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JOHN MICHELS, Editor.

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OBSERVATIONS UPON THE COMET AT PRINCETON.

The comet has been seen and observed every night since June 25, except on June 30th. Every night, however, except July 2d and 3d, the observations have been interfered with by clouds, so that very little continuous thoroughly satisfactory work has been possible.

The light has fallen off rapidly. On the 26th, the comet was for half an hour better seen than at any other time, and the nucleus was judged to be just about equal to Arcturus in brilliancy. On July 2d, it was compared pretty carefully with the Pole Star and with α Urs. Majoris by *squinting*, so that the blurred images of star and comet were brought close alongside. I judged it just equal to Polaris and about $\frac{1}{4}$ to $\frac{1}{3}$ of a magnitude fainter than Dubhe.

The nucleus and coma have presented a very interesting series of telescopic phenomena, in the main such as have been seen in all other large comets. It is noteworthy, however, that immediately behind the nucleus no strongly marked dark shadow-like stripe has been developed, nor, what is perhaps just as common on the contrary, any bright central streamer. On the whole, the central portion of the tail has been a little less brilliant than the edges, even close to the head, but the difference has been slight. On the 25th, the nucleus about 10 P. M. showed 5 projecting jets, much like the pseudopodia of some low animal organism—not well formed, nor distinct, nor symmetrical,—their length from two to six times the diameter of the nucleus, those on the front of the nucleus being the longer.

On the 26th, the nucleus was almost entirely surrounded with a nearly complete, well defined, circular envelope about 1′ in diameter. In this envelope was a curious oval vacuole, behind the nucleus, but on the preceding side of the axis of the tail.

On subsequent evenings no envelopes nearly so complete were noted—only jets of varying length and position, those on the side of the sun being apparently blown back, like flowing hair, by some solar repulsion.

On the 29th there was but one jet on the sunward side, and this was curiously curved toward the preceding side, making the whole look like a comma. (We use preceding rather than Western, because below the the pole where the comet was, the terms Eastern and Western might lead to misapprehension.)

On July 1st the head was curiously unsymmetrical. The coma was extended out in the South following direction like a great liberty cap, the axis of the principal jet which divided both ways, in front like hair parted in the middle, being inclined some 50° to the line of this extension.

With the spectroscope a number of observations have been made.

The nucleus has generally given a simply continuous spectrum, extending from below C well above G; but on June 25th and July 1st, it showed distinct banding at points where the bands of the spectrum of the coma crossed it.

This was seen by several observers on the 25th, and by both Mr. McNeill and myself on the 1st.

The spectra of some of the brighter jets had been caught and isolated several times. They were in all cases continuous, without detectable bands of any kind.

The spectrum of the tail was found to be continuous, with a faint superposed band-spectrum, the same as that of the coma. On July 1st and 2d this band-spectrum was distinctly traceable to at least 15′ distance from the head of the comet, the continuous spectrum perhaps 5′ or 10′ further.

The spectrum of the coma consisted of the usual three bands; but both the upper and lower bands, though pretty bright, were very ill defined; so much so, that I could obtain no satisfactory measurements of wave length, farther than to observe on June 25th and 26th, that the lower edges of the upper and lower bands of the so-called 'first' spectrum of Carbon, (λ, 5635 and 4740) given by a Bunsen burner, fell apparently near the lower limit of these two bands in the comet spectrum as seen with a one prism spectrum. But these comet-bands did not look at all like the flame bands, the difference of appearance being so great, as somewhat to shake my belief for the time being, in the identity of the two spectra.

The middle band, on the contrary, was perfectly defined at its lower edge, and with the one prism spectroscope distinctly showed three fine lines in the band, and these, so far as could be judged, coincided exactly

with the three lines in the middle band of the carbon spectrum.

This resolution into lines was seen by Professor Brackett, as well as by Mr. McNeill and myself, on June 29th; it was still evident on July 2d, but no longer on July 3d.

