II. "The Specific Volumes of Oxygen and Nitrogen Vapour at the Boiling Point of Oxygen." By Professor J. Dewar, F.R.S.

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"The Chemical Origins of the Lines in Nova Persei."

By Sir Norman Lockyer, K.C.B., F.R.S.

Received December 23, 1901,—Read January 30, 1902.

In the first two papers* which I communicated to the Royal Society on the observations of Nova Persei at Kensington, a general description of the spectrum in its earliest stages was given, and also a statement as to the probable origins of some of the strongest lines, depending upon a comparison of the Nova Spectrum with those of α Cygni, α Canis Majoris, γ Orionis, &c.

A table showing the results of the detailed reduction and discussion of the bright lines in the best spectrum typical of the Nova in this early stage (that obtained with the 6-inch objective prism on February 25, when the star was nearly as bright as Capella), was undertaken later for inclusion in a general summary of the observations in course of preparation.

As various conclusions as to the chemical origin of some of the Nova lines have recently been published which differ widely from those arrived at from a careful study of the Kensington photographs, I think it desirable to publish the above-mentioned table at once. A detailed statement of the evidence on which these conclusions as to origin are based, will follow in the general summary before referred to.

That many of the stronger lines in the early spectra of Nova Aurigæ were chromospheric, has been pointed out by several observers, and all agree that there is little difference in the general aspect of the spectrum of Nova Aurigæ and that of Nova Persei at a corresponding stage of development. In confirmation of this it may be said that by means of direct comparison of the various Kensington photographs, the identity of most of the strong bright Nova bands with lines of α Cygni and the chromosphere—already known to be due to enhanced lines of certain metals—has been established.

With regard to the stellar relations of the Nova, I may state that in my note of February 28,† the agreement in position of its lines with

* 'Roy. Soc. Proc.,' vol. 68, p. 119 and p. 142.

† 'Roy. Soc. Proc.,' vol. 68, p. 121.

Comparison Table of Bright Lines in the Spectra of Nova Persei and Nova Aurigæ with α Cygni Lines, Chromospheric Lines, and the Enhanced Lines of some of the Metals.

Nova Persei (Kensington).		Nova Aurigæ.		α Cygni.	Chromosphere (1898 Eclipse).	Enhanced lines.		Remarks.
λ of middle of line.	Description of line.	Campbell.	Vogel.			λ.	Substance.	
3836	Very broad, weak	—	3835	—	3835·6	—	—	Hη.
3889	Very broad. ? Narrow reversal in centre	—	3889	3889·1	3889·1	—	—	Hζ.
3934	Broad, rather weak. Fine narrow reversal in centre	—	3934	3933·8	3933·83	3933·83	*p*Ca	K(Ca).
3969	Very broad and fairly strong; shows fine narrow reversal in position of H (Ca) and possibly another weaker one in position of Hε	—	3969	3968·6 3970·2	3968·63 3970·25	3968·63	*p*Ca	H(Ca) + Hε.
3982 4003 4019	All these are very weak diffuse lines which can just be seen with the unaided eye, but which will not bear any magnification, and their wave-lengths can only be roughly determined	—	—	4002·7	—	4002·77	*p*Fe	
4029		—	—	4028·5	4028·5	4028·50	*p*Ti	
4067		—	4067	4067·3	4067·3	4067·30	*p*Ni	Strongest enhanced line of Ni.
		4082	—	4077·9	4077·9	4077·88	*p*Sr	
4102	Broad and strong	4095 4102 4108	4102	4101·8	4101·9	—	—	Hδ.

