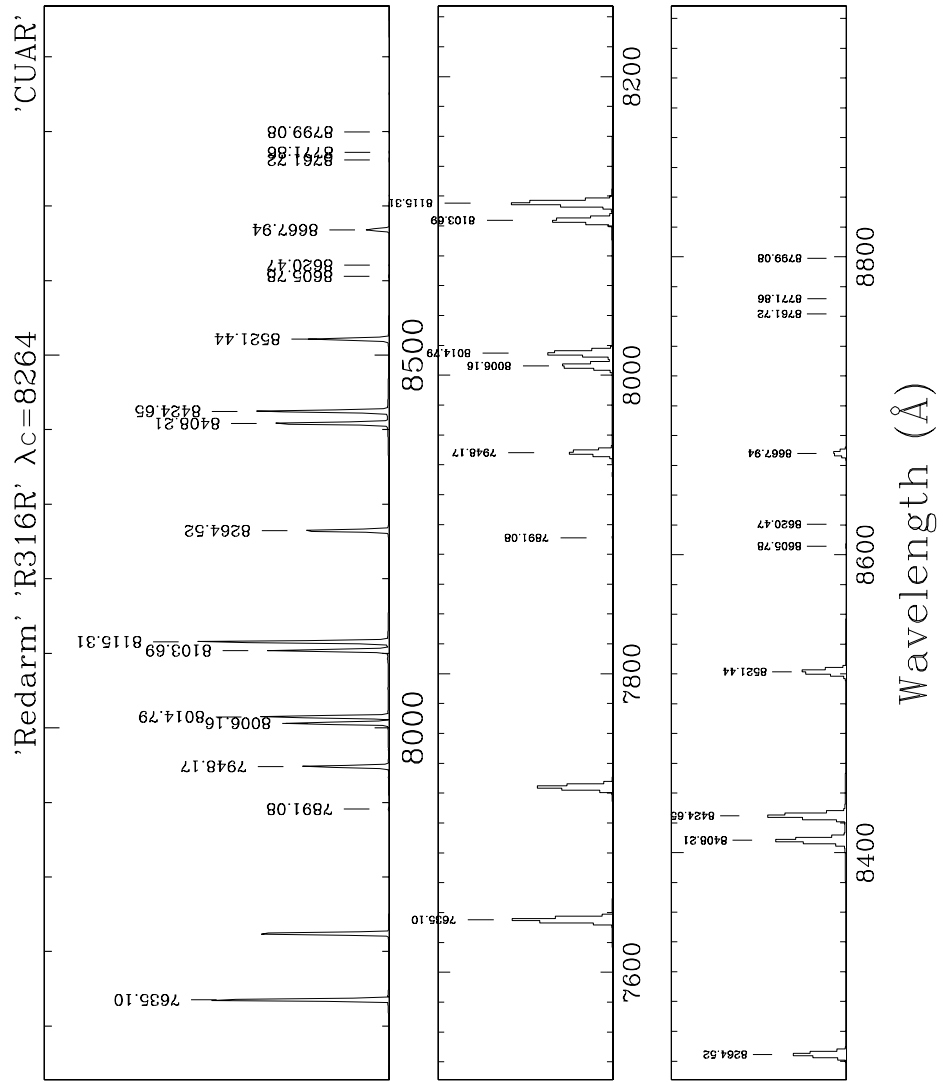


Figure 2: Copper-Argon Lamp with R316R. Central wavelength = 8265 Å.

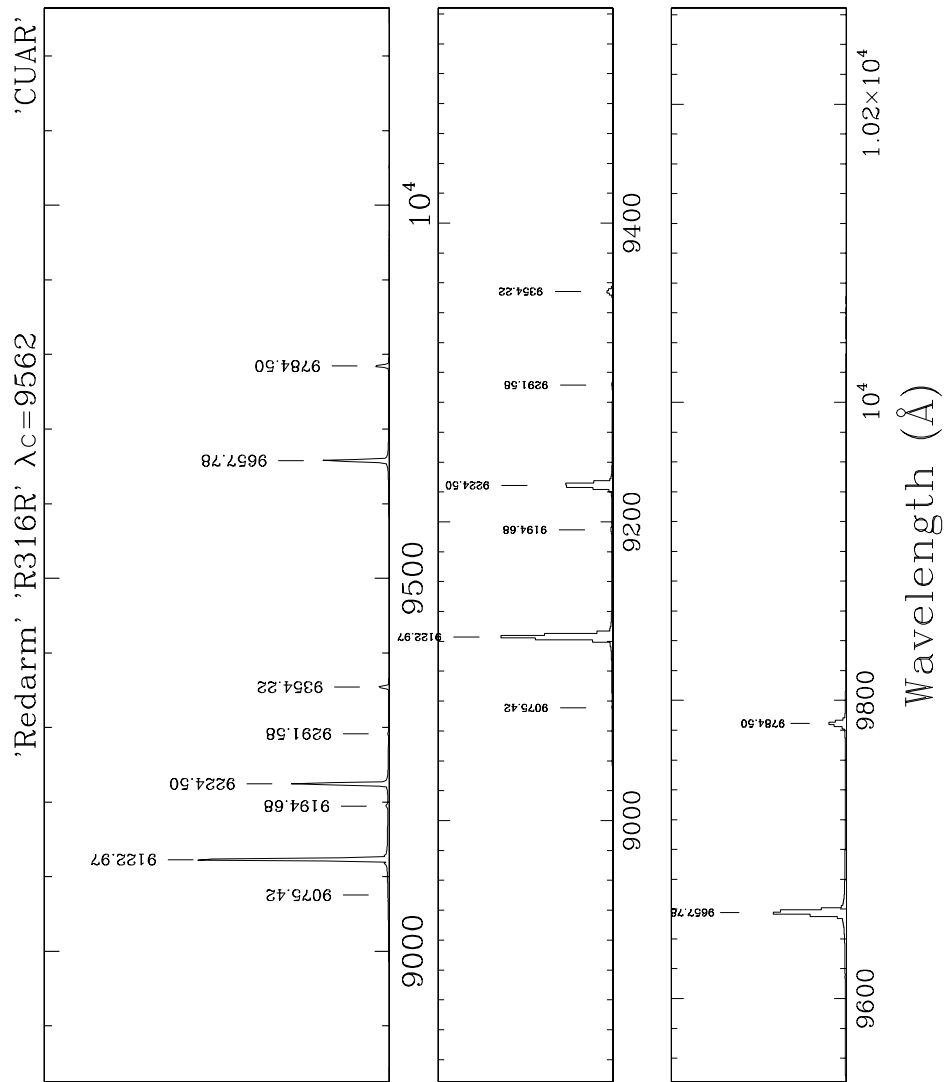


Figure 3: Copper-Argon Lamp with R316R. Central wavelength = 9560 Å.

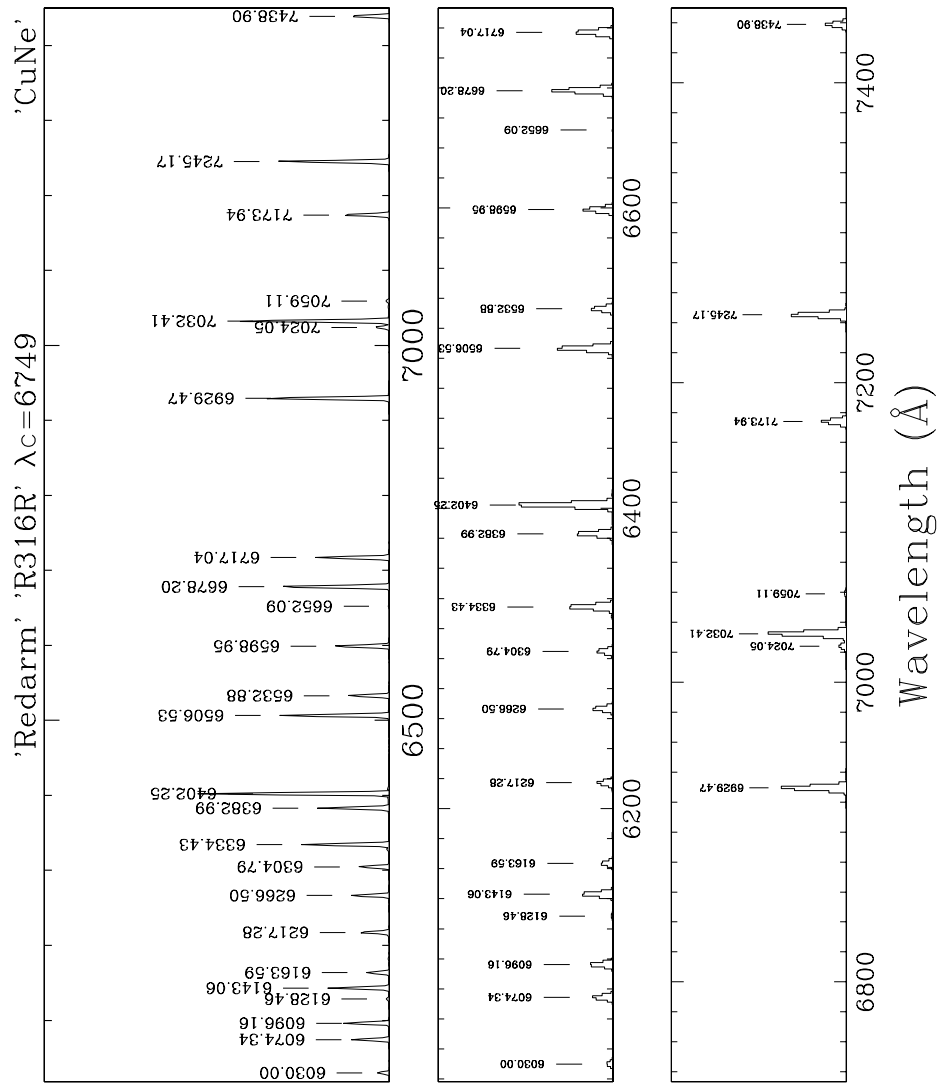


Figure 4: Copper-Neon Lamp with R316R. Central wavelength = 6750 Å.

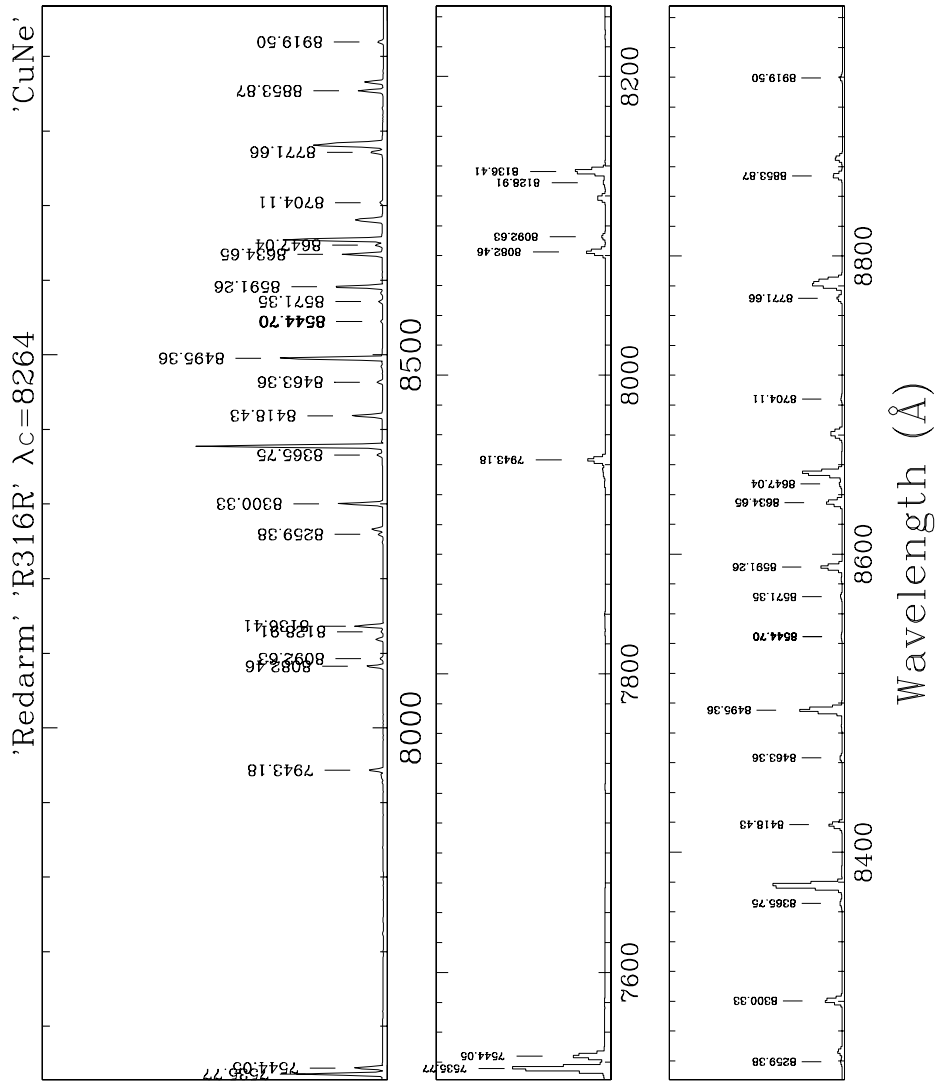


Figure 5: Copper-Neon Lamp with R316R. Central wavelength = 8265 Å.

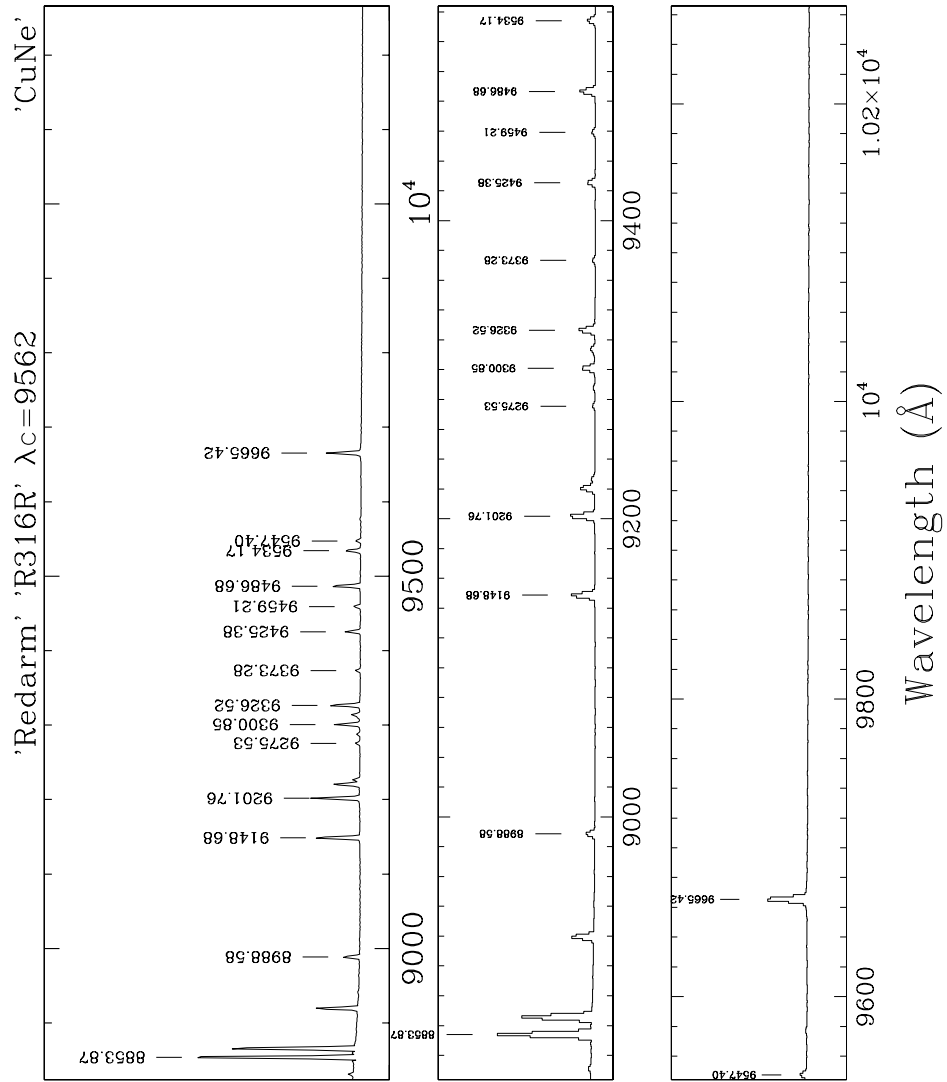


Figure 6: Copper-Neon Lamp with R316R. Central wavelength = 9560 Å.

