

Using an E.M.F. of 100 volts, the following values of the current were obtained ( $1 = 10^{-5}$  ampere) :—

Temperature .....	300°	400°	500°	600°	700°	800°
Current .....	0·2	1·9	5·1	5·4	5·5	5·5
Temperature .....	900°	1000°	1100°	1200°	1300°	
Current .....	5·5	5·3	6·8	8·2	9·2	

Thus the current has a maximum value near 900° C., and rises very rapidly near 1150°. Similar results were obtained with other salts.

The energy required to ionize 1 gramme molecular weight of KI at about 300° C. was estimated to be 15,000 calories in the same way as was done for air.

The maximum current carried by the salt vapour (at 1300° with 800 volts) was found to be nearly equal to that required to electrolyse the same amount of salt in a solution.

This fact must be regarded as considerable evidence in favour of the view that the ions are of the same nature in the two cases.

“Further Observations on Nova Persei, No. 2.” By Sir NORMAN LOCKYER, K.C.B., F.R.S. Received and Read March 28, 1901.

In continuation of two previous papers, I now bring the observations of the Nova made at Kensington to midnight of March 25. Since the last paper\* of March 7th, estimates of the magnitude of the Nova have been made on ten evenings, visual observations of the spectrum on eight evenings, and photographs of the spectrum on four evenings up to the evening of the 25th.

In consequence of the greater faintness of the Nova, the 6-inch prismatic camera has not been utilised, but the 10-inch refractor to which it is attached has been used for eye observations of the spectrum with a McClean spectroscope.

With the 30-inch reflector four photographs have been secured on the evenings of the 6th, 10th, 24th, and 25th by Dr. Lockyer, and with the 9-inch prismatic reflector seven photographs on the nights of 10th, 21st, and 25th by Messrs. Butler and Hodgson.

#### *Change of Brightness.*

Since March 5th the magnitude of the star has been gradually decreasing, but between the nights of the 24th and 25th the light of

\* *Supra*, p. 142.

the Nova decreased very suddenly, dropping from 4.2 to 5.5 in twenty-four hours, and becoming only just visible as a naked-eye star.

The following gives a summary of the eye estimates made by (1) Dr. Lockyer, (2) Mr. Fowler, and (3) Mr. Butler:—

	(1.)	(2.)	(3.)
March 5.....	2.7	2.7	—
6.....	2.9	—	—
9.....	—	3.5	3.5
10.....	3.7	—	—
11.....	—	—	< 4.0
12.....	—	3.8	—
21.....	—	4.0	4.2
22.....	—	—	—
23.....	4.2	4.2	4.5
24.....	4.2	4.2	4.5
25.....	5.5	5.5	5.5

#### *Colour.*

The colour of the Nova has undergone some distinct changes since the observation on March 5th last, when it was shining with a clarety-red hue. On the 9th and 10th it was observed to be much redder, due probably to the great development of the red C line of hydrogen.

On the 23rd and 24th, the star was noted as yellowish-red, while on the 25th (after the sudden drop in magnitude) it was very red, with, perhaps, a yellow tinge.

#### *The Visual Spectrum.*

Since March 5th the spectrum from C to F has become very much fainter, the bright lines of hydrogen being relatively more prominent than they were before; indeed, C and F throughout this period have been the most conspicuous lines, especially the former, while the bright lines  $\lambda\lambda$  5169, 5018, and 4924, and the line in the yellow near D, were the most prominent of the others.

All these lines have been gradually becoming weaker, but there is an indication that  $\lambda$  5018\* has been brightening relatively to  $\lambda$  5169.

Accompanying the great diminution in the light of the Nova observed on the evening of the 25th, the spectrum was found to have undergone a great change: the continuous spectrum had practically disappeared, and a line near D (probably helium,  $D_3$ ) became more distinct. The other lines were hardly visible.

\* The line near this wave-length in later observations is probably the chief nebular line 5007, which accounts for the apparent brightening of 5018.

*The Photographic Spectrum.*

On March 6th the photographs were very similar to those obtained in the earlier stages, the only apparent difference being in the relative intensity of the bright hydrogen lines as opposed to those having other origins, most of which have been shown to be probably due to iron and calcium. The hydrogen lines have sensibly brightened, while the others have become much feebler.

