ena that now appear puzzling. It is hoped that the long series of images of the past years will greatly expedite the study and interpretation of the spectrum observations with rapid, high dispersion instruments. There are recurrences of identical or practically identical forms of the entire nebula with several such instances at intervals of years, but such changes cannot be called periodic. It may be possible to correlate spectral characteristics with certain forms of the nebula, and with the magnitude of the nucleus which has not undergone variations in brightness to exceed about two magnitudes.

Dr. Slipher's observations of the spectrum of this object in 1916 resulted in the interesting discovery that the outlying nebulosity was illuminated by the irregular variable star (R Monocerotis) at the apex of the nebulosity. The spectra of the star and nebulosity were identical and unusual, that of some novae in the early stages (Nova Aurigae 1892, and also a later one can now be added in Nova Herculis 1934). He reports the spectrum had retained this characteristic up to the time of his last observation in 1939.

It is expected that a memoir on NGC 2261, illustrated with an extensive series of 42-inch reflector photographs, will be published before long. It is thought that a series of images on films, showing more detail in the structure of the nebulosity, should be useful for students and investigators occupied with this object.

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McDonald, Jean K. The spectroscopic binary HD 193611.

The star HD 193611, magnitude 9.2, type B0.5, was discovered to be a binary by Dr. J. A. Pearce from a spectrogram obtained on September 29, 1947. To date, radial velocity measures of 31 spectrograms appear to be satisfied almost equally well by either of two periods: 1.1814 days and 2.8815 days. The brighter component being determined by line intensity measures, the distribution of its velocities appears to favor the longer period, as do the radial velocity measures of the most recent plates obtained on June 4, 1948.

Orbital elements determined on the basis of the longer period are as follows:

$$\begin{array}{ll} P = 2.8815 \text{ days} & m_1 \sin^3 i = 14.2 \odot \\ T = \text{JD } 2432458.777 \pm 0.878 & m_2 \sin^3 i = 14.4 \odot \\ e = 0.006 \pm 0.010 & A \sin i = 18.1 \times 10^6 \text{ km.} \end{array}$$

$$\begin{array}{l} \omega = 195^\circ \pm 110^\circ \\ V_0 = -11.1 \text{ km./sec.} \pm 1.7 \\ K_1 = 230.2 \text{ km./sec.} \pm 3.2 \\ K_2 = 226.9 \text{ km./sec.} \pm 3.2 \end{array}$$

The distance of the system, deduced from the measured intensity of the K line is 1500 parsecs. From considerations of the absolute magnitudes and projected masses, the orbital inclination is predicted to be $i = 77^\circ$, and a small partial eclipse is definitely indicated. It is hoped that the star will be observed photometrically so that the absolute dimensions of this important system of large mass may be determined.

Dominion Astrophysical Observatory,
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McLaughlin, Dean B. The emission band structures of Nova Persei 1901 and Nova Geminorum 1912.

Abridged tabulations of velocities of maxima, minima, and edges of bands are given in Tables I and II.

Nova Persei (maximum, 1901, Feb. 23). The bands appeared less than a day after maximum. Increase of displacement of red edge p for two days is attributed to decreasing occultation by the star. The most prominent structures, maximum c and minimum d, were present Feb. 25. Most others appeared within two or three days and continued with only slight changes of position into the nebular stage. All were still present 18 months after maximum. In 1933-1937, maximum c was localized in the brightest part of the nebula.

Nova Geminorum (maximum, 1912, Mar. 14). An outer emission wing, edges a and y, shrank inward and joined the main band during the first week. Its interpretation is uncertain, but a second eruption, retarded either by gravitation or by collision with the principal shell, is suggested. The main band appeared a day after maximum light, and its edges, d and w, remained nearly fixed. The structure pattern required several days to become stable. Thereafter, during 10 months, only moderate changes of position occurred. Although more than one burst is a possibility, the principal shell was fully developed within four days after maximum. The maxima f and u were very strong in the nebular stage.

The minima in the bands of both novae were equally strong in hydrogen and nebular lines, and were therefore true emission minima, not absorption lines.

The author gratefully acknowledges use of spectra from Allegheny, Harvard, Lick, Lowell, Mount Wilson, Solar Physics (Cambridge), South Kensington and Yerkes Observatories.