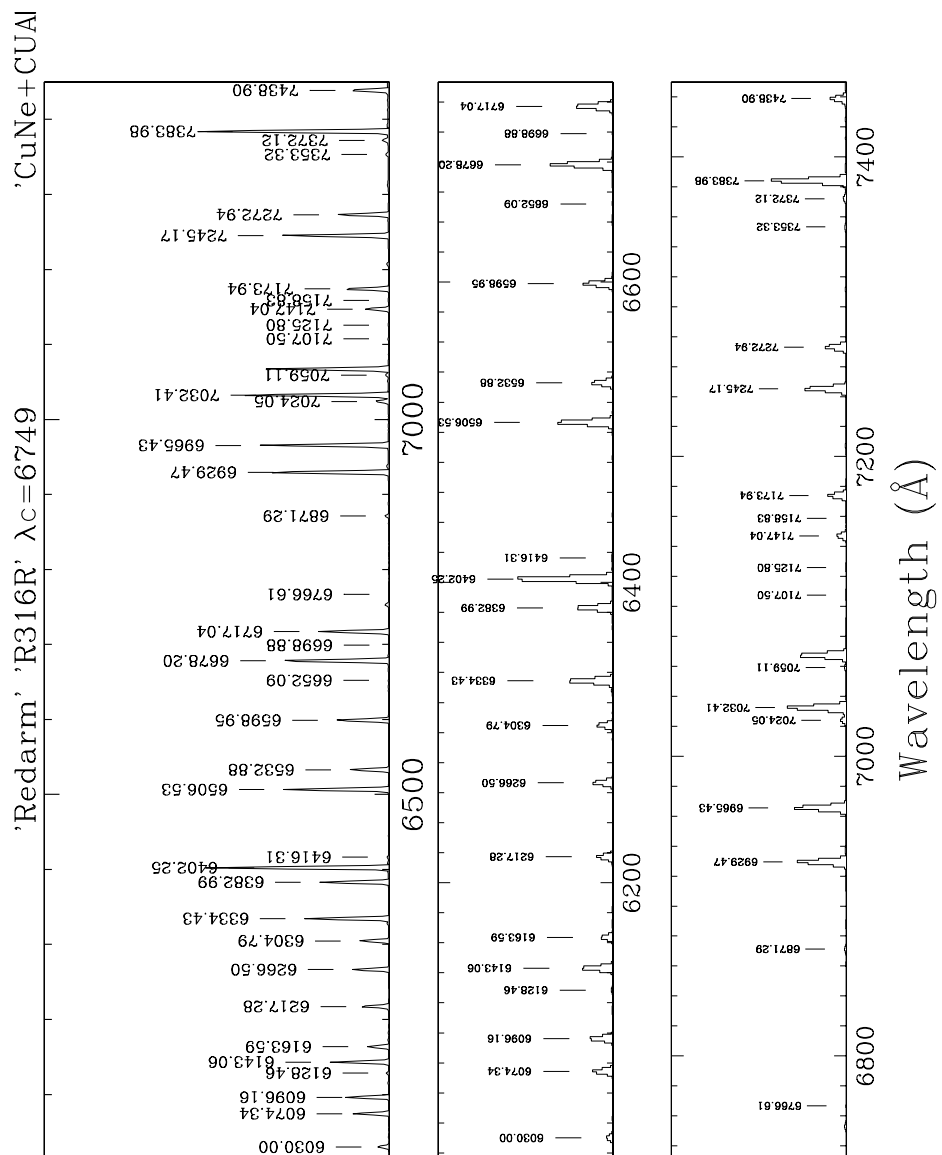


Figure 7: Copper-Neon & Copper-Argon Lamps with R316R. Central wavelength = 6750 Å.

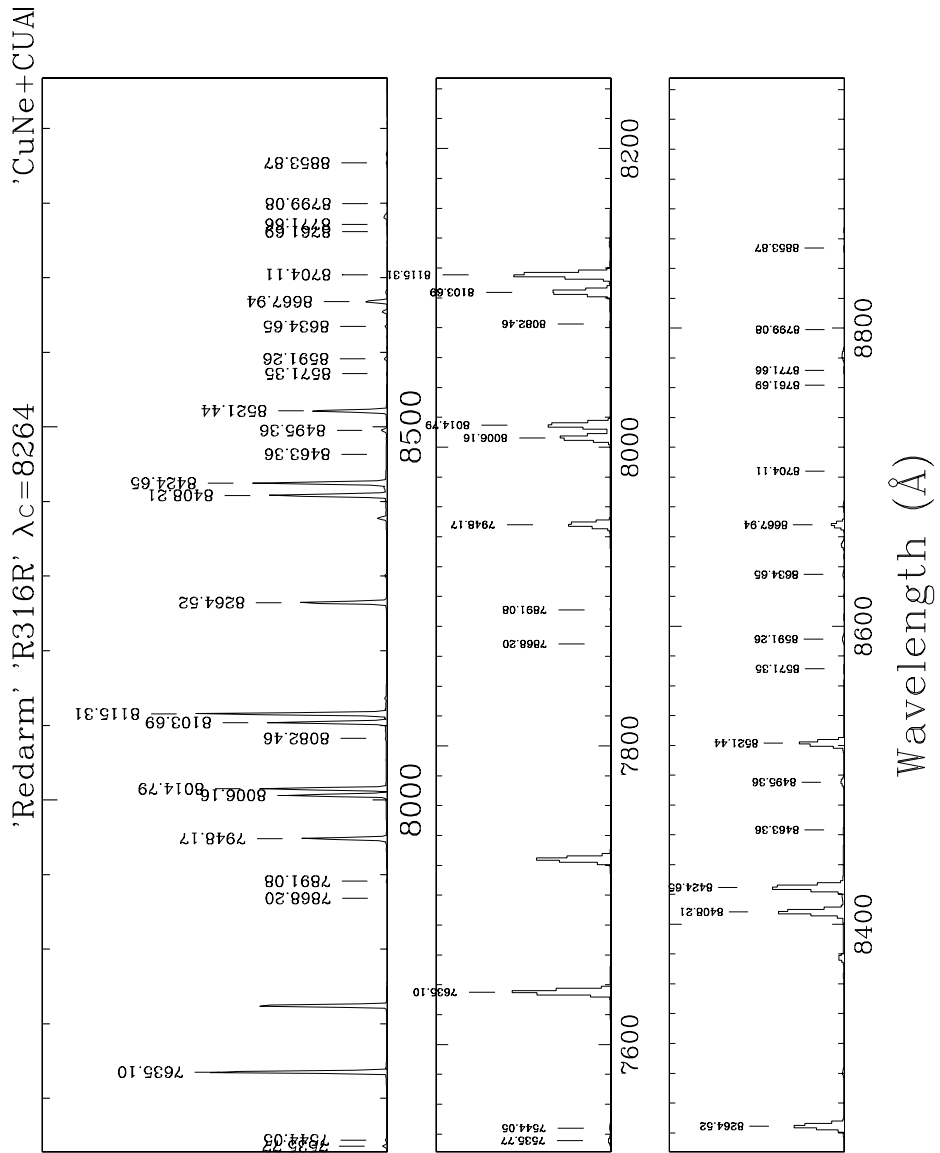


Figure 8: Copper-Neon & Copper-Argon Lamp with R316R. Central wavelength = 8265 Å.

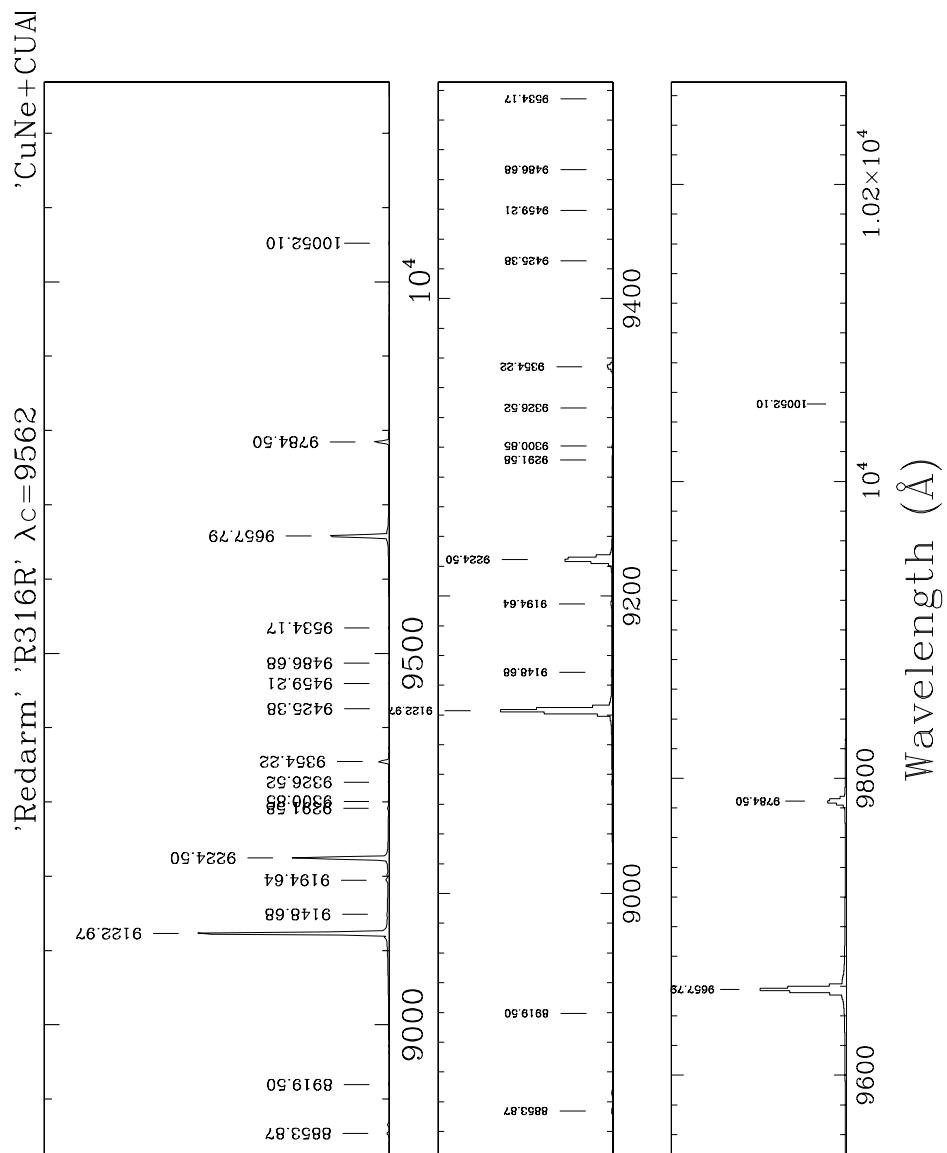


Figure 9: Copper-Neon & Copper-Argon Lamp with R316R. Central wavelength = 9560 Å.

R600R Grating

Table 1: Copper-Argon Lamp with R600R

Range (Å)	Exp. (s)	Filter	Disp (Å/pixel)	Lines	RMS (Å)
5998-6765	80	GG495	0.788	32	0.055
6790-7559	4	GG495	0.791	24	0.046
7574-8346	4	GG495	0.793	10	0.045
8366-9140	4	GG495	0.795	11	0.065

Table 2: Copper-Neon Lamp with R600R

Range (Å)	Exp. (s)	Filter	Disp (Å/pixel)	Lines	RMS (Å)
5998-6765	8	GG495	0.788	19	0.033
6790-7559	8	GG495	0.791	13	0.090
7573-8346	60	GG495	0.794	15	0.069
8367-9140	20	GG495	0.795	20	0.039

Table 3: Copper-Argon and Copper-Neon Lamps with R600R

Range (Å)	Exp. (s)	Filter	Disp (Å/pixel)	Lines	RMS (Å)
5998-6765	8	GG495	0.789	31	0.065
6790-7559	4	GG495	0.791	36	0.067
7574-8346	2	GG495	0.793	17	0.074
8367-9140	4	GG495	0.795	22	0.057

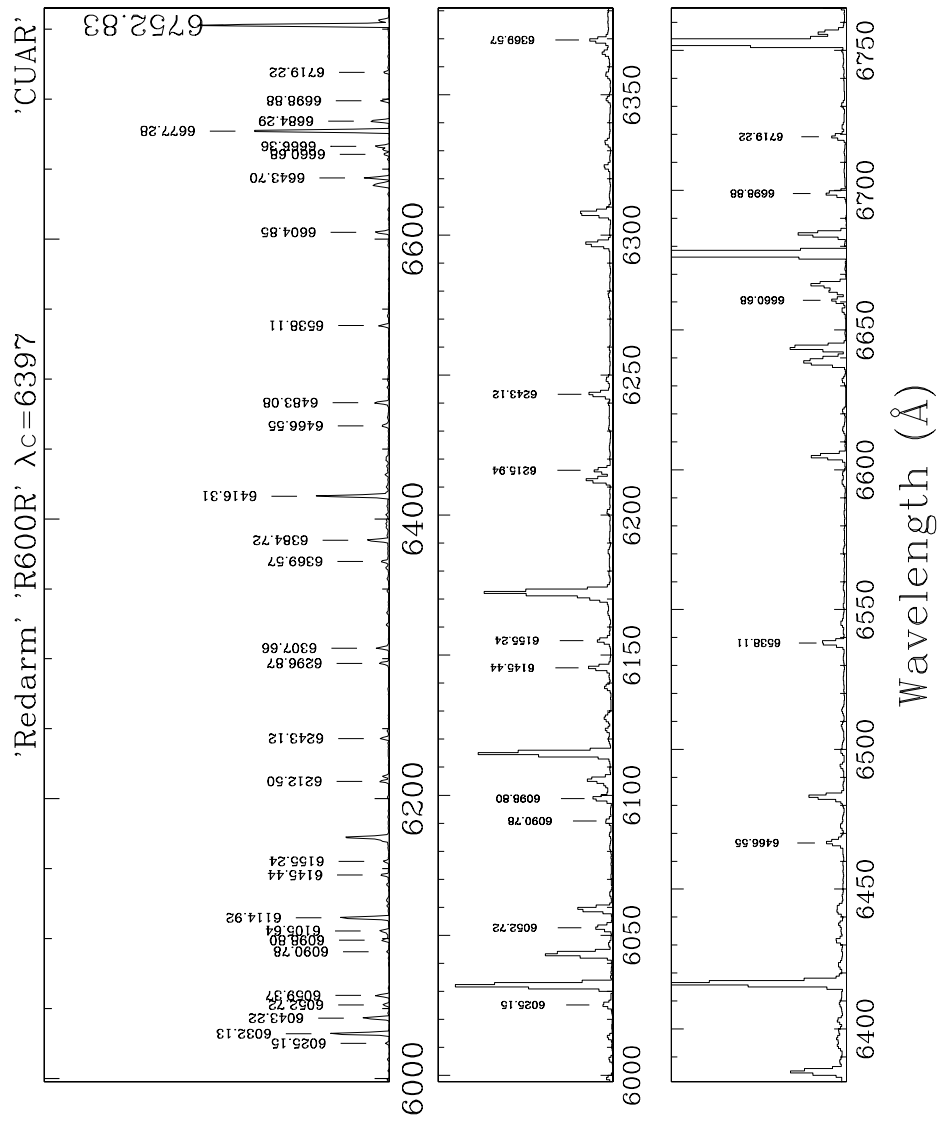


Figure 1: Copper-Argon Lamp with R600R. Central wavelength = 6400 Å.

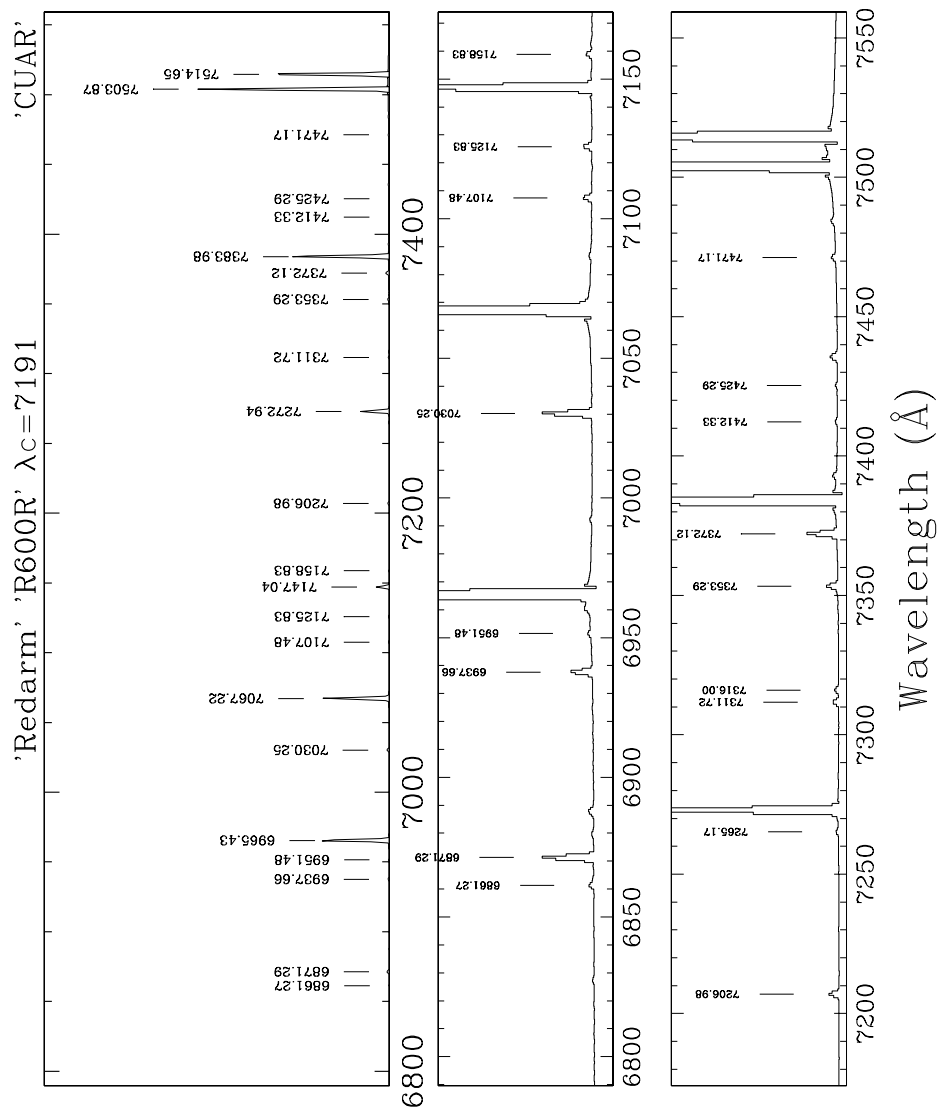


Figure 2: Copper-Argon Lamp with R600R. Central wavelength = 7190 Å.