Comparison Table—*continued.*

Nova Persei (Kensington).		Nova Aurigæ.		α Cygni.	Chromosphere (1898 Eclipse).	Enhanced lines.		Remarks.
λ of middle of line.	Description of line.	Campbell.	Vogel.			λ.	Substance.	
4128	Very broad and merging into Hδ	4126	4125	4128·1 4131·1	— —	4128·1 4131·1	*p*Si *p*Si	
		4166	4158	4163·8	4163·8	4163·82	*p*Ti	
4175	Broad and fairly strong.....	4180 4209	4176	4173·5 4179·0	4173·5 4179·0	4173·52 4178·95	*p*Fe *p*Fe	Mean λ of enhanced double = 4176·23.
4232	Broad, but not very strong	4227 4236	4230	4233·3	4233·3	4233·25	*p*Fe	
4247	Comparatively narrow, but merging into the broader 4232 line, slightly stronger than the latter	4246	—	4247·2	4247·0	4247·00	*p*Sc	Strongest spark line of Sc.
4262	Narrow, but fairly strong	4267	4262	4262·2	—	4262·15	*p*Cr	
			4288	4290·4	4290·2	4290·38	*p*Ti	
4300	Broad line, fairly strong.....	4296	—	4296·7 4300·2 4303·3	4296·7 4300·2 4303·0	4296·65 4300·21 4303·34	*p*Fe *p*Ti *p*Fe	Mean λ of enhanced Fe double = 4300.
4314	Comparatively narrow, merging into 4300	4316	4315	4315·1	4314·0 4315·1	4315·14	*p*Ti	Possibly due to Sc 4314·25, one of the strongest spark lines.
4341	Broad and very strong. Doubtful reversal in centre	4331·3 4340·6 4347·8	4341	4340·7	4340·7	—	—	Hγ.
		4355	—	—	4355			
		4375	—	4374·9	4374·9	4374·90	*p*Ti	
		4385	4383	4385·5	4385·5	4385·55	*p*Fe	

4392	Fairly broad, rather weak.							
4411	Broad and moderately strong ...	—	—	4411·2	4411·2	4411·20	*p*Ti	
		4419	4417	4417·0 4417·9	4417·9	4417·88	*p*Ti	
4425	Weak and rather narrow.							
4434	— —	4436	4435	4434·4	4435·5			
4444	Fairly broad, but weak	4445	4445	4444·0	4444·0	4443·98	*p*Ti	
4454	Rather narrow, weak.							
4470	,, ,, and weak	4471	4473	4468·7	4468·7	4468·66	*p*Ti	
4481	,, ,, fairly strong.....	4481	4480	4481·3		4481·30	*p*Mg	Strongest enhanced line of Mg.
4493	,, ,, ,, ,, ...	4490	4495	4489·0 4491·6	4489·3 4491·6	4489·35 4491·57	*p*Fe *p*Fe	
4509	,, ,, ,, ,, ...	4502	4507	4501·5	4501·5	4501·45	*p*Ti	
				4508·5	4508·5	4508·46	*p*Fe	
				4515·5	4515·5	4515·51	*p*Fe	
4519	,, ,, ,, ,, ...	to	4520	4520·4	4520·4	4520·40	*p*Fe	
				4522·7	4522·7	4522·69	*p*Fe	
4535	,, ,, weak.....	4534	4530	4534·1	4534·1	4534·14	*p*Ti	
4548	,, ,, moderately strong	4549	—	4549·8	4549·7	4549·64 4549·81	*p*Fe *p*Ti	
		4554	4557	4556·1	4556·1	4556·10	*p*Fe	
		4559		4558·8	4558·8	4558·83	*p*Cr	
		4564	—	4563·9	4563·9	4563·94	*p*Ti	
4568	,, ,, ,, ,,	4570	—	4572·2	4572·2	4572·16	*p*Ti	
		4576	—	4576·5	4576·5	4576·51	*p*Fe	
4583	,, ,, but fairly strong.	4586	4583	4584·0	4584·0	4584·02	*p*Fe	
4628	Broad and fairly strong	4630	4628	4629·6	4629·5	4629·50	*p*Fe	
4670	,, rather weak	4669						
4705	,, weak	4707	—	—	4707·8			
		4737	—	—	4737·0			
		4774						
*4822	Fairly broad, weak	—	—	4824·3	4824·3	4824·33	*p*Cr	Strongest enhanced line of Cr.
4862	Very broad and strong.....	4851·2 4861·6 4869·9	4862	4861·5	—	—	—	Hβ.