The photograph of March 10th shows a further dimming of the bright lines other than those of hydrogen.

On March 25th, when the next good photograph was taken, the spectrum had undergone great modifications. The hydrogen lines are still very bright, though they do not show the structure which they did in the photographs taken between February 25th and March 10th. The bright lines other than those of hydrogen, which are seen in the earlier photographs, have now disappeared, and other lines become visible. The continuous spectrum has also greatly diminished.

Approximate determinations of the wave-length of these new lines have been made by Mr. Baxandall by comparison with lines of known wave-length in the spectra of  $\alpha$  and  $\epsilon$  Persei photographed with the same instrument. They are as follows :—

- | $\lambda$ |   |
|-----------|---|
| 3870.     | Broad, and merging into $H\zeta$ (3889).  |
| 4367.     | Weak.   |
| 4472.     | Not very strong. Probably helium ( $\lambda$ 4471.6).   |
| 4565.     | Weak.   |
| 4650.     | Very strong broad line. Possibly the 465 line of the bright-line stars and the belt stars of Orion.           |
| 4690.     | Moderately strong. Possibly new hydrogen ( $\lambda$ 4687.88) seen in bright-line stars and some Orion stars. |
| 471.      | Weak. Probably helium ( $\lambda$ 4713).  |

The hydrogen lines in the spectra are  $H\zeta$ ,  $H\epsilon$ ,  $H\delta$ ,  $H\gamma$ , and  $H\beta$ .

The lines at  $\lambda$  3870 and 4650 are perhaps identical with those observed by von Gothard\* in the spectrum of Nova Aurigæ after it had become nebular, but associated with these lines in his record is the chief nebular line at 5007, no trace of which is yet visible in the photographs of the spectrum of Nova Persei. On the other hand,  $H\beta$ , which is the brightest line in the present spectrum of Nova Persei, does not appear at all in von Gothard's spectrum of Nova Aurigæ.

*Characteristics of the Hydrogen Lines.*

In my former paper I referred to the structure of the broad bright lines of hydrogen. A more detailed examination of the lines as photo-

\* 'Ast.-Phys. Jour.,' vol. 12, 1893, p. 51.

graphed on several evenings shows that this structure has been undergoing changes.

The annexed figure (fig. 1) gives light curves showing the variation

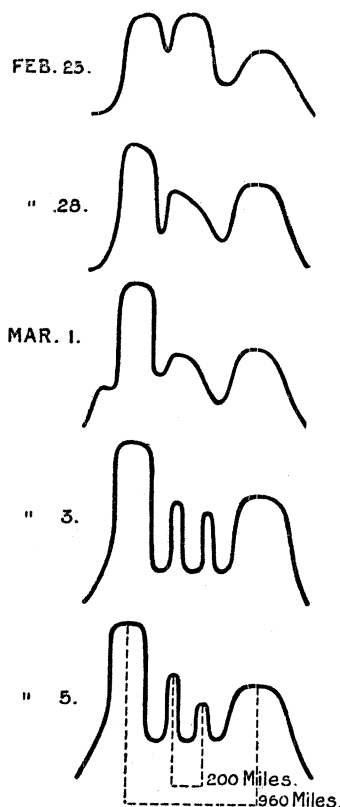


FIG. 1.—Light curve of  $H\beta$  (6-inch objective prism).

in the loci of intensity of the line  $H\beta$ , as photographed with the 6-inch prismatic camera. These curves were plotted by Messrs. Baxandall and Shaw independently of each other, and I have satisfied myself of their accuracy. It will be seen that on February 25th there were three points of maximum luminosity, the two maxima on the blue side being of equal intensity, and greater than the third on the red side. By March 1 the centre one had been greatly reduced in intensity, and on the 3rd it had been broken up into two portions, thus making four distinct maxima.

Rough measures made on the relative positions of these points of maxima show that the difference of velocity indicated between the two external maxima is nearly 1,000 miles per second, while that between

the two inner maxima is 200 per second. We thus have indications of possible rotations or spiral movements of two distinct sets of particles travelling with velocities of 500 and 100 miles per second.