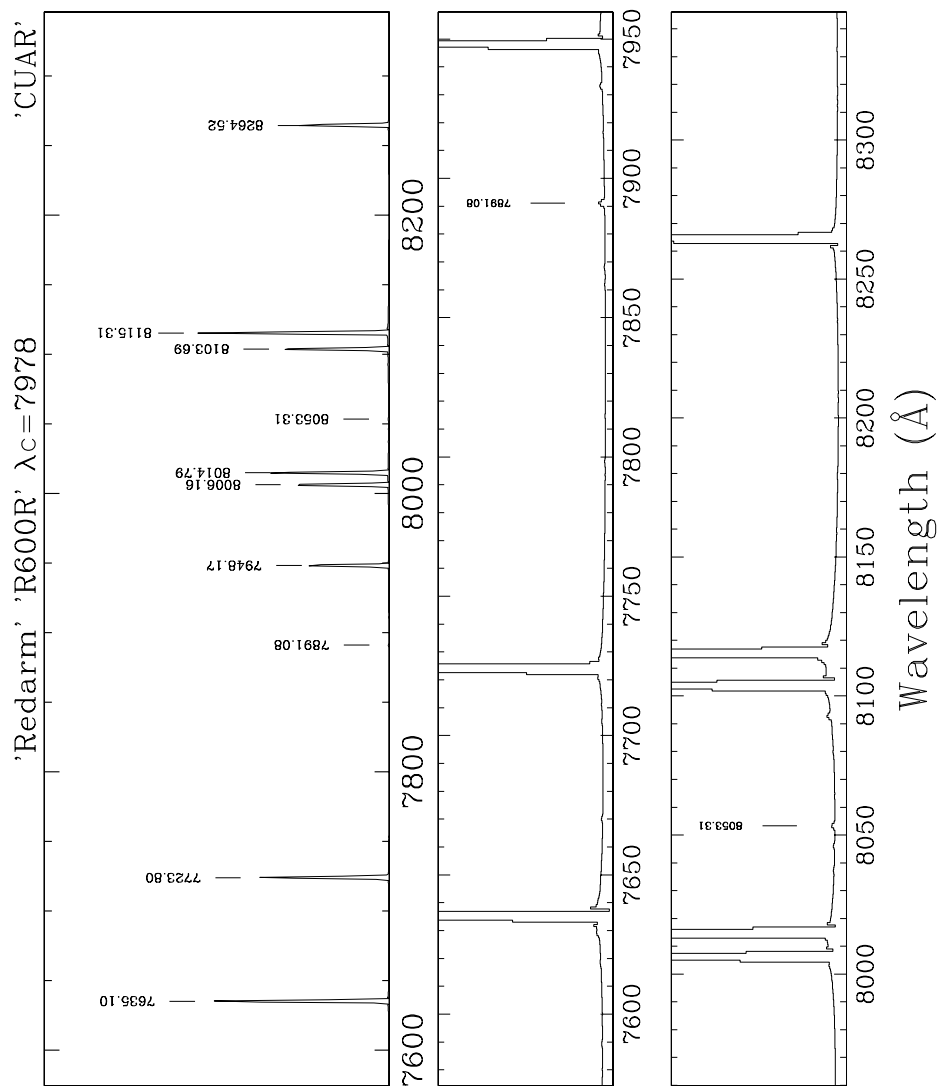


Figure 3: Copper-Argon Lamp with R600R. Central wavelength = 7980 Å.

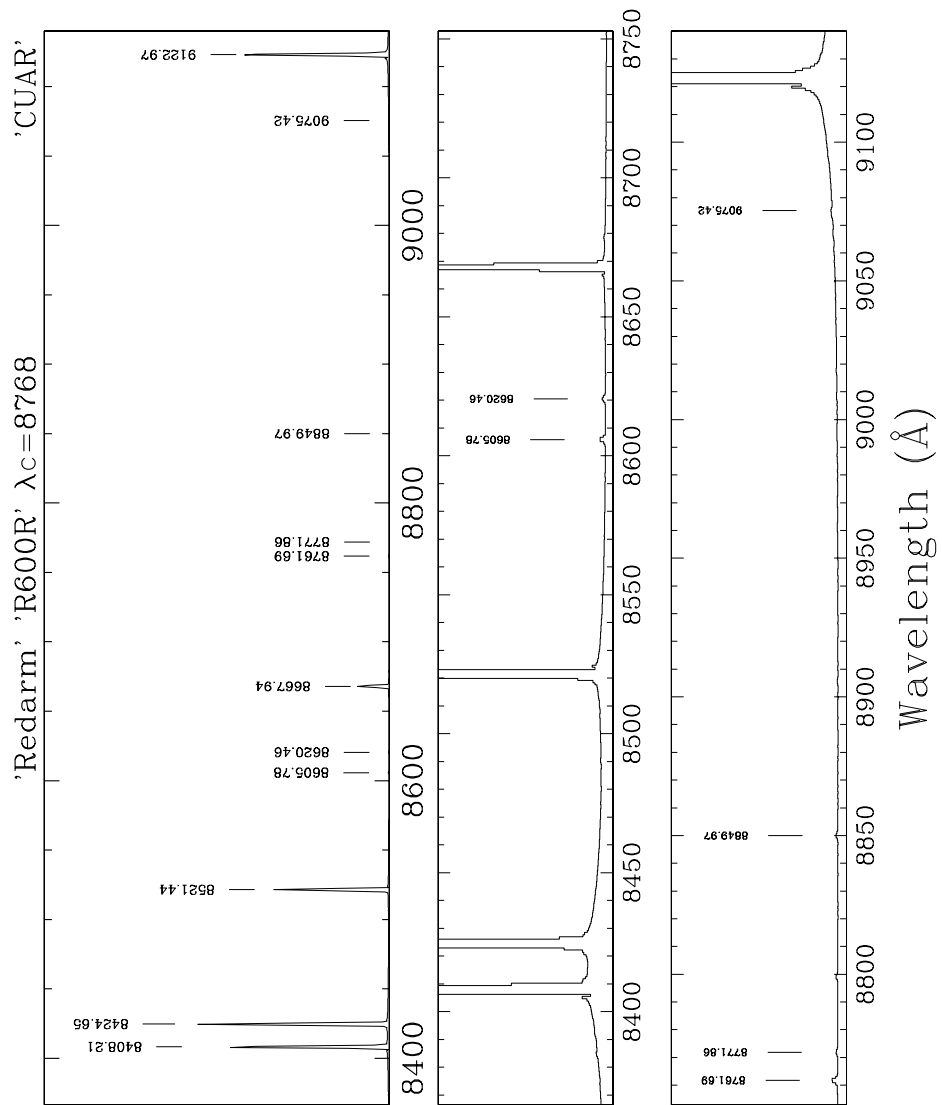


Figure 4: Copper-Argon Lamp with R600R. Central wavelength = 8770 Å.

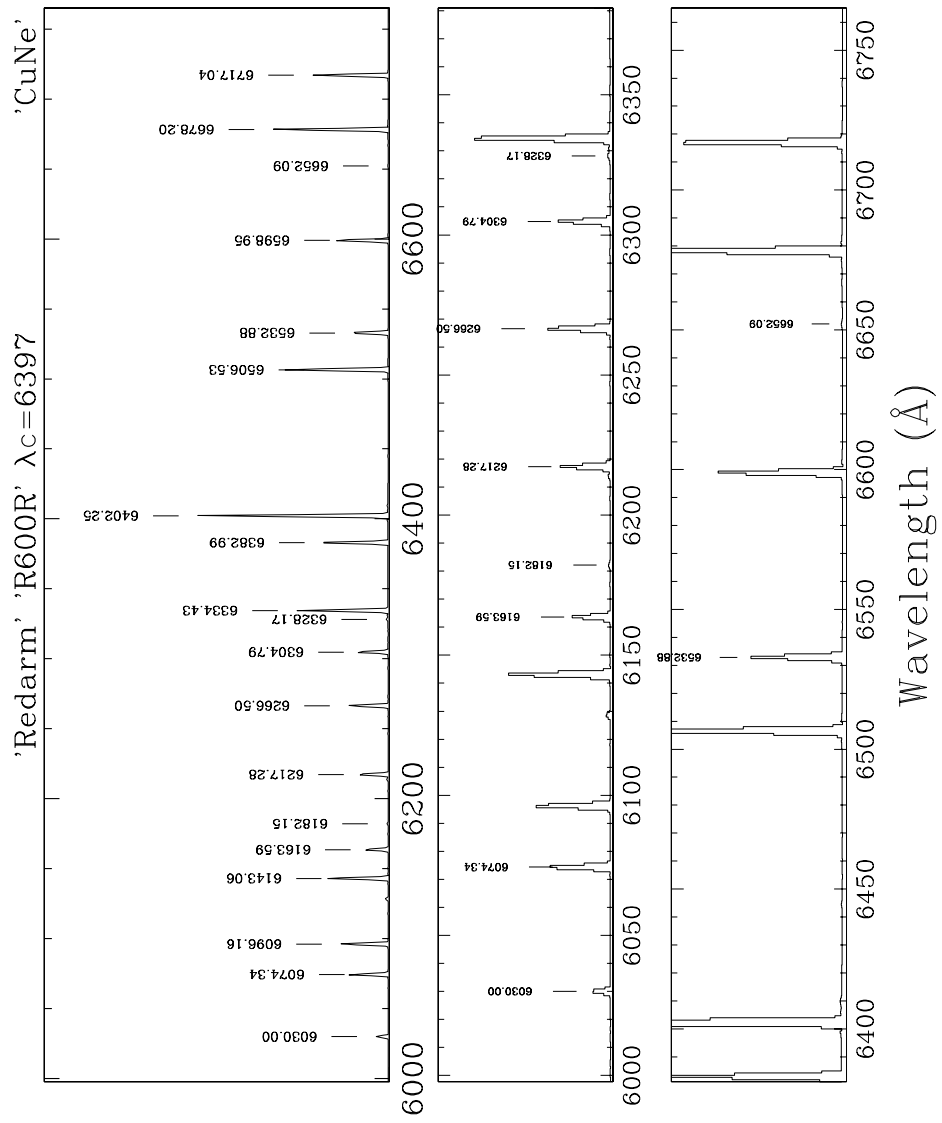


Figure 5: Copper-Neon Lamp with R600R. Central wavelength = 6400 Å.

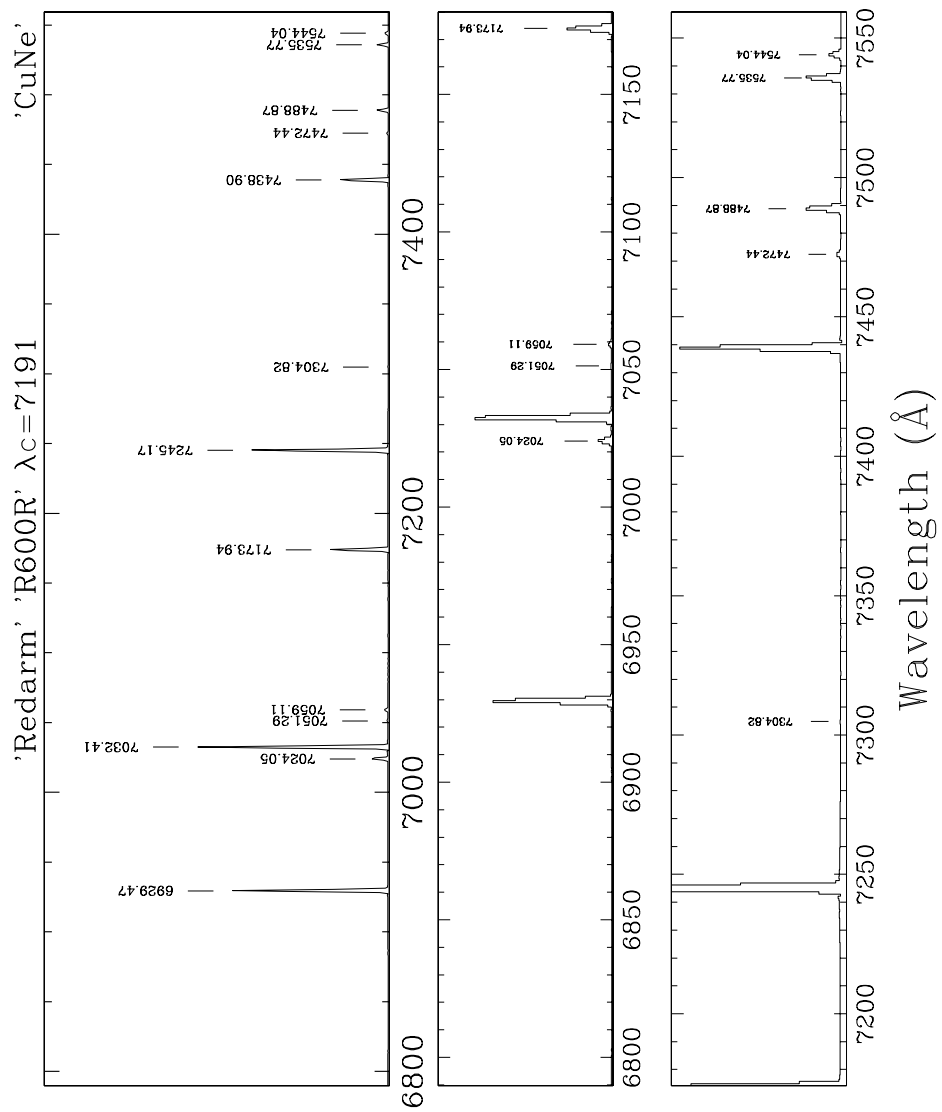


Figure 6: Copper-Neon Lamp with R600R. Central wavelength = 7190 Å.

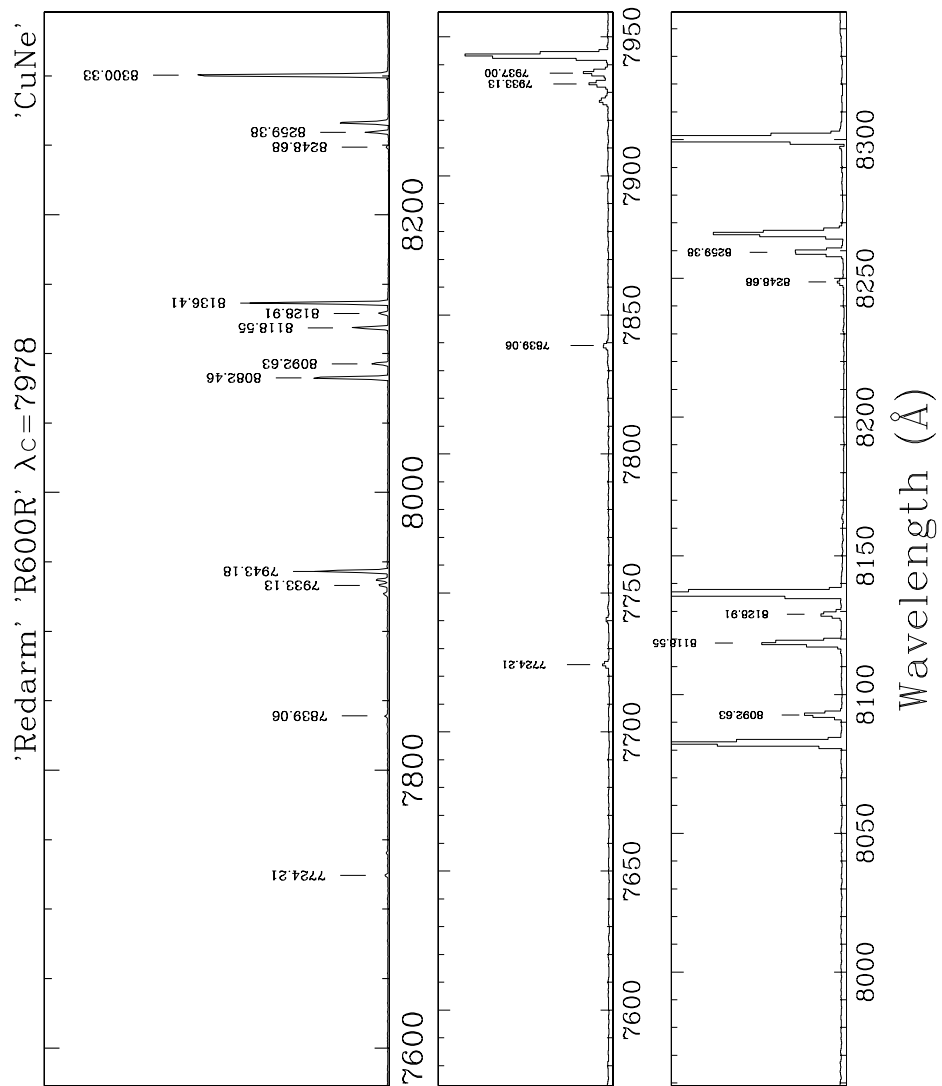


Figure 7: Copper-Neon Lamp with R600R. Central wavelength = 7980 Å.

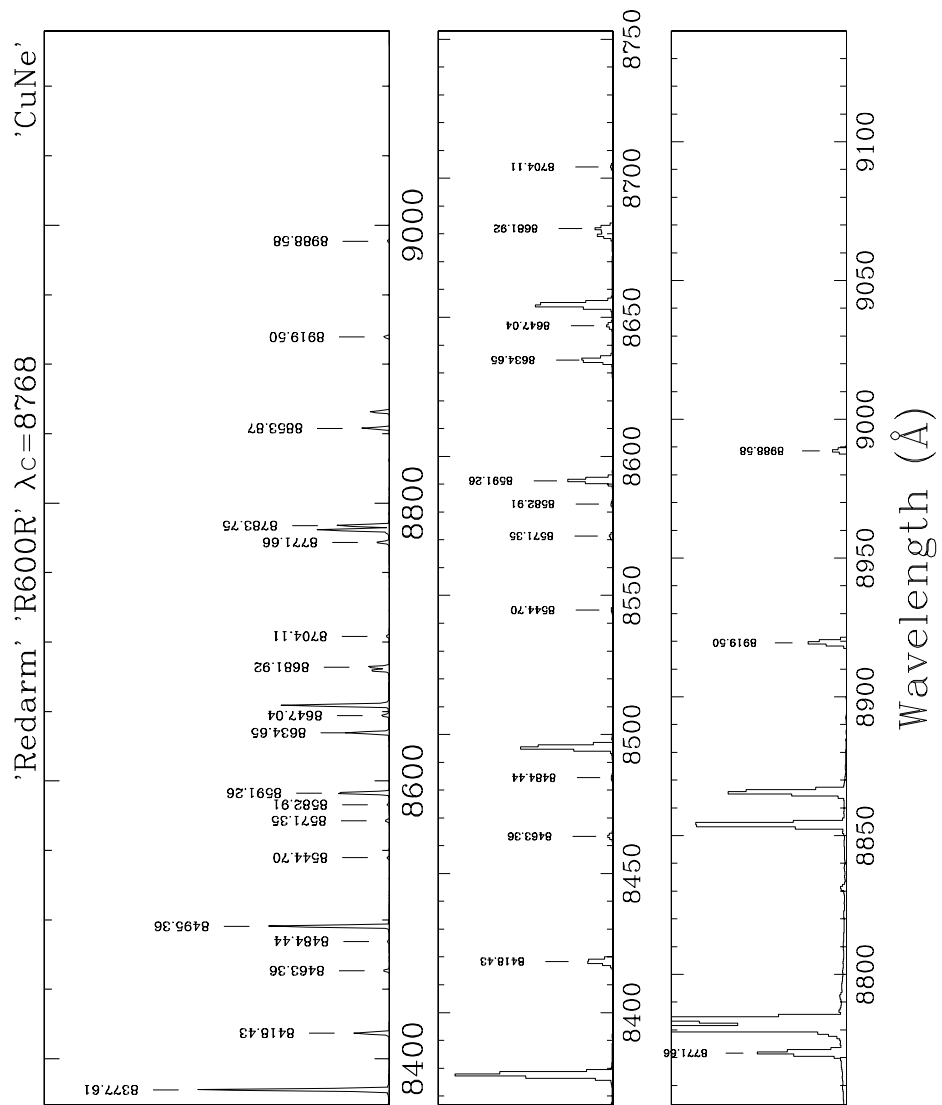


Figure 8: Copper-Neon Lamp with R600R. Central wavelength = 8770 Å.