Comparison Table—*continued.*

Nova Persei (Kensington).		Nova Aurigæ.		α Cygni.	Chromosphere (1898 Eclipse).	Enhanced lines.		Remarks.
λ of middle of line.	Description of line.	Campbell.	Vogel.			λ.	Substance.	
4924	Broad and strong.....	4913 4923 4929	4923 4925	4924·1	4924·1	4924·11	*p*Fe	
5019	„ „	4969 5007 5018	5016	5018·6	5018·6	5018·63	*p*Fe	
5169	Broad and very strong	5095 5142 5159 5169 5176 5200	5167	5169·1	5169·1	5169·07 5169·22	*p*Fe	Certainly not the *b*-group of magnesium.
*5224	Narrow and weak.	5234	523	—	5234·8			
*5273	„ „	5276 5285	528	—	5275·1 to 5276·2	5276·17	*p*Fe	
5316	Moderately broad and strong....	5318 5329 5379	5317	5316·8	5316·8	5316·79	*p*Fe	
*5420	Weak and rather narrow.	5454						
*5475	Weak and narrow.							
*5530	Fairly strong and broad.....	5535	—	—	5527·6	5527·03	*p*Sc	By far the strongest spark line of Sc in the visual region.

*5575	„	„	„	.....	5575 5584 5630						
*5686	„	„	„	.....	5685 5761 5841 5885						
*5893	„	„	„	.....	5896	5686†	—	5890·2 5896·2	—	—	D(Na).

† As given by Vogel (probably 5886).

Note.—The lines marked * cannot be seen in the photographs taken with the 6-inch prismatic camera, and their positions have been reduced from the spectrum photographed with the 30-inch reflector with a two-prism slit spectroscope.

those of α Cygni was pointed out. Later, Mr. McClean* confirmed this, and further stated that the bright lines of η Argus corresponded with the dark lines of the Nova; while later still, Sir David Gill† has shown the similarity between the spectra of η Argus and Nova Aurigæ. Hence we are led to the conclusion that the temperatures reached in the outbursts of both these Novæ were not greatly different from those of the stars named, and that in η Argus there are constant conditions which are similar to those temporary conditions which produce the appearance of Novæ.

In the table the lines of Nova Persei are compared with those recorded by Campbell‡ and Vogel§ in Nova Aurigæ.

The probably corresponding lines of α Cygni, chromospheric lines, and enhanced lines, are also given in separate columns.

The reduction to wave-lengths and discussion of the lines in relation to those of other celestial and terrestrial spectra, has been undertaken by Mr. F. E. Baxandall, to whom my best thanks are due.

"The Specific Volumes of Oxygen and Nitrogen Vapour at the Boiling-point of Oxygen." By JAMES DEWAR, M.A., D.Sc., LL.D., F.R.S. Received January 21,—Read January 30, 1902.

In my paper on "The Boiling-point of Liquid Hydrogen determined by Hydrogen and Helium Gas Thermometers"‖ it was pointed out that a constant-volume gas-thermometer filled with oxygen gas, having a pressure at 0° C. of about 800 mm., gave a very accurate value of the boiling-point of liquid oxygen. As it seemed advisable to confirm this result indirectly, an attempt was made to determine the vapour density of oxygen at its boiling-point by direct weighing, the intention being, if the experimental results proved at all encouraging, to repeat the work on a larger scale and with greater precautions. As at present there is no likelihood of my being able to undertake the more accurate determinations, the results of the preliminary enquiry are presented to the Society. They give in any case, with considerable accuracy, the Specific Volumes which have never been directly determined.

In order to obviate any question of the buoyancy of the air, two flasks A and B of as nearly as possible the same air displacement were counterpoised on an Œrtling balance. The B flask remained per-

* 'M.N., R.A.S.,' vol. 61, p. 387.
† 'Roy. Soc. Proc.,' vol. 68, p. 457.
‡ 'Ast. and Ast. Phys.,' vol. 11, p. 808.
§ 'Ast. and Ast. Phys.,' vol. 12, p. 912.
‖ 'Roy. Soc. Proc.,' vol. 68, 1901.