The coincidence with the middle band of the flame spectrum, has always appeared to be precise; but to obtain further evidence as to the exact position of the band a careful comparison was made on July 2 with the *b* lines of the magnesium spectrum, using the Grubb spectroscope with a dispersive power of *four* sixty-degree-dense flint prisms and a magnifying power of about 25. The slit was opened until the well defined upper edge of *b* just touched the lower edge of b_2. Then, the spark producing the magnesium spectrum being suppressed, the bright wire of the micrometer was set upon the lower edge of the comet band; finally, the spark being restored, the distance was measured from the edges of b_2. In this way twelve readings were obtained by Mr. McNeill and myself, all giving results ranging between 5160.0 and 5169.5, the mean being 5164.8 ± 0.7. I do not think the possible error can exceed 2 divisions, or three times the probable error. If so, the Comet spectrum cannot possibly be identified with the *second* Carbon spectrum, (the spark spectrum of a Geissler tube containing C O). Since the corresponding band of that spectrum has a wave-length of 5198.4. The wave-length of the band in the flame spectrum is 5165.3—both according to the figures of Dr. Marshall Watts, given in *Nature*, vol. 20, page 28.

As a further test, on July 3d, the suggestion of Dr Watts, made in the paper referred to, was followed out by confronting the comet-spectrum by means of an occulting bar, directly with Geissler tubes containing CO and CO_2, and with the Bunsen-burner flame. The bands on this night were more distinctly defined than on previous occasions, though the nucleus spectrum was less brilliant, and the result of the confrontal was very satisfactory and decisive. The upper and middle bands were found undoubtedly coincident, so far as the power used could show, with the flame spectrum, and *not* with the bands of the tube spectra. In the case of the lower band, the evidence was less conclusive, because the edge was ill defined and faint, making pointing difficult, and because bands of the flame and tube spectra are nearly coincident here. Still, even with this band, the evidence of about half a dozen pointings turned in the same direction.

On the whole, I consider it now absolutely certain, that the comet-spectrum is not the *second* spectrum of Carbon, whether it be the *first* or not. As to this latter point I do not feel quite sure, but the coincidences are certainly very remarkable and close, hough the peculiar appearance of the upper and lower bands when the comet was brightest requires explanation.

C. A. YOUNG.

PRINCETON, *July* 4, 1881

PRIMORDIAL COSMIC RINGS.

III.

BY EDGAR L. LARKIN.

The doctrine that a sphere of atoms, abandoned rings, or any other shaped masses can develop into planets is a physical error. It is impossible that the ball revolved. Face the south, hold the plane of the page of "SCIENCE" horizontally, call the paper the centre of the sphere, and it will be seen that to cause rotation force must be applied, if above the centre, from west to east; below, from east to west; to the right, from below, upward; and to the left, from above, downward. The gas was of excessive tenuity, and external force instead of causing rotary motion would displace the atoms in front of it. The mildest, or most violent force alike, would be unable to cause revolution in a globe of atoms of such extreme mobility. But there was no external force; energy is a property of matter, and the nearest matter was 20 trillions of miles away. If the sphere rotated the motion came from internal causes, none of which could have at that time existed. There were no vortices, currents, tides or whirlwinds in matter of such rarity; no force outside, and none within save the slowest possible radial descent. The sphere was at rest. No point in the experiment of M. Plateau had analogy to the generation of rings on the gaseous globe. He placed a globule of oil in a fluid having like specific gravity, passed a wire through it, and turned it as an axis until the sphere of oil partook of the rotation, flattened and detached a ring. The cosmical mass was of rare gas, and existed in a void, with no external power to turn it. If Plateau had suspended a ball of hydrogen in a vacuum, annihilated the attraction of the earth, and then made it revolve without applying force, the cases would be similar.

Neglecting the laws of Nature we will assume that the primitive sphere was in rotation. Admitting it, a demonstration will be made that if by unknown law it cast off a ring or any other form of mass, said portion could not have been abandoned anywhere in the vicinity of the orbit of Neptune.

First proposition:—If the sphere by rotary motion, or other mode of force cast off its equator, matter which condensing made Neptune, then that planet formed, and now moves on a line that coincided with the *Centre of Gravity* of the discarded mass, no matter what was its shape, size or density.

This statement we deem self-evident, incapable of argument, and an absolute truth.

Second proposition:—If the ring that contained the matter now existing in Neptune, was thrown off the equator of a sphere, a section of the ring perpendicular to its length would be either a circle, or a segment of a circle. That is, the ring would be either cylindrical, or flat inside and curved outside, the curvature being the arc of a great circle, a meridian bisecting the poles of the sphere. We can conceive of no form of mass capable of being detached from the circumference of a sphere. other than cylindric or segmental.

Third proposition:—If the Neptunian ring was not cast off when the mass was a sphere, it was abandoned after the ball had depressed at the poles, and elongated at the equator. And a perpendicular section of such detached protuberance would be some one of the Conic Sections.

Draw a chord of an arc from north to south any distance below the orbit of Neptune, so that it does not de-