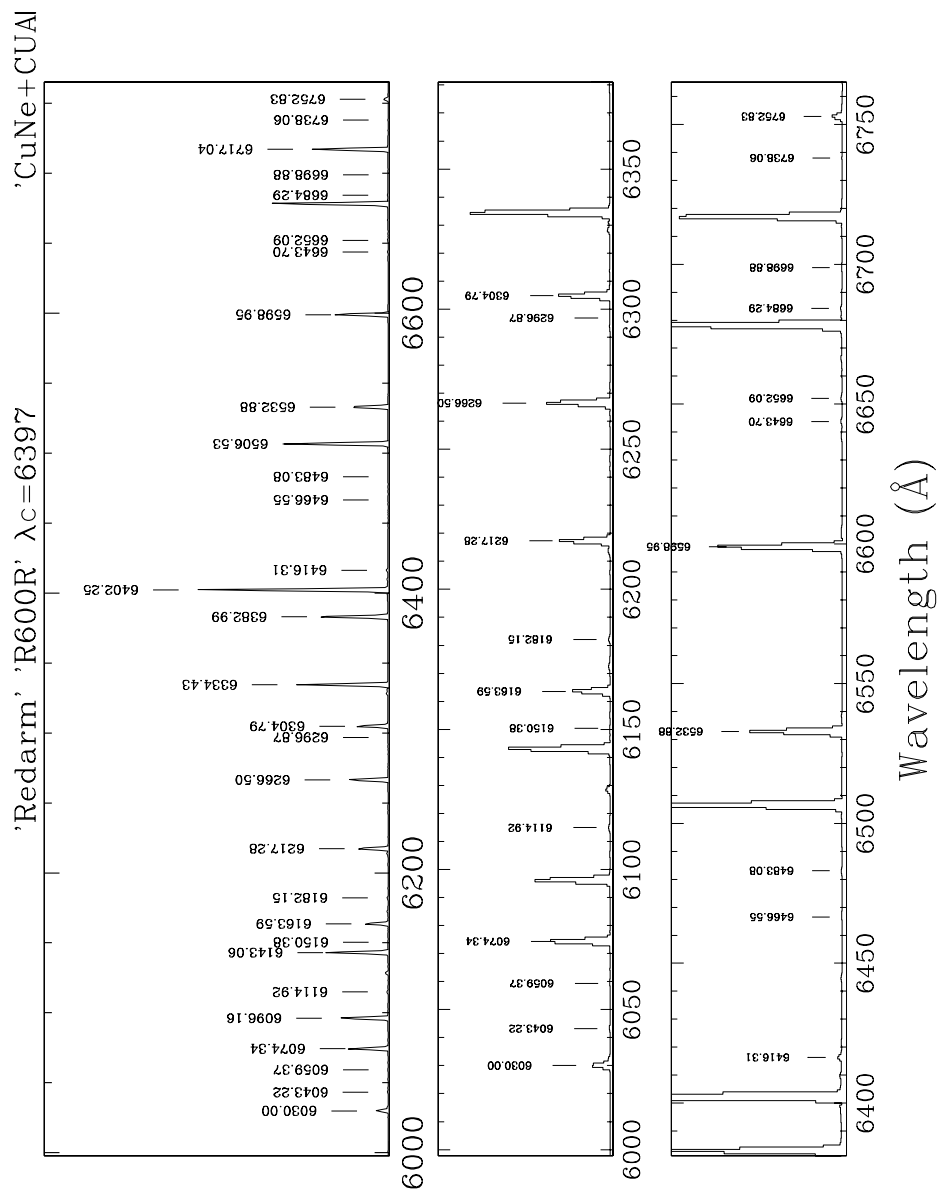


Figure 9: Copper-Neon & Copper-Argon Lamps with R600R. Central wavelength = 6400 Å.

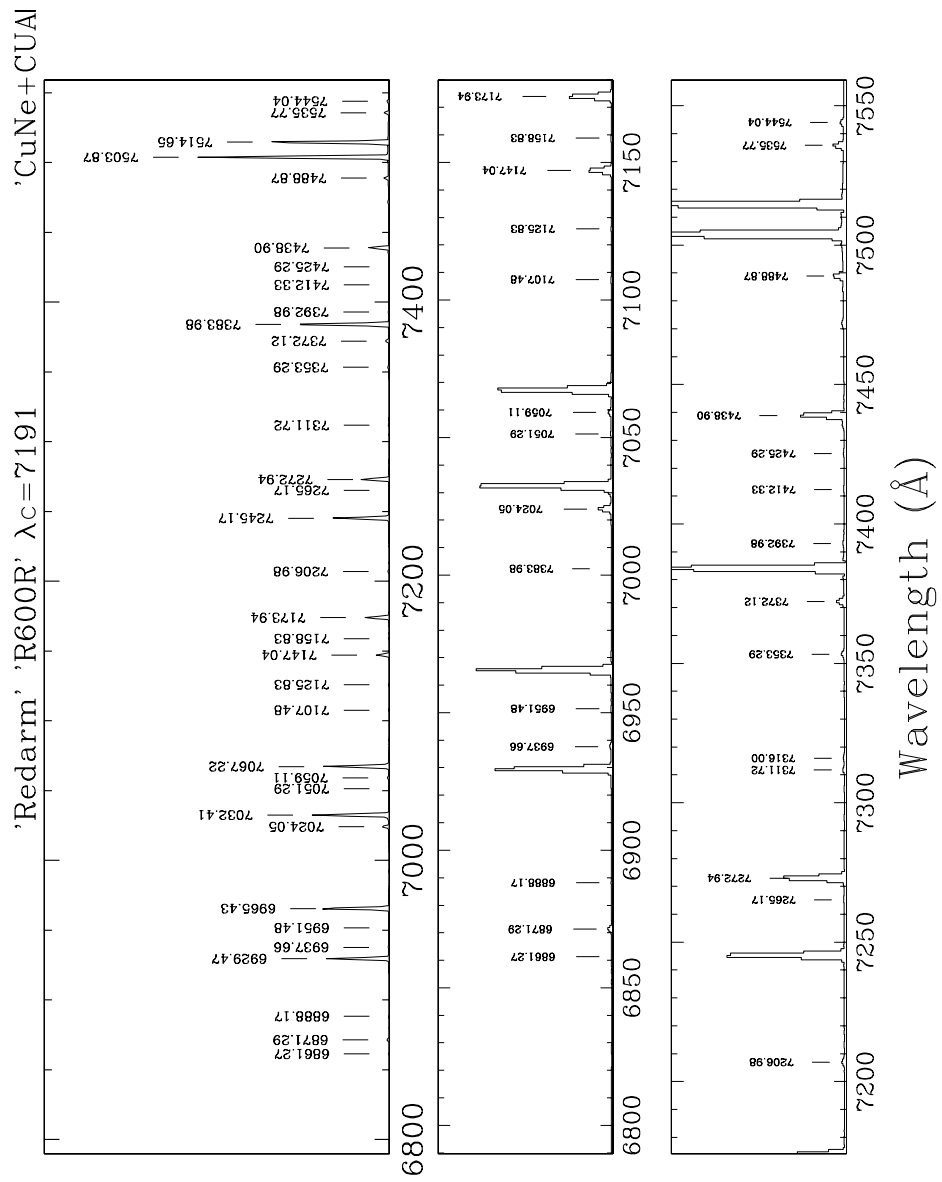


Figure 10: Copper-Neon & Copper-Argon Lamp with R600R. Central wavelength = 7190 Å.

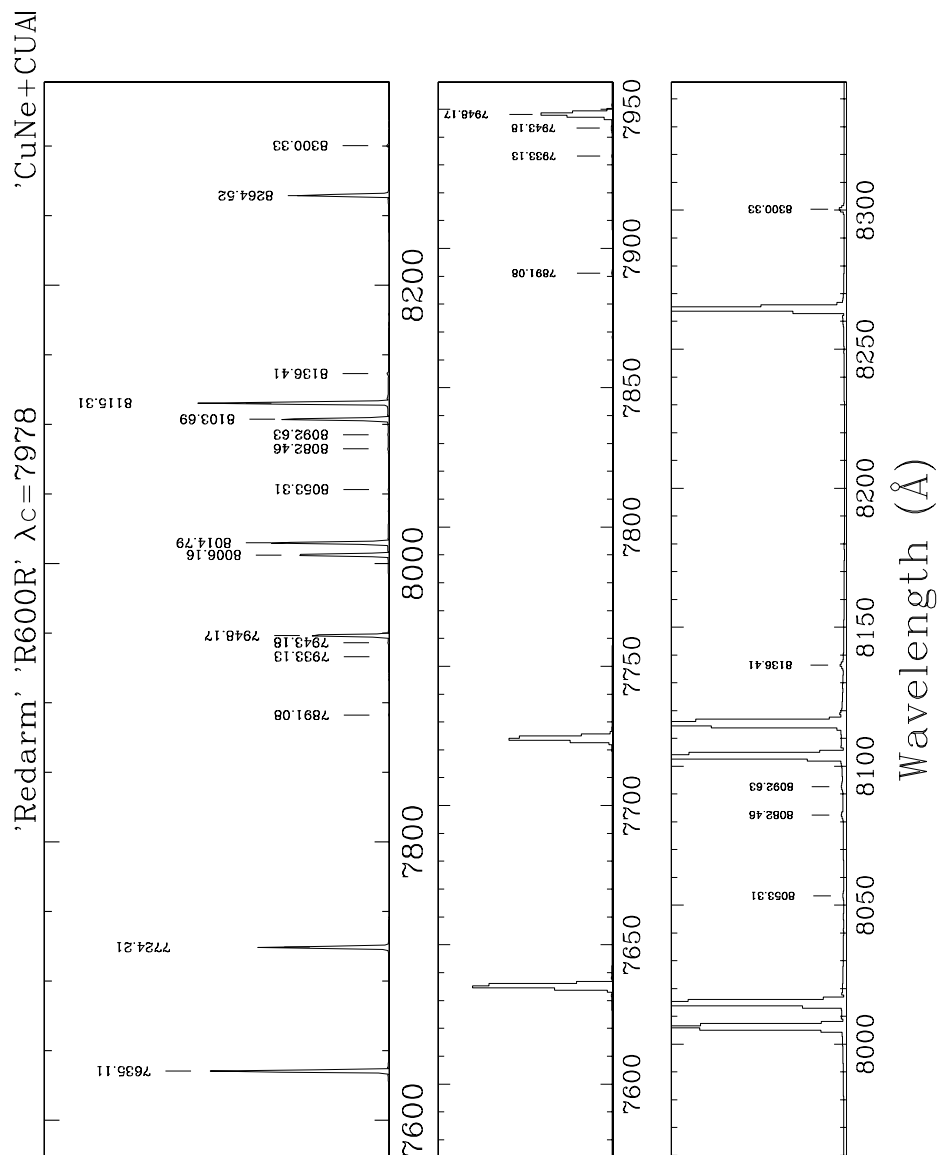


Figure 11: Copper-Neon & Copper-Argon Lamp with R600R. Central wavelength = 7980 Å.

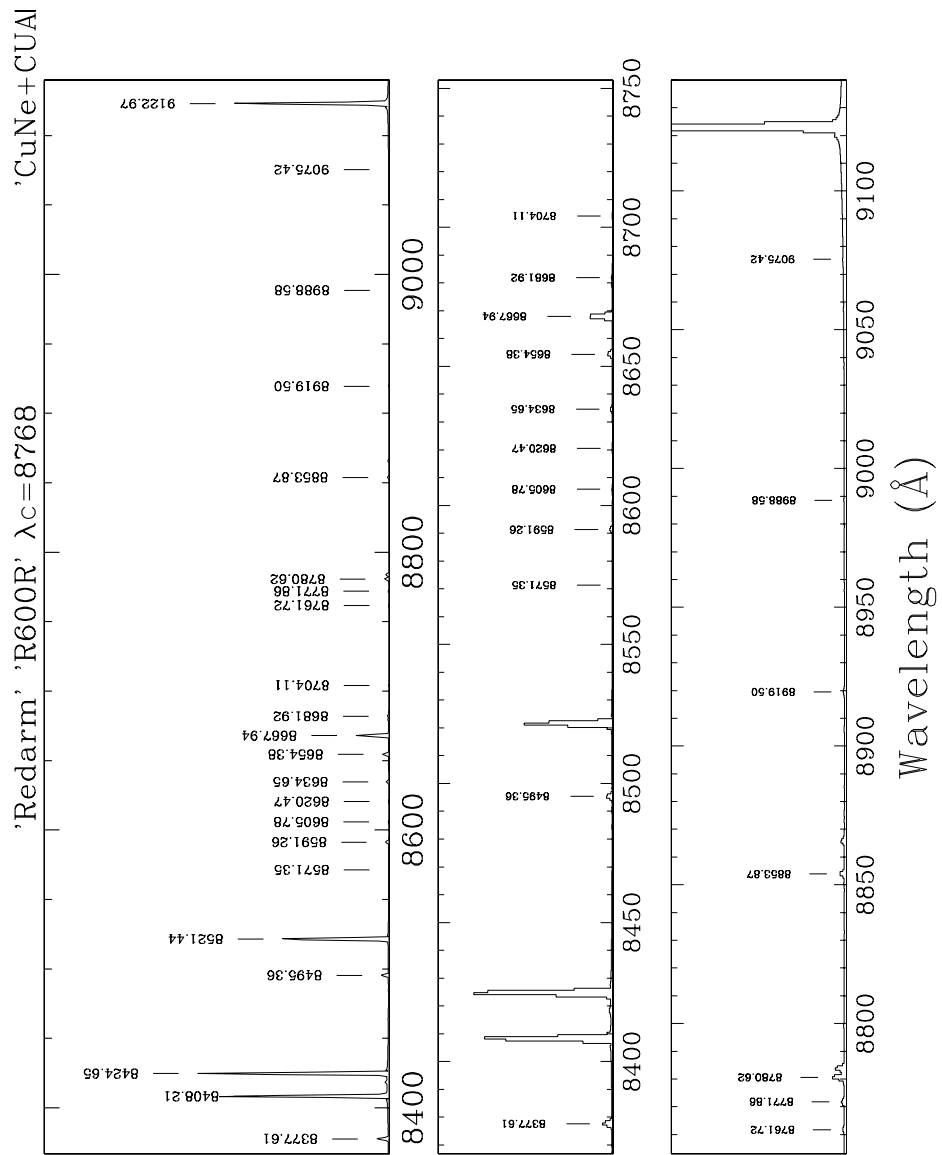


Figure 12: Copper-Neon & Copper-Argon Lamp with R600R. Central wavelength = 8770 Å.

R1200R Grating

Table 1: Copper-Argon Lamp with R1200R

Range (\AA)	Exp. (s)	Filter	Disp ($\text{\AA}/\text{pixel}$)	Lines	RMS (\AA)
5991-6438	60	GG495	0.3977	22	0.0156
6392-6838	60	GG495	0.3967	18	0.0271
6794-7238	2	GG495	0.3955	16	0.0375
7194-7637	2	GG495	0.3941	16	0.0269
7594-8034	2	GG495	0.3919	10	0.0607
7996-8434	2	GG495	0.3897	9	0.0321
8397-8832	2	GG495	0.3872	8	0.0196
8799-9231	2	GG495	0.3840	10	0.1107

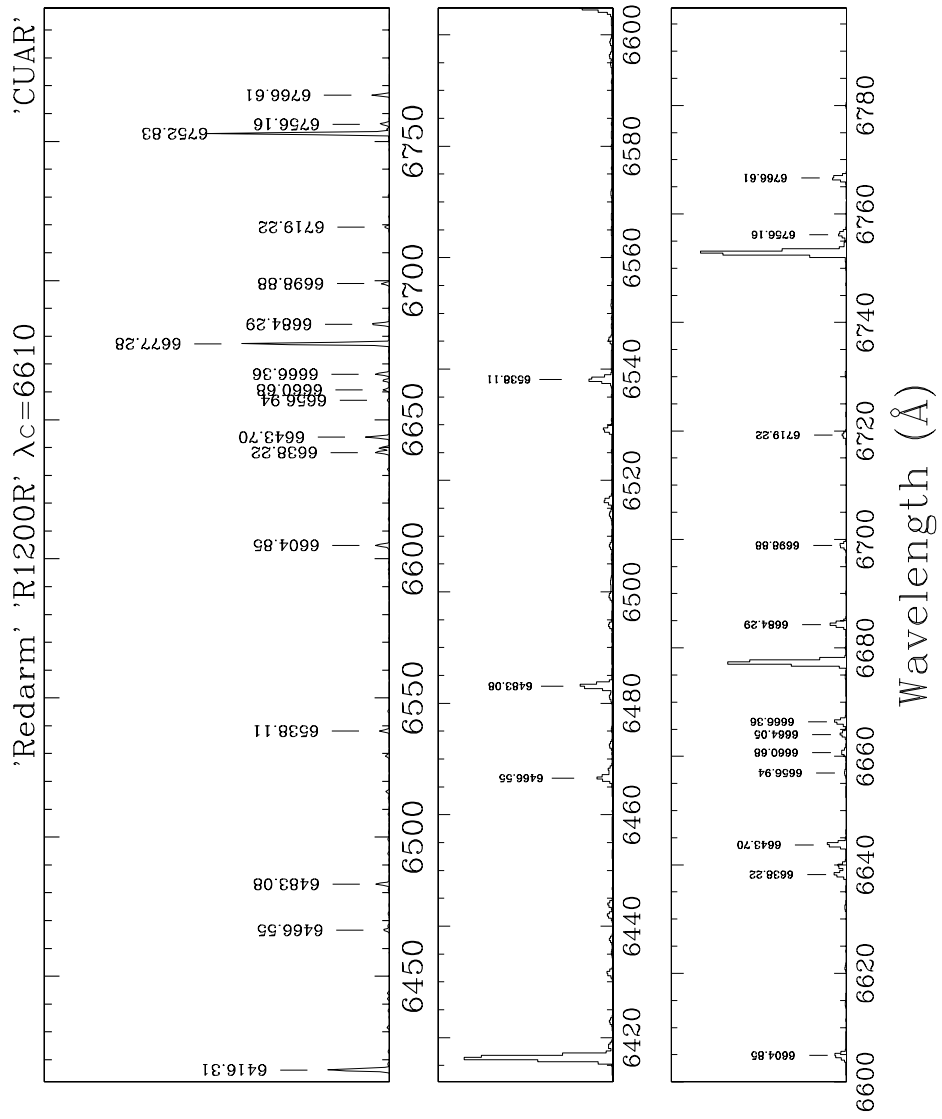


Figure 2: Copper-Argon Lamp with R1200R. Central wavelength = 6610 Å.