A similar examination of the F and G lines of hydrogen in the photographs obtained with the 30-inch reflector has also been made by Dr. Lockyer, and the light curves for the G line are here illustrated (fig. 2). In this longer series the most important point comes out that

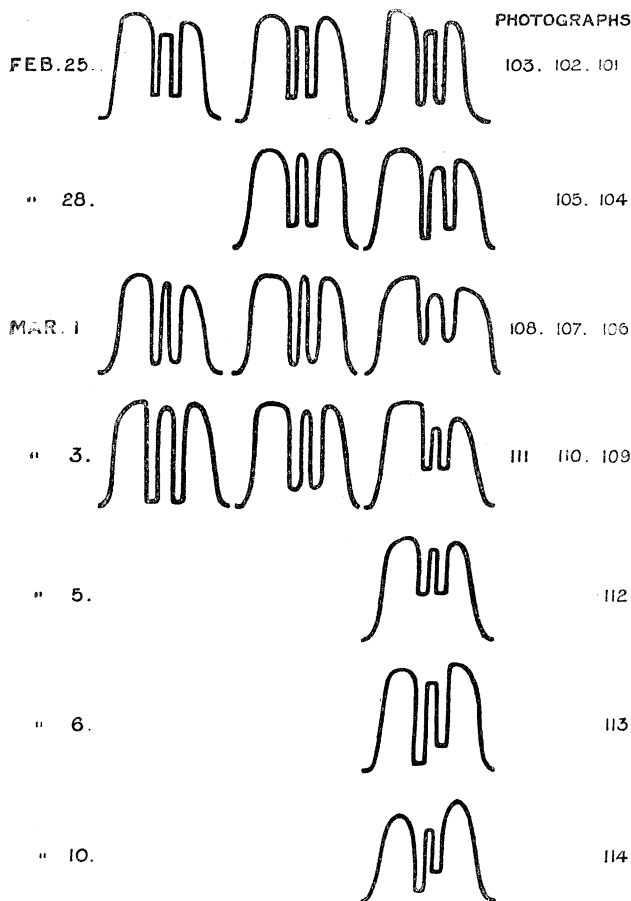


FIG. 2.—Light curve of H $\gamma$  (30-inch reflector).

the maximum intensity changes from the more to the less refrangible side of the bright hydrogen line.

The small dispersion given by the 30-inch prevents some of the details recorded by Messrs. Baxandall and Shaw from being seen.

So far as the observations have gone, they strongly support, in my

opinion, the view I put forward in 1877 that "new stars" are produced by the clash of meteor-swarms; and they have suggested some further tests of its validity.

We may hope since observations were made at Harvard and Potsdam very near the epoch of maximum brilliancy, that a subsequent complete discussion of the results obtained will very largely increase our knowledge. The interesting question arises whether we may not regard the changes in spectrum as indicating that the very violent intrusion of the denser swarm has been followed by its dissipation, and that its passage has produced movements in the sparser swarm which may eventuate in a subsequent condensation.

My best thanks are due to those I have named for assistance in this inquiry.

"Elastic Solids at Rest or in Motion in a Liquid." By C. CHREE, Sc.D., LL.D., F.R.S. Received November 19,—Read December 13, 1900.

§ 1. The problems dealt with in the present paper are probably of little practical importance; but they seem of considerable interest from the standpoint of dynamical theory. The hard and fast line which it is customary to draw between Rigid Dynamics and Elastic Solids has been discarded, and a more direct insight is thus obtained into the modes of transmission of force in solids.

Let us consider a solid of any homogeneous elastic material, possessed only of such symmetry of shape as will ensure that if it falls under gravity in a liquid, each element will move vertically. Take the origin of rectangular Cartesian co-ordinates at the centre of gravity, the axes of  $x$  and  $y$  being horizontal, and the axis of  $z$  being drawn vertically downwards. At time  $t$  let  $\xi$  be the depth of the C.G. below a horizontal plane in the liquid, the pressure on which is uniform and equal to  $\Pi$ . The existence of gaseous pressure on the liquid surface would only contribute to  $\Pi$  without modifying the general conditions of the problem.

Consider first the elementary hydrostatical theory, according to which the liquid pressure at any point  $x, y, z$  on the surface of the solid acts along the normal, and is equal to

$$\Pi + g\rho'(\xi + z),$$

where  $\rho'$  is the density of the liquid, supposed uniform.

If the solid fall or rise very slowly, and the viscosity of the liquid is very small, the results based on the hydrostatical theory ought to give a close approximation to the truth.