TABLE I. EMISSION STRUCTURE OF NOVA PERSEI.
VELOCITIES IN KM/SEC

Feature	Feb. 24	25	26-28	Mar. 2-18	Mar.- Apr.	July- Oct.
a, vio. edge					-1736	
b, vio. edge	- 698	- 982	- 929	- 906	-1148*	-1064
c, maximum	- 495	- 695	- 704	- 686	- 648	- 645
d, minimum		- 304	- 336	- 370	- 380	- 356
e, maximum					- 50	- 91
f, minimum			+ 28	+ 98	+ 100	+ 72
g, maximum				+ 390	+ 404	
h, red edge	+ 416	+ 366	+ 368			
i, minimum			+ 480	+ 460	+ 467	+ 492
n, minimum			+ 613	+ 668	+ 752	+ 802
o, maximum			+1020	+ 971	+ 920	
p, red edge	+1070	+1242	+1303	+1232	+1242	+1130
q, red edge					+1720	

* Increased shift due to fading of bordering absorption.

TABLE II. EMISSION STRUCTURE OF NOVA
GEMINORUM. VELOCITIES IN KM/SEC

Feature	Mar. 15	16-17	18-19	20-23	27-3	Apr. 4-10	Aug.- Jan.
a, vio. edge		-1242	-1044				
c, maximum		- 940	- 997				
d, vio. edge†	- 529	- 753	- 722	- 731	- 733	- 755	- 750
f, maximum		- 601	- 458	- 358	- 316	- 387	- 453
h, minimum		- 250		- 216	- 212	- 234	- 268
i, maximum		- 239:					- 121
l, maximum	- 18	+ 14	- 70	- 18	- 14	- 9	+108
n, minimum		+160	+ 158		+135	+175	+223
q, minimum	+ 333	+ 338		+280	+325	+314	+398
r, maximum			+ 383		+441	+419	**
s, minimum		+ 412	+ 450	+448	+548	+561	**
u, maximum	+ 678	+ 732	+ 706	+693	+685	+703	+643
w, red edge†	+ 841	+ 884	+ 868	+883	+921	+921	+890
x, maximum	+1124	+1140					
y, red edge	+1310	+1283	+1164	+998			

† March 13-17, edges of central part of band at -316 and +270.

** Maxima r and u merged.

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McMath, R. R., O. C. Mohler, and L. Goldberg.

Recent developments in infra-red solar spectroscopy.

Since the late fall of 1947, the McGregor tower of the McMath-Hulbert Observatory has been used for study of the infra-red solar spectrum beyond the photographic limit. A specially designed, all-mirror optical system and Pfund-type grating spectrometer, with monochromator, have been used in conjunction with a Cashman lead-sulphide cell to obtain direct-intensity tracings of the solar spectrum over the entire region between 8000 and 25000 Å. The spectrum is recorded on a scale of about five millimeters per angstrom. In the 15000 Å region, lines with separation of 0.3 angstroms are just resolved.

Water vapor absorption almost completely obliterates the spectrum in the regions 1.3-1.5 microns and 1.75-1.95 microns. The intervening portions of the spectrum, however, are relatively

clear and contain a wealth of solar atomic lines, as well as telluric molecular lines and bands. Progress in identification has been slow, largely because of the complete absence of high-resolution laboratory studies in this region of the infra-red spectrum. Approximately 200 solar atomic lines have been identified in the infra-red spectrum on the basis of wave lengths computed from known atomic energy levels. The elements for which lines have been found include *Fe*, *Si*, *Na*, *Mg*, *Al*, *C*, *Ca*, as well as the third and seventh members of the Brackett series of hydrogen. The vast majority of these lines have excitation potentials higher than five volts.

Band systems of molecules originating in the earth's atmosphere constitute some of the most interesting features of the infra-red spectrum. Among these are four *CO*₂ bands in the 1.6 micron region, which have been resolved for the first time, and three strong bands of *CO*₂ at 2.1 microns. Among the identified molecular bands, those of ammonia and methane are particularly noteworthy. The evidence for ammonia as a constituent of the earth's atmosphere is very strong, while the evidence for methane is conclusive.

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Mayall, N. U. Inclinations of spectrum lines in spirals.

The investigation is a preliminary report on nebular rotations as indicated by inclined spectrum lines shown on 30 spectrograms of low dispersion (300 Å/mm at H and K). Since in all cases the lines appear to be sensibly straight, the inclined lines were measured as a whole. Inclinations ranged from 5°.4 to 0°.2, probable errors from ±0°.5 to ±0°.03, with an inclination of 0°.1 as the limit of detection. Periods of rotation and absolute magnitudes were computed from distance estimates deduced mainly from red shifts and groups including spirals resolved into their brightest stars. The results do not indicate any correlation of period of rotation with absolute magnitude, but there is some suggestion that, for normal spirals, the periods lengthen with advancing nebular type. Incomplete data for a few early types, So, Sa, and one E7 yield periods of 1.5 to 11 million years, with no distinction between nuclear regions and main bodies. The nuclear regions of Sb spirals appear to rotate in periods ranging from 5 to 16 million years. In the