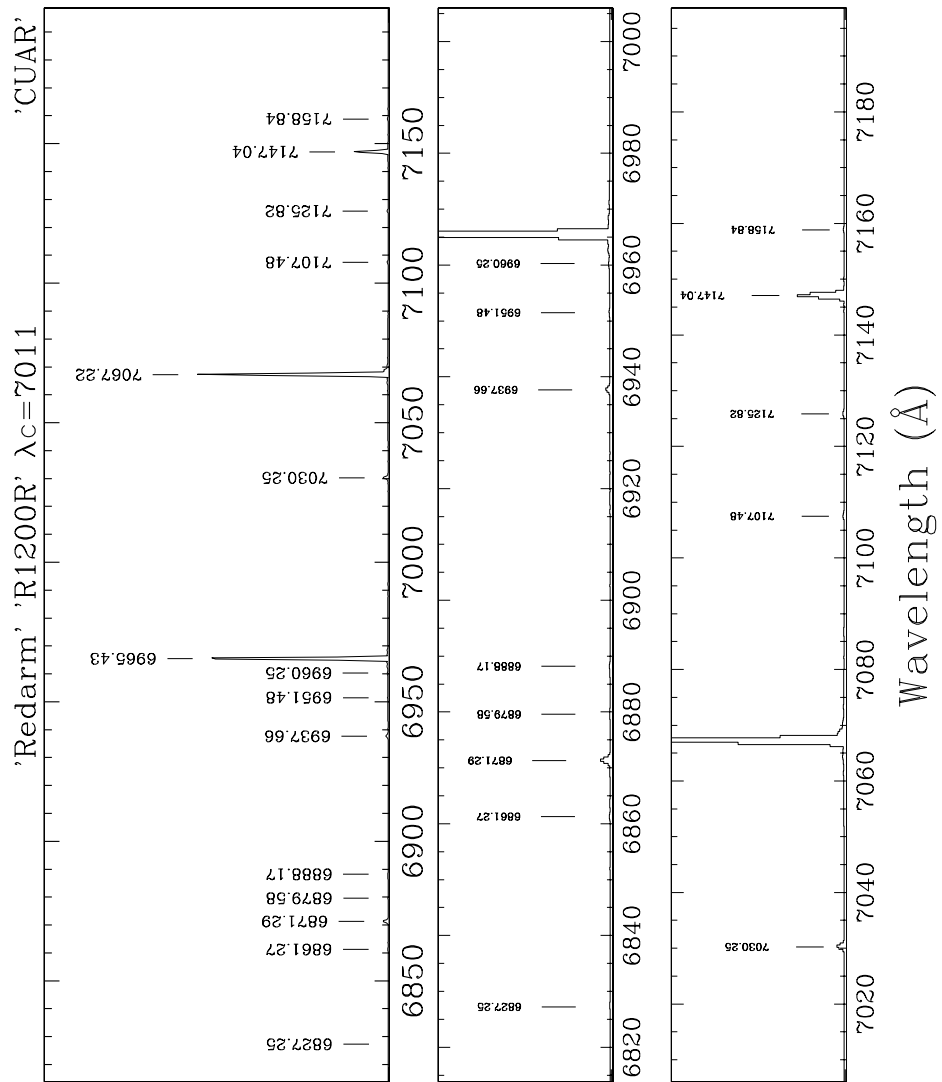


Figure 3: Copper-Argon Lamp with R1200R. Central wavelength = 7010 Å.

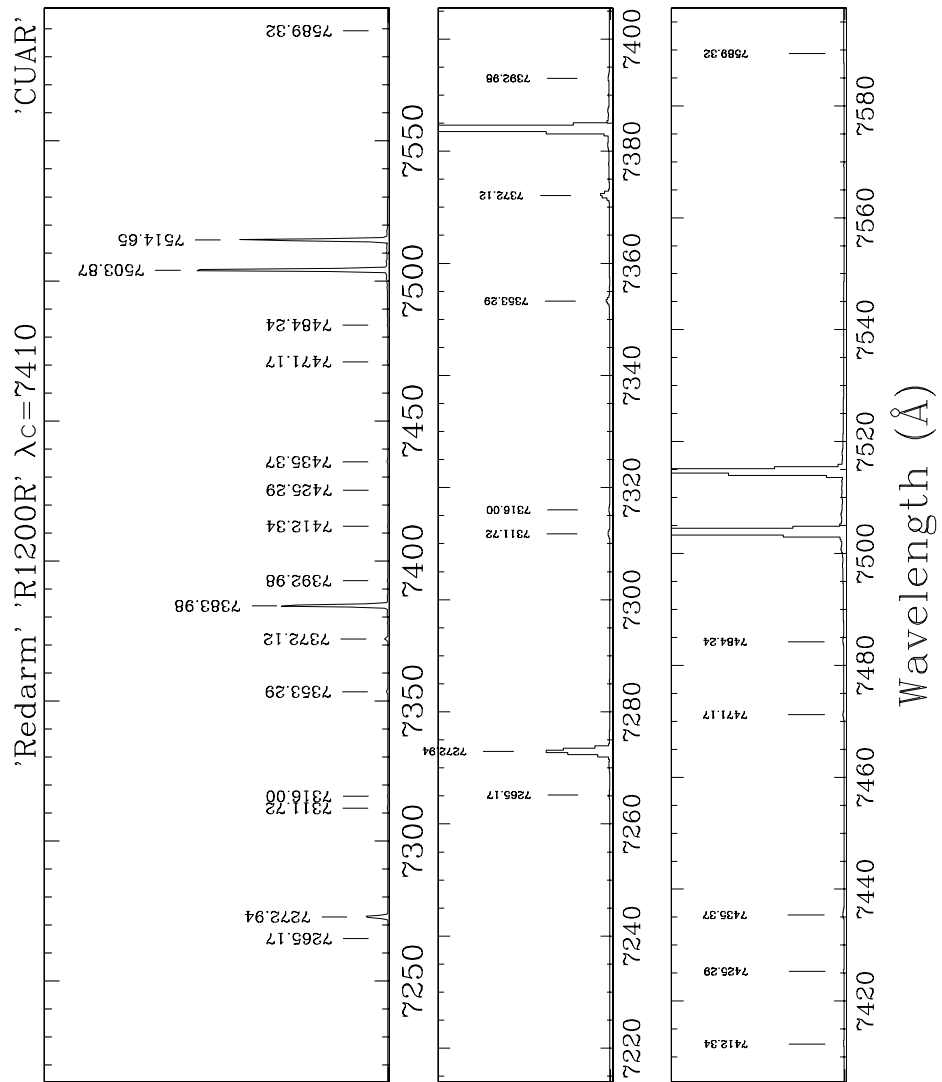


Figure 4: Copper-Argon Lamp with R1200R. Central wavelength = 7410 Å.

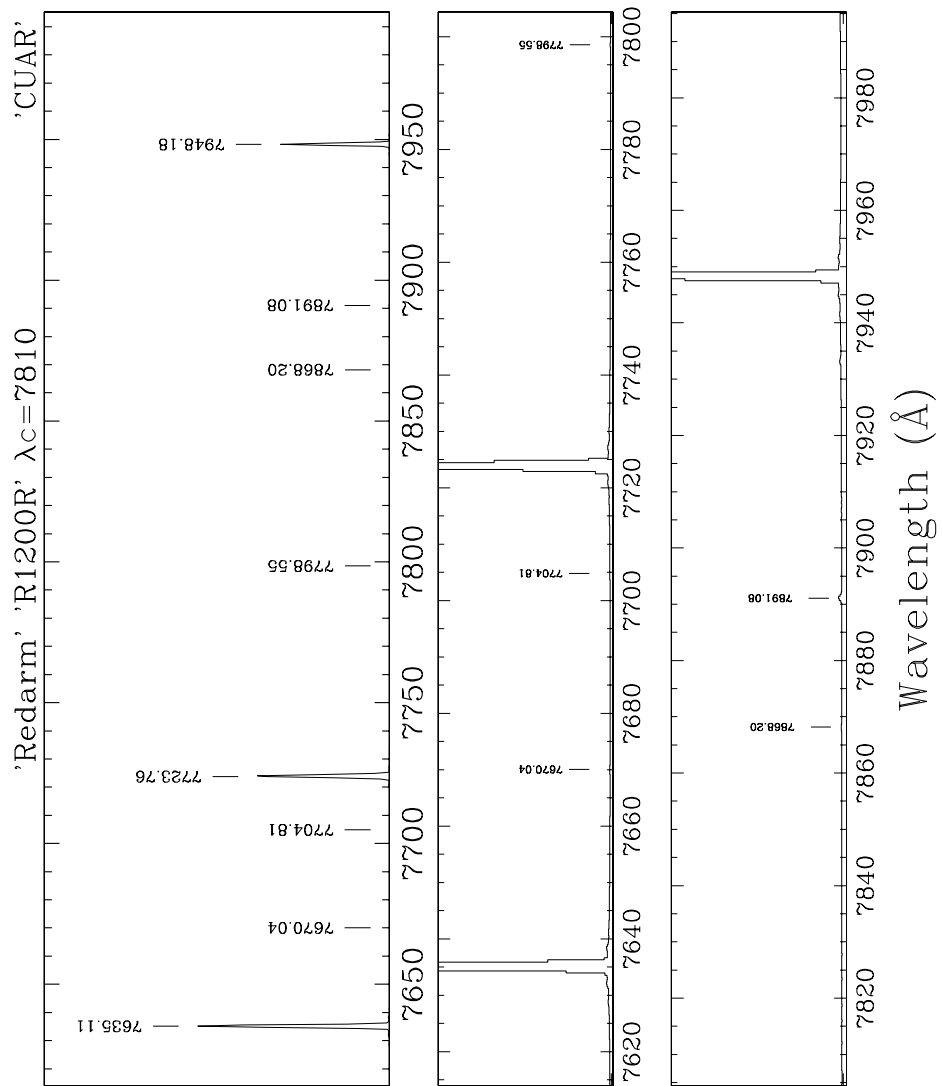


Figure 5: Copper-Argon Lamp with R1200R. Central wavelength = 7810 Å.

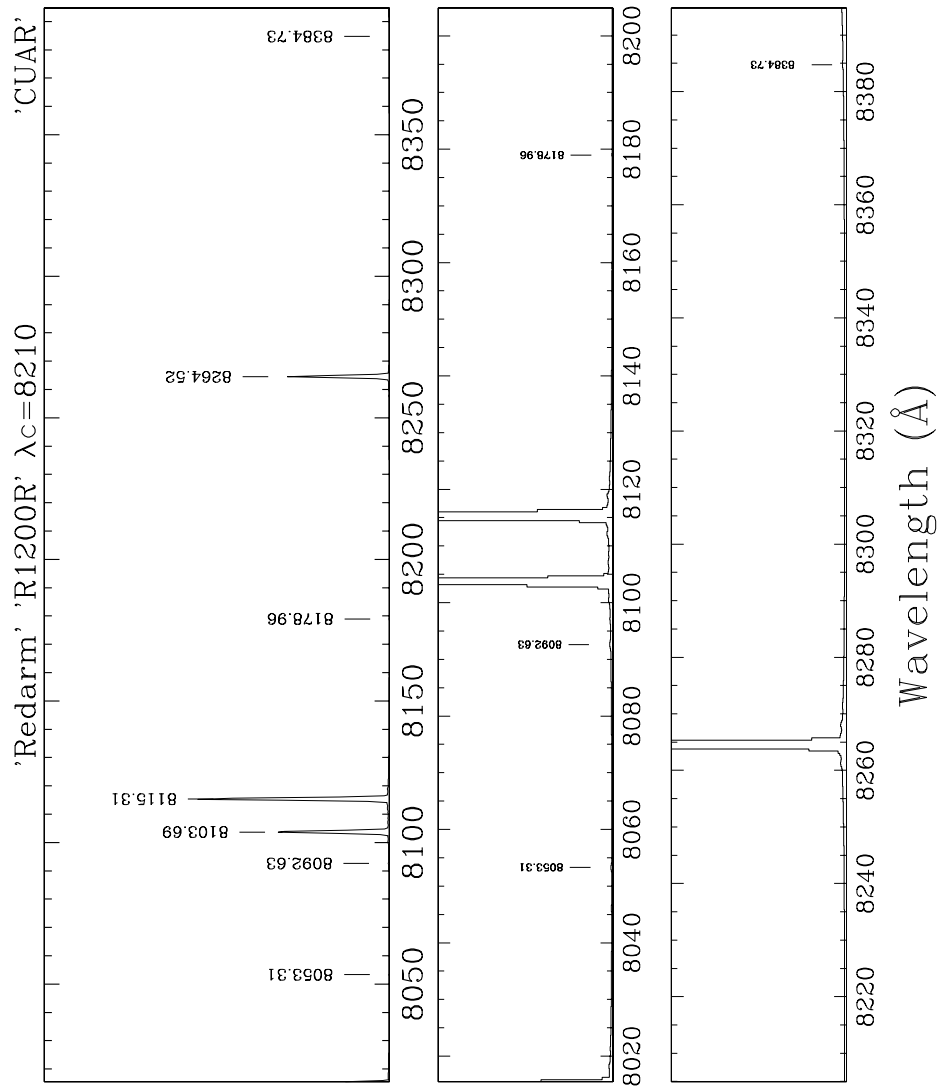


Figure 6: Copper-Argon Lamp with R1200R. Central wavelength = 8210 Å.

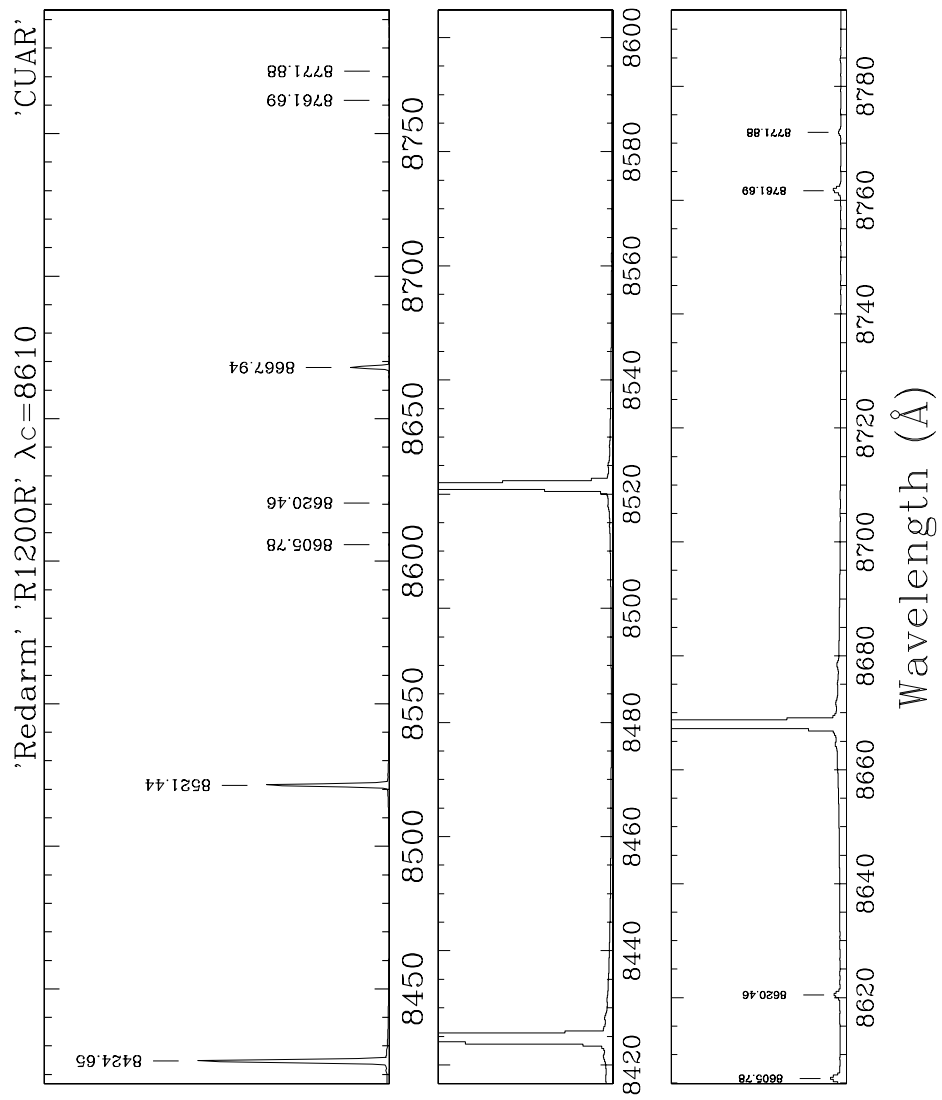


Figure 7: Copper-Argon Lamp with R1200R. Central wavelength = 8610 Å.

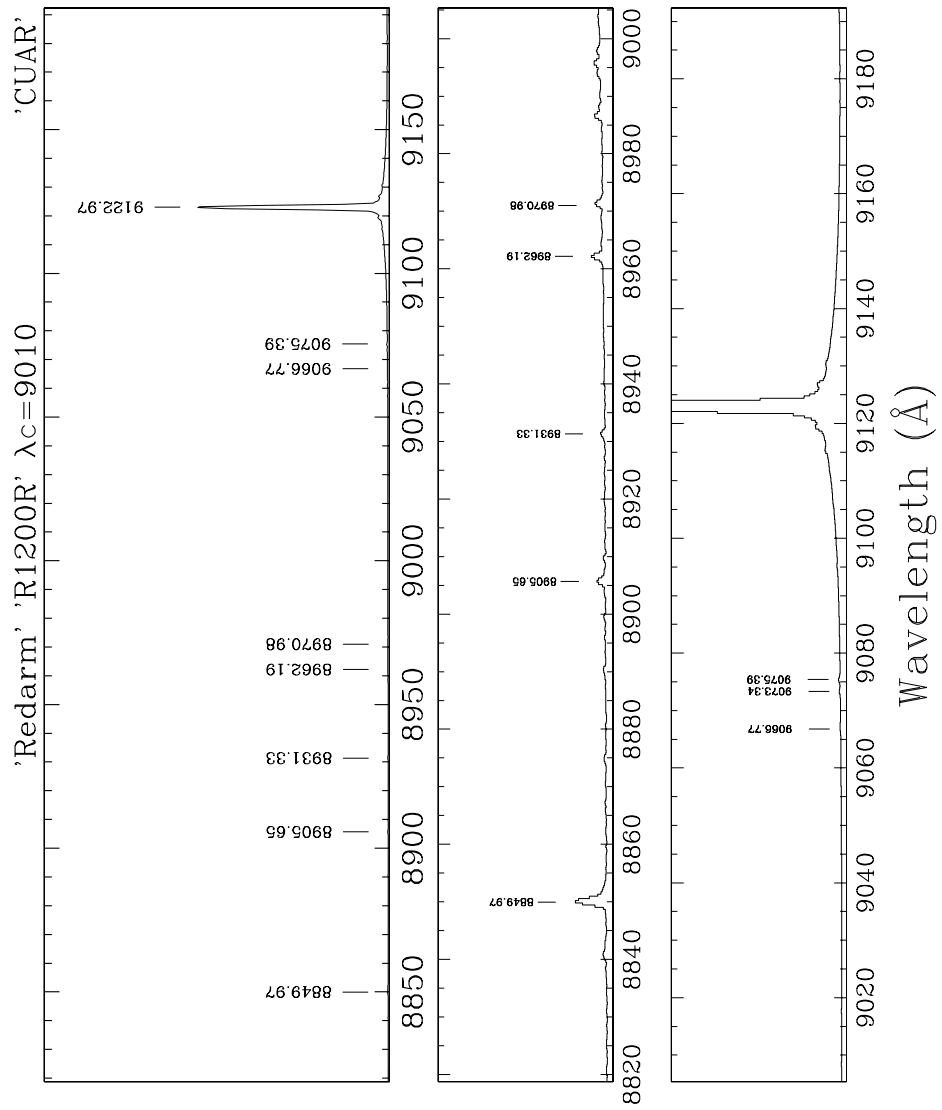


Figure 8: Copper-Argon Lamp with R1200R. Central wavelength = 9010 Å.

R1200R Grating

Table 1: Copper-Neon Lamp with R1200R

Range (\AA)	Exp. (s)	Filter	Disp ($\text{\AA}/\text{pixel}$)	Lines	RMS (\AA)
5991-6438	2	GG495	0.3977	17	0.0168
6392-6838	2	GG495	0.3967	7	0.0238
6794-7238	2	GG495	0.3984	7	0.0253
7194-7637	2	GG495	0.3937	7	0.0101
7594-8034	2	GG495	No lines	No lines	No lines
7996-8434	20	GG495	0.3900	11	0.0252
8397-8832	20	GG495	0.3876	18	0.1315
8799-9231	60	GG495	0.3842	6	0.0125

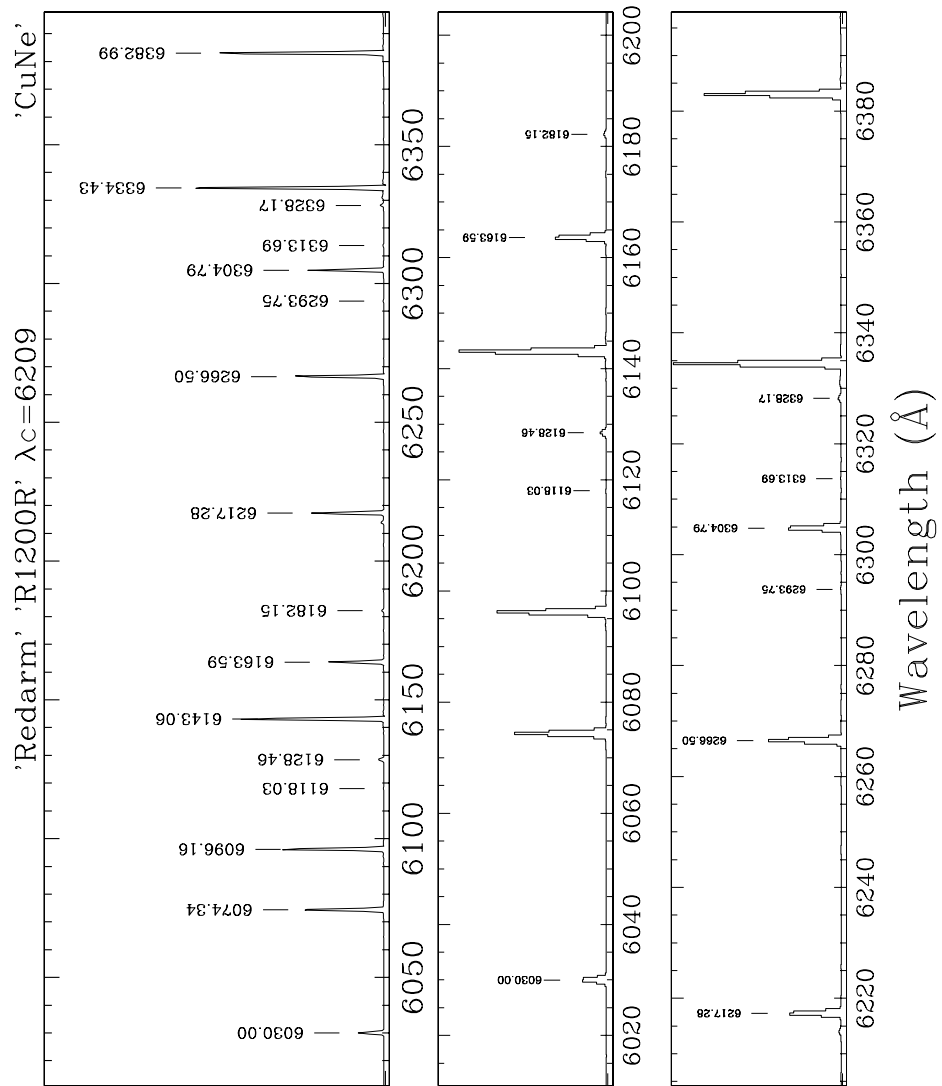


Figure 1: Copper-Neon Lamp with R1200R. Central wavelength = 6210 Å.

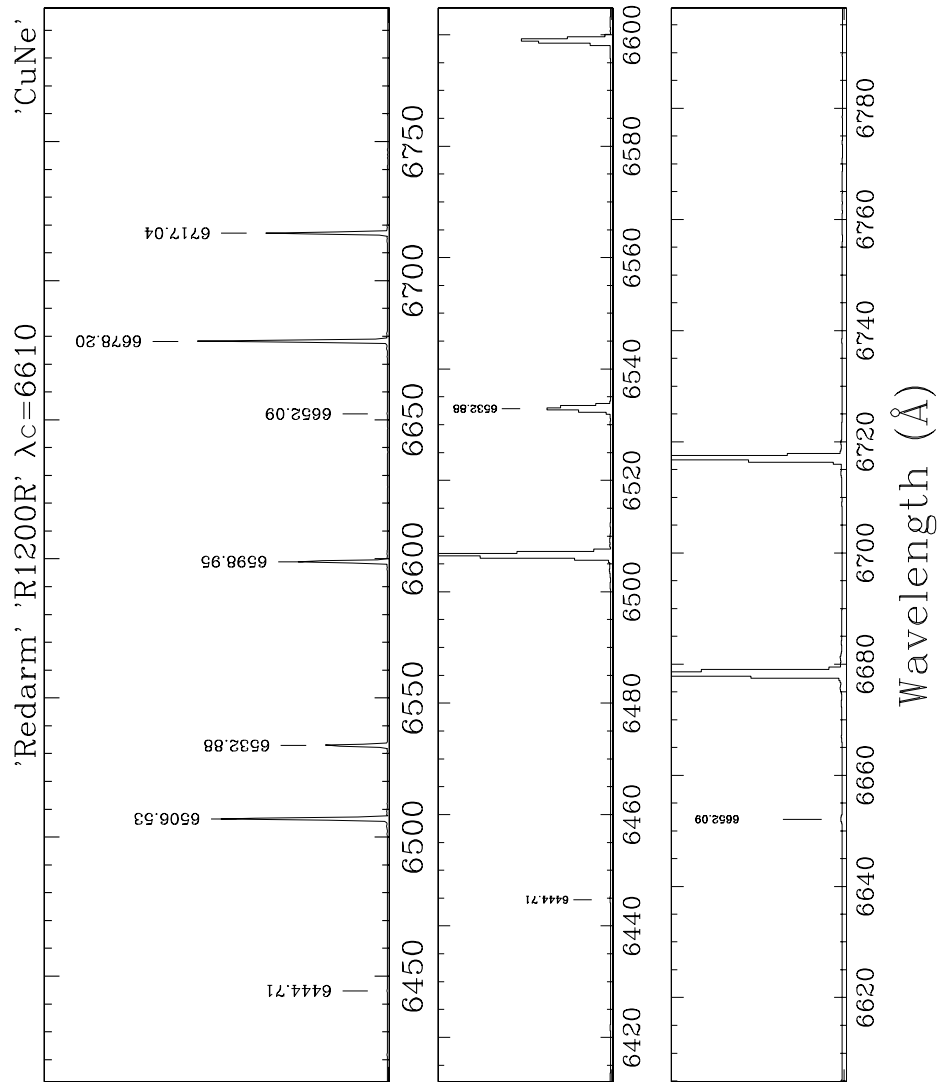


Figure 2: Copper-Neon Lamp with R1200R. Central wavelength = 6610 Å.

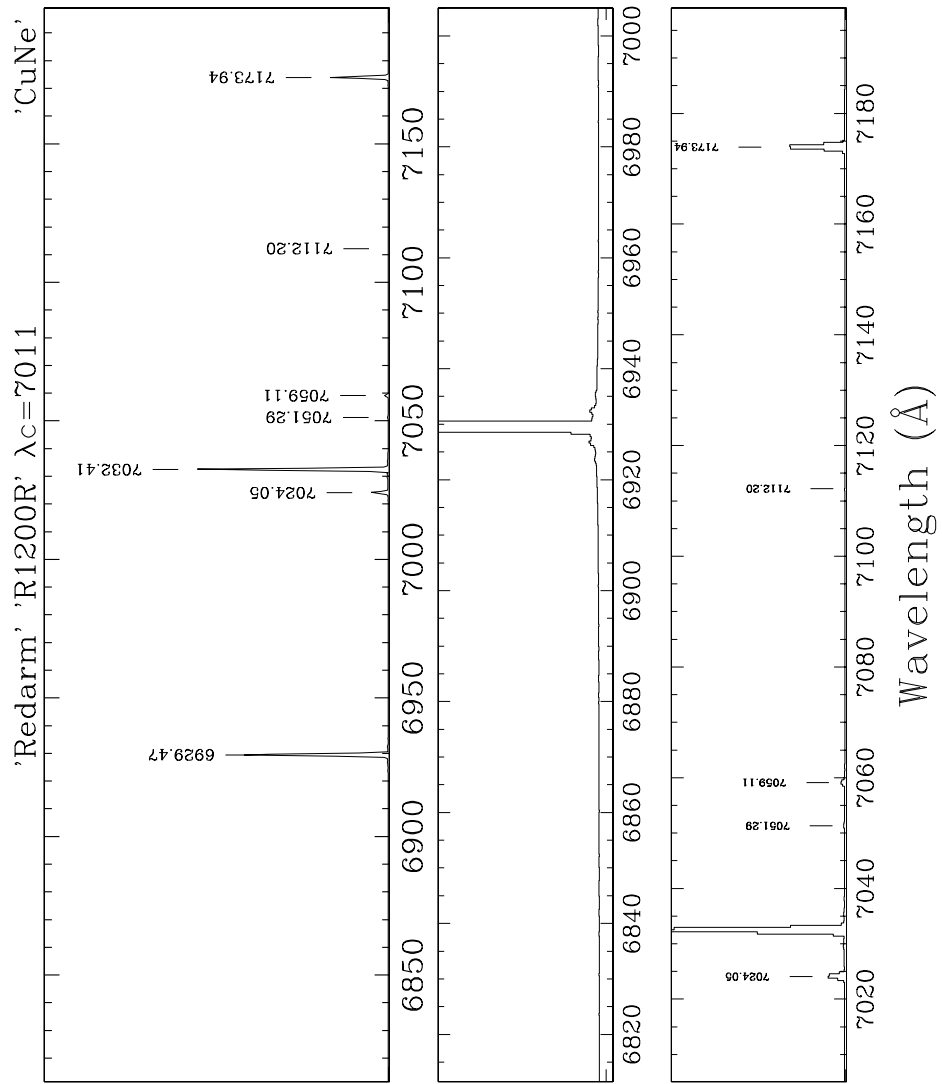


Figure 3: Copper-Neon Lamp with R1200R. Central wavelength = 7010 Å.

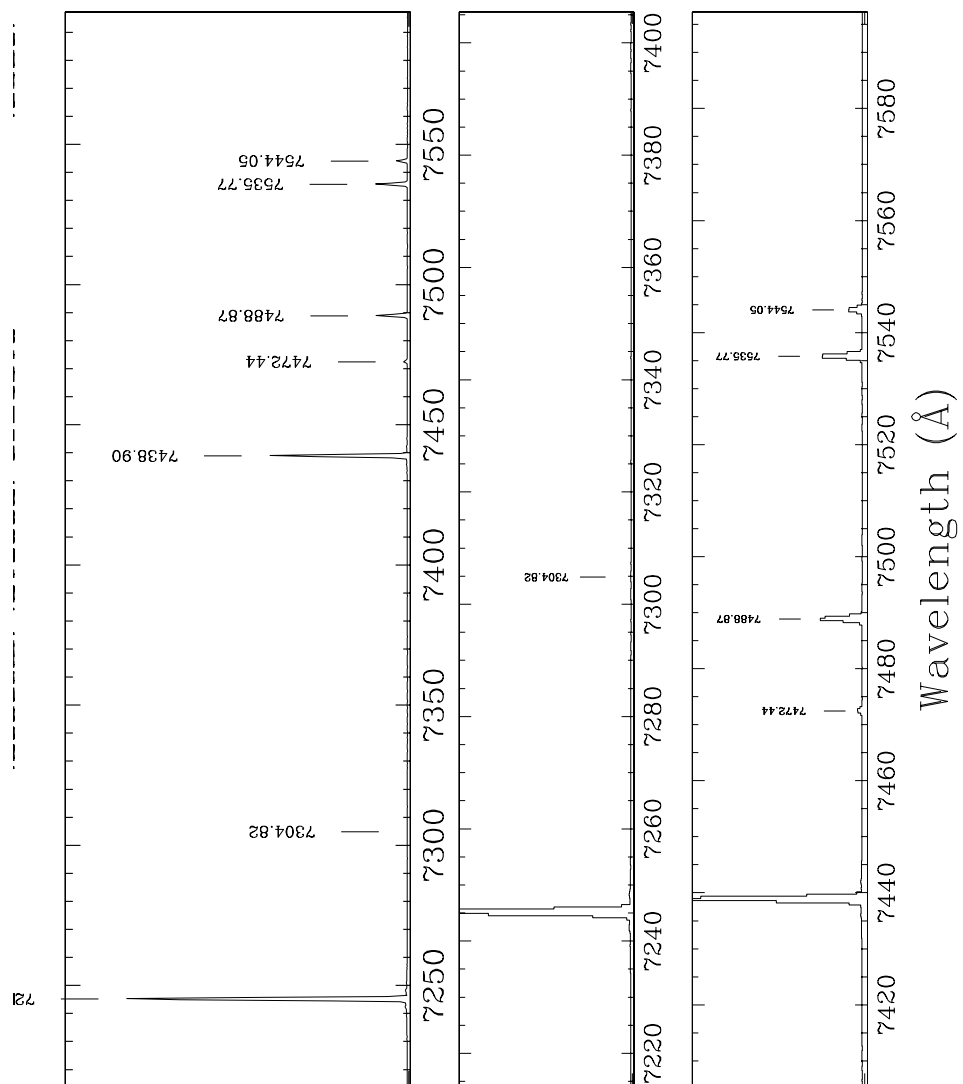


Figure 4: Copper-Neon Lamp with R1200R. Central wavelength = 7410 Å.

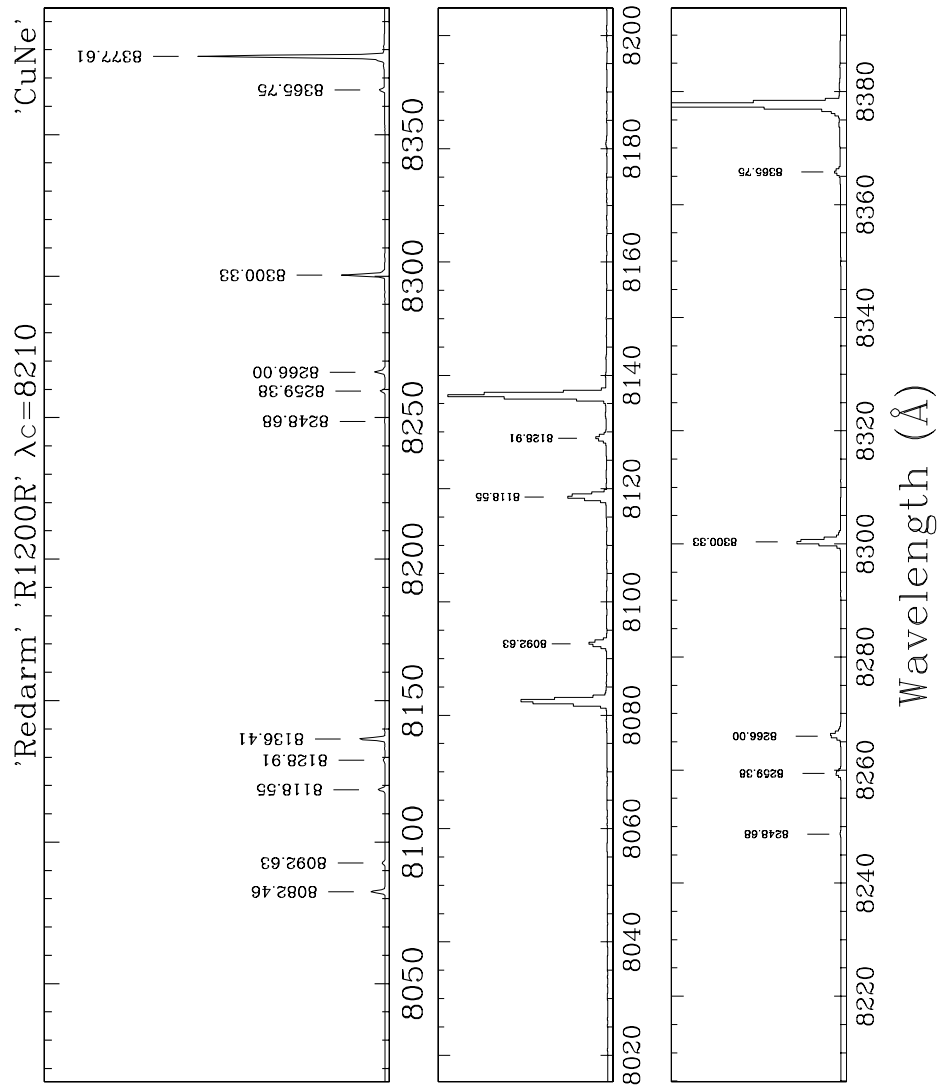


Figure 5: Copper-Neon Lamp with R1200R. Central wavelength = 8210 Å.

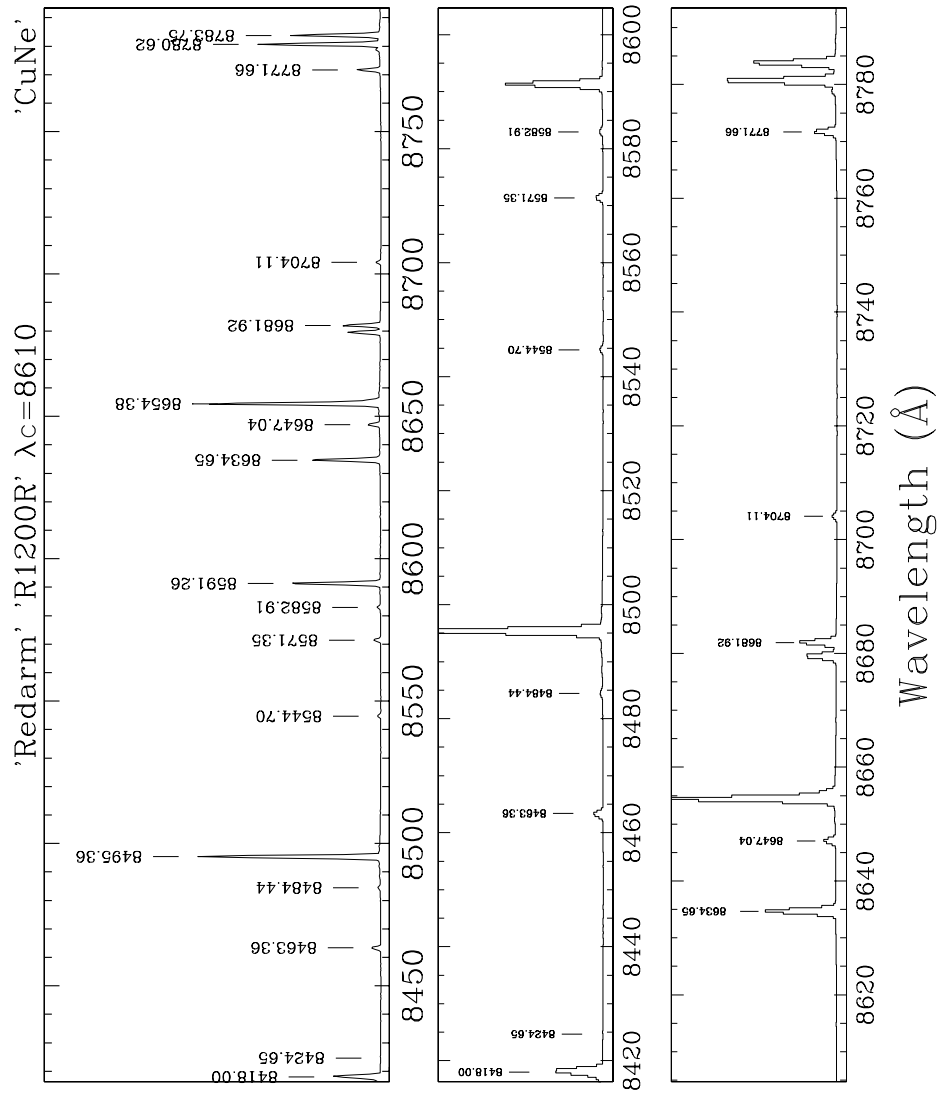


Figure 6: Copper-Neon Lamp with R1200R. Central wavelength = 8610 Å.

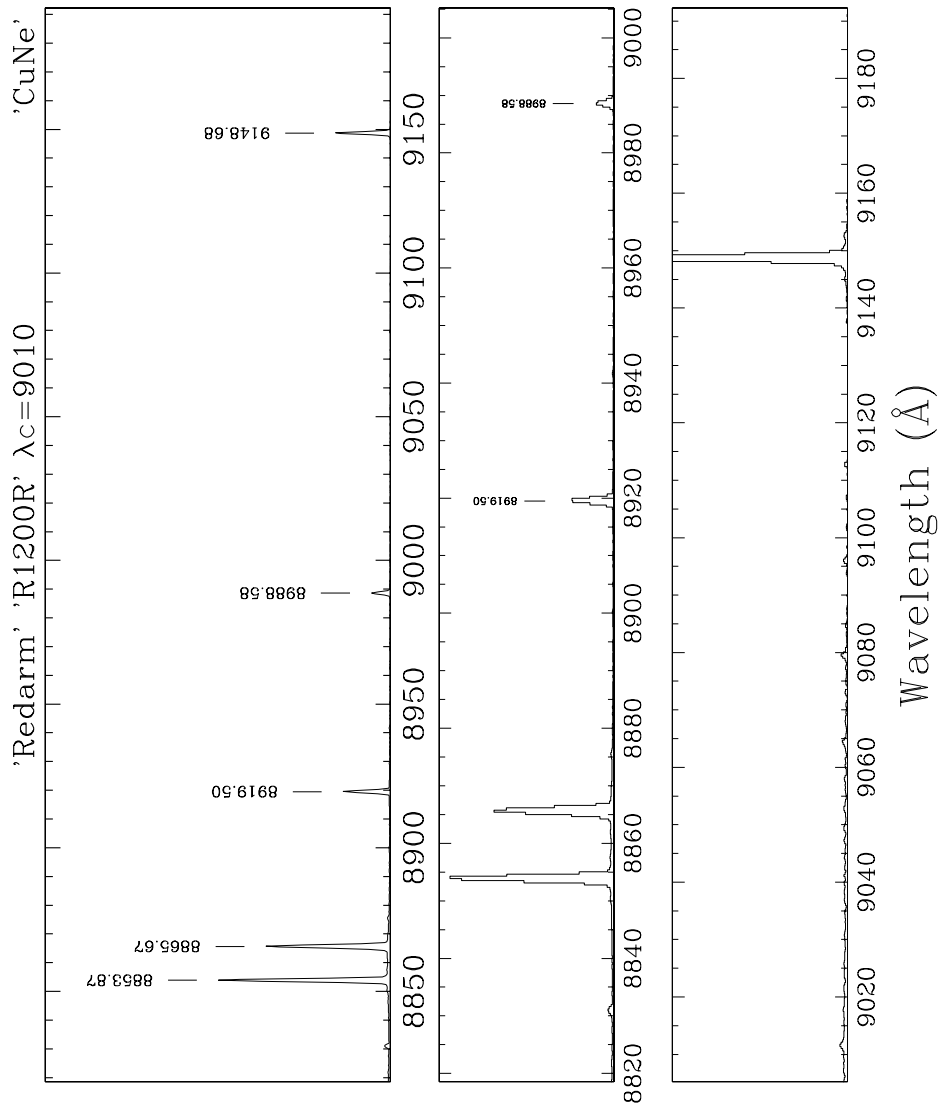


Figure 7: Copper-Neon Lamp with R1200R. Central wavelength = 9010 Å.

R1200R Grating

Table 1: Copper-Argon and Copper-Neon Lamps with R1200R

Range (\AA)	Exp. (s)	Filter	Disp ($\text{\AA}/\text{pixel}$)	Lines	RMS (\AA)
5991-6438	2	GG495	0.3977	30	0.0412
6392-6838	2	GG495	0.3968	19	0.0441
6794-7238	2	GG495	0.3955	8	0.0275
7194-7637	2	GG495	0.3941	20	0.0187
7594-8034	2	GG495	0.3920	8	0.0154
7996-8434	2	GG495	0.3899	10	0.0302
8397-8832	2	GG495	0.3872	20	0.0307
8799-9231	20	GG495	0.3839	8	0.0799

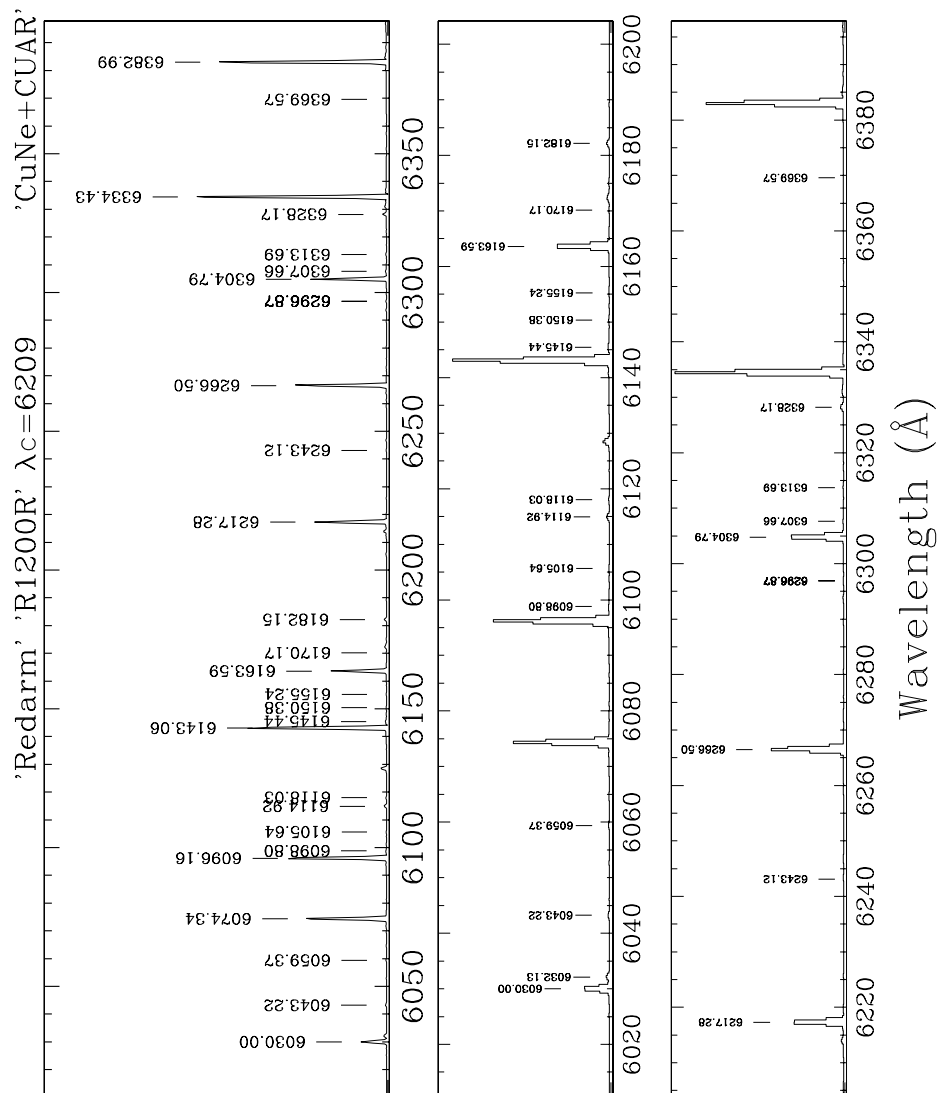


Figure 1: Copper-Neon Lamp with R1200R. Central wavelength = 6210 Å.

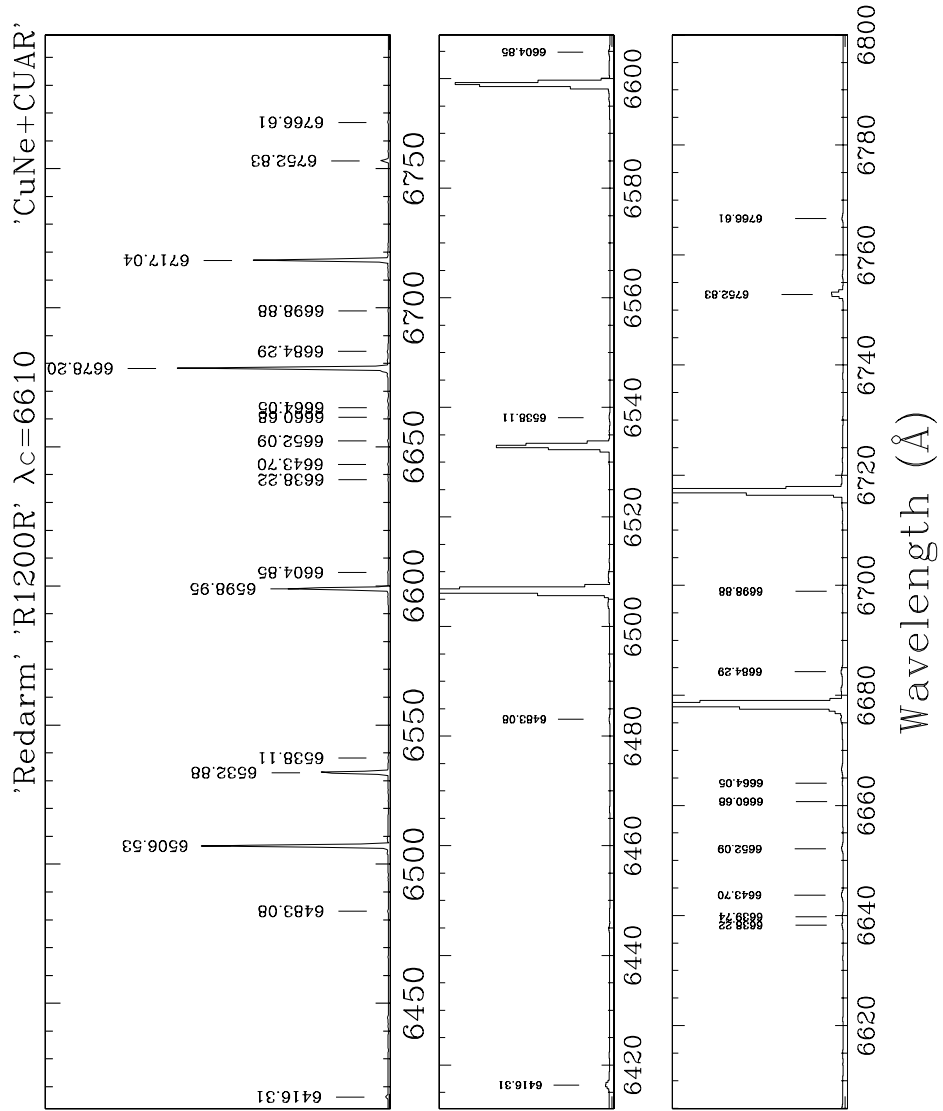


Figure 2: Copper-Neon Lamp with R1200R. Central wavelength = 6610 Å.

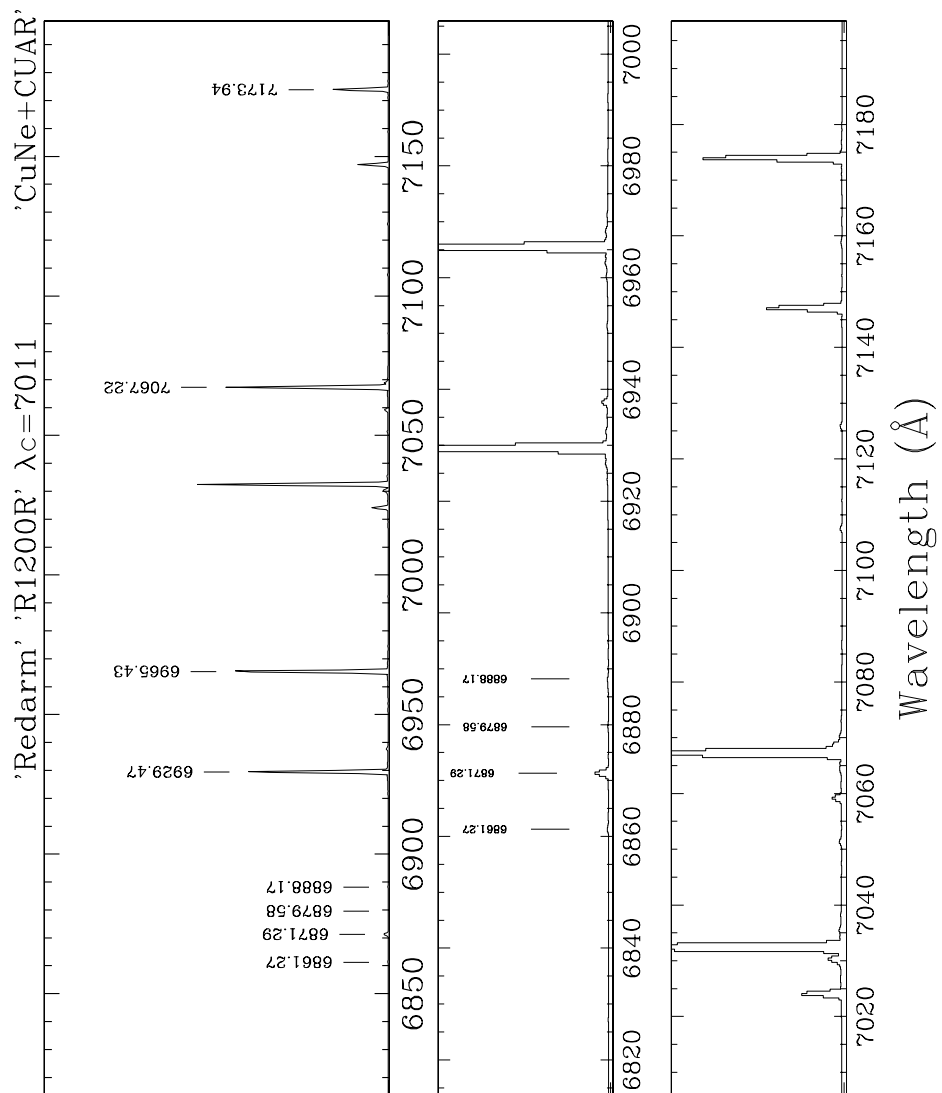


Figure 3: Copper-Neon Lamp with R1200R. Central wavelength = 7010 Å.

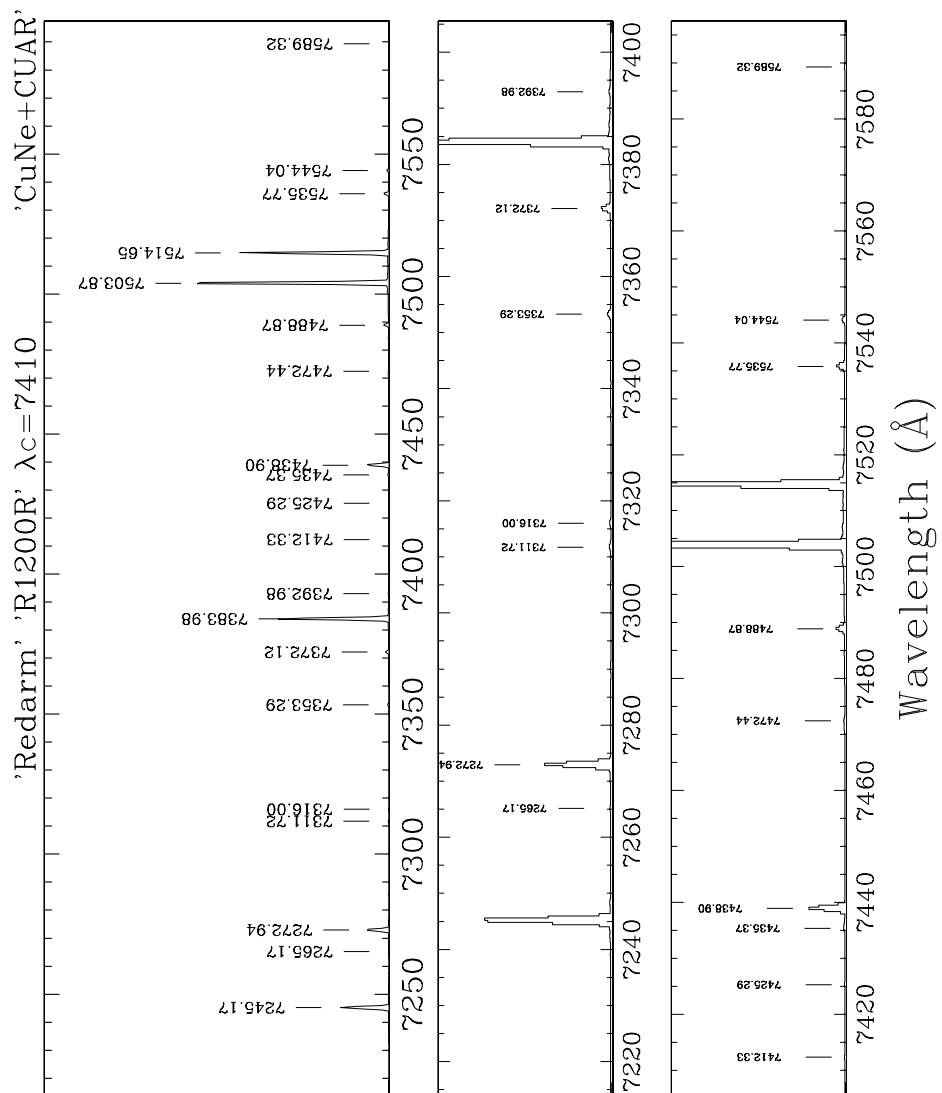


Figure 4: Copper-Neon Lamp with R1200R. Central wavelength = 7410 Å.

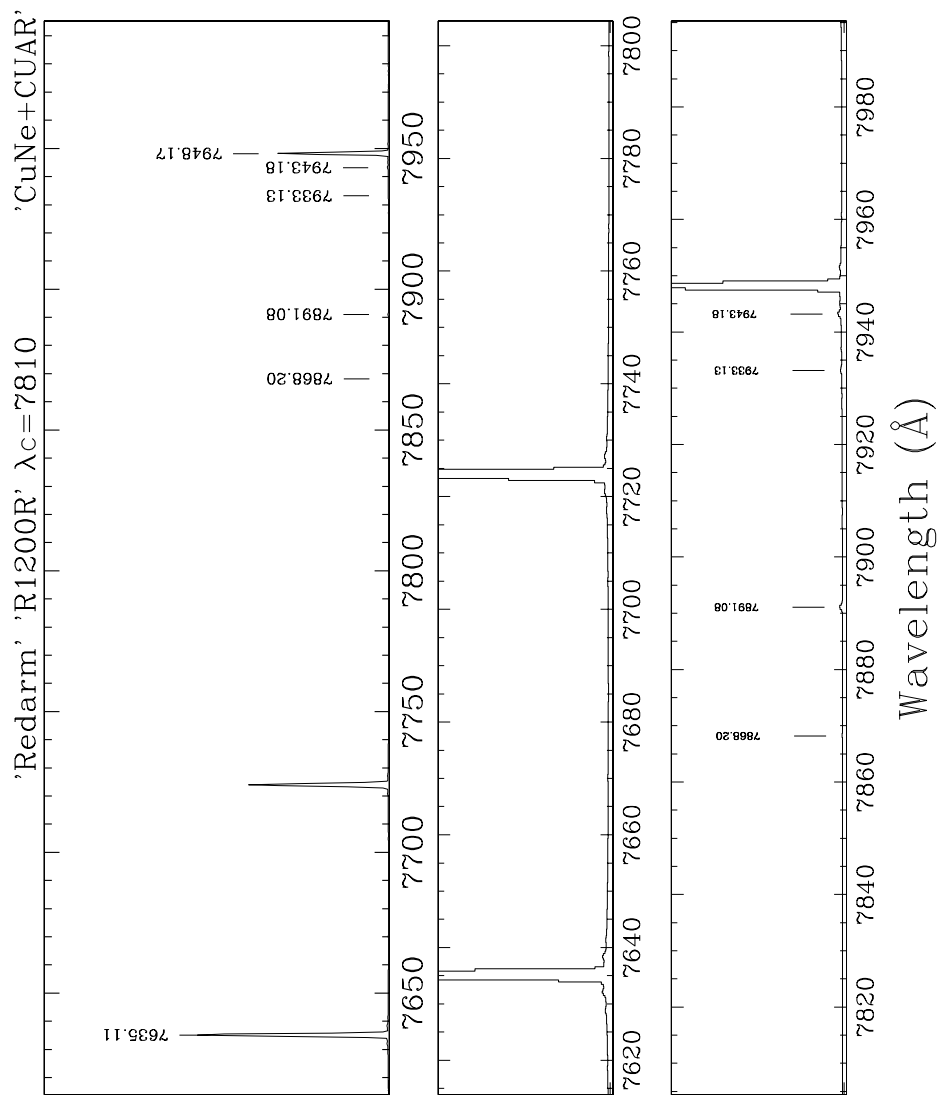


Figure 5: Copper-Neon Lamp with R1200R. Central wavelength = 7810 Å.

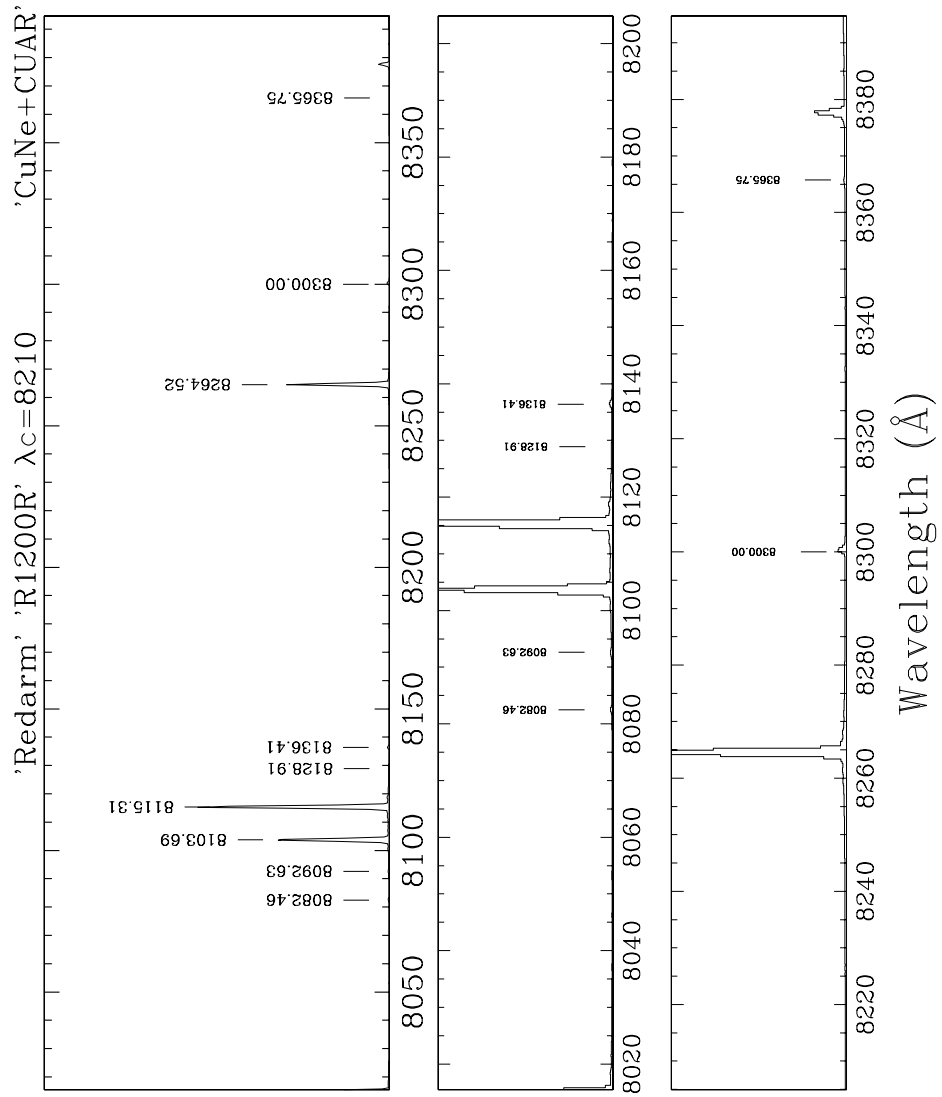


Figure 6: Copper-Neon Lamp with R1200R. Central wavelength = 8210 Å.

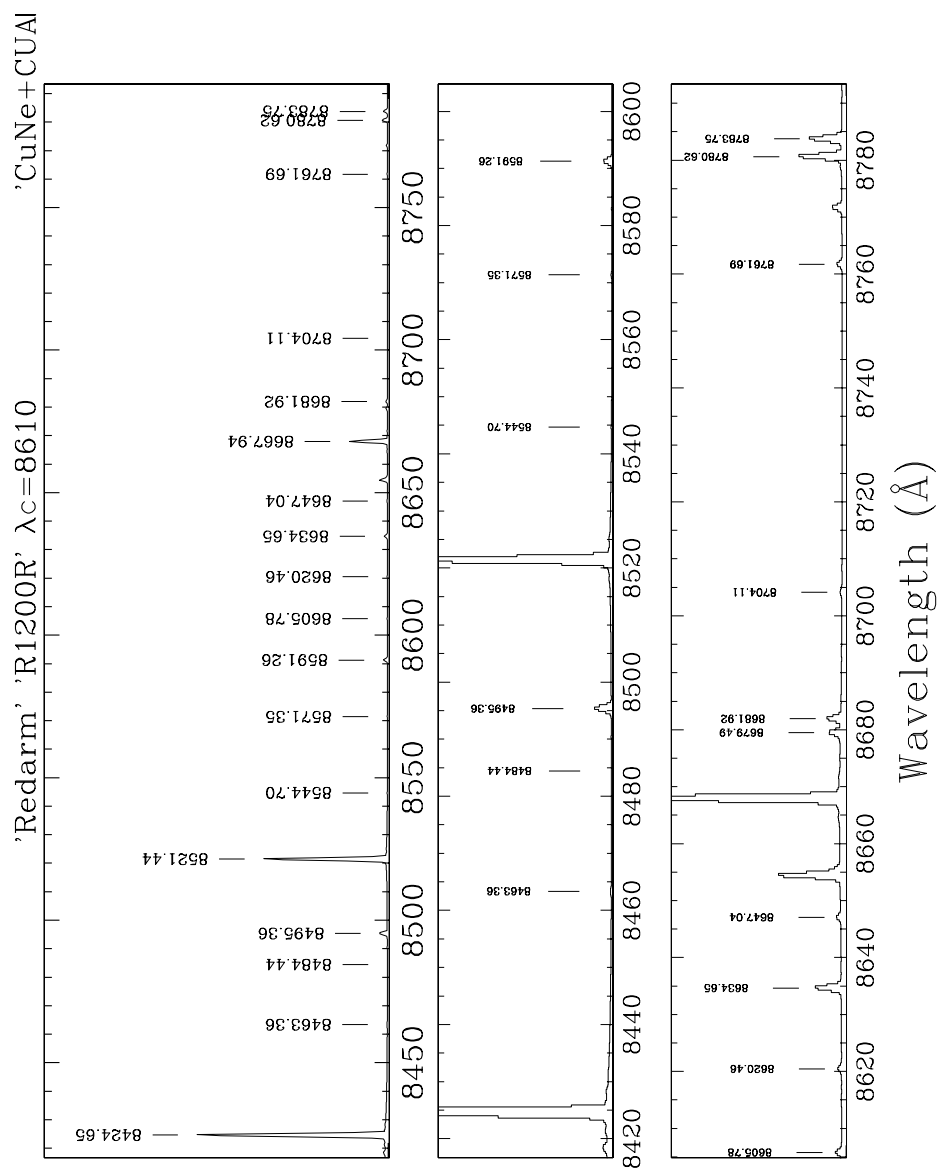


Figure 7: Copper-Neon Lamp with R1200R. Central wavelength = 8610 Å.

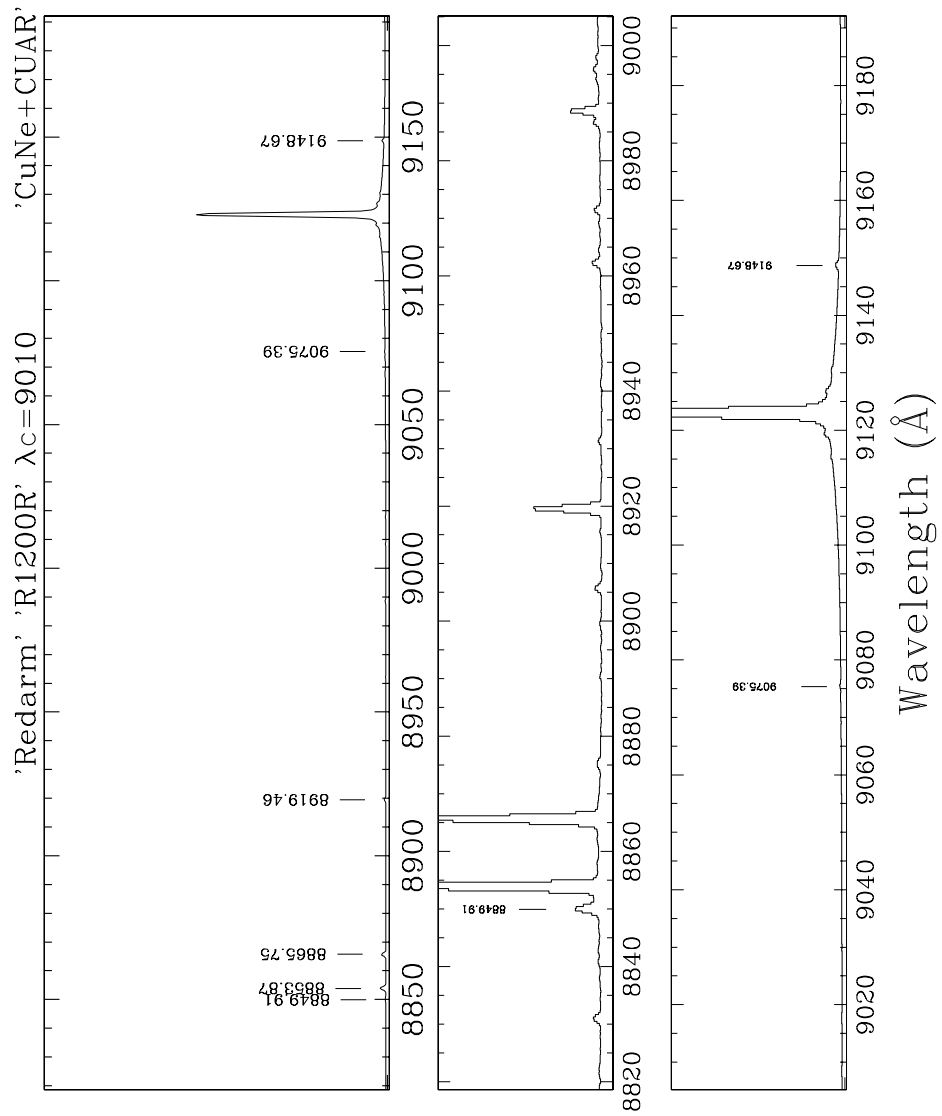


Figure 8: Copper-Neon Lamp with R1200R. Central wavelength = 9010 Å.