June 16, 1892.

The LORD KELVIN, D.C.L., LL.D., President, in the Chair.

Lieut.-Col. Robert Young Armstrong, Professor John Ambrose Fleming, Dr. Robert Giffen, Professor William Abbott Herdman, Mr. John Joly, Dr. Joseph Larmor, Professor Louis C. Miall, and Dr. Augustus D. Waller were admitted into the Society.

A List of the Presents received was laid on the table, and thanks ordered for them.

The following Papers were read:—

I. "On a Multiple Induction Machine for producing High-Tension Electricity, and on some remarkable Results obtained with it." By the LORD ARMSTRONG, C.B., F.R.S. Received May 18, 1892.

[Publication deferred.]

II. "On certain Appearances of Beams of Light, seen as if emanating from Candle or Lamp Flames." By the late Professor JAMES THOMSON, F.R.S. Communicated by LORD KELVIN, P.R.S., with an Introductory Notice. Received June 10, 1892.

About the end of last January, when my brother was fully occupied in writing his paper on the Trade Winds for the Bakerian Lecture, he called my attention to the well-known beams or ladders of light seen below or above a lamp flame viewed with partially-closed eyelids, and he gave me verbally an explanation of the phenomenon which surprised me very much. By some simple and interesting trials with my own eyes, which he explained to me how to make, I was perfectly convinced that his explanation was correct; and believing it, as I still believe it, to be new, I urged him to write a short paper on the subject for the Royal Society, but not to let it interfere with his work for the Bakerian Lecture; and he undertook to do so as soon as might be after being freed from this work. We hoped, somewhat confidently, that he might be able to give the thus promised paper before the end of the present session of the Royal Society. That

hope has not been fulfilled, and I had offered to the Secretaries a communication describing my recollection of what my brother had told me, when his son found a memorandum of date 18th October, 1891, and a little book of notes of date 29th December, which tell the story better than I could have told it, and which, therefore, though not completed in proper form for publication, I now give in the unfinished form in which they have been found, with only a somewhat more clear drawing, and description of drawing, substituted for the rough sketch found in his note of date October 18, 1891.

Proposed probable Paper for the (?) Society, by J. T., "On the Nature and Origin of certain Appearances of Beams of Light as if emanating from Candle or Lamp Flames."

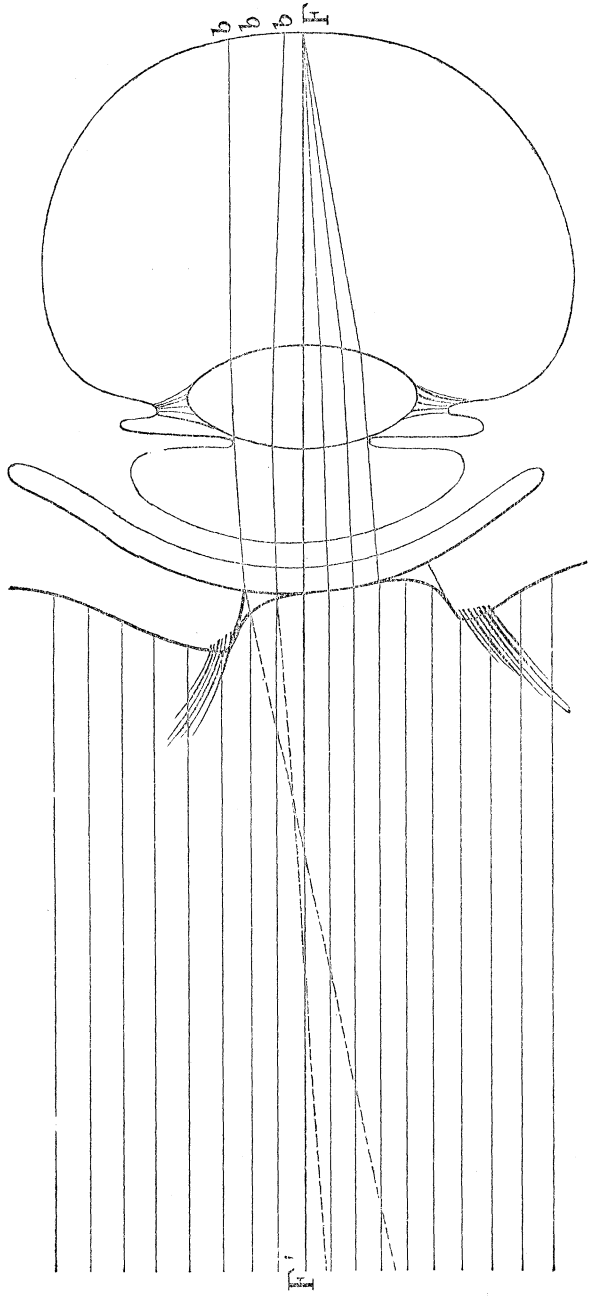
Description of the Drawing.

[The drawing represents a vertical section of the eye, eyelids, and watery prismoids,* through FF′, the axis of the eye. The large number of parallel lines outside represent rays of light coming from a flame several feet or yards away in the direction of F′, to the eyelids, the prismoids, and the undisturbed outer surface of the cornea between the prismoids. The lines within the eye below FF′ represent the convergence to F, the image of the flame, of those of the external rays from the flame which fall on the undisturbed portion of the surface of the cornea. The lines within the eye above FF′ represent rays disturbed by the prismoid of the upper eyelid which, incident on the retina at *bbb*, give the perception as if of light coming from without in the direction of the dotted lines outside the eye. It is this perception that constitutes the appearance of the downward beams or ladders of light, due to the prismoid of the upper eyelid. The rays disturbed by the prismoid of the lower eyelid, in the position represented in the diagram, are all stopped by the lower part of the iris.

Looking now at the diagram, we understand perfectly that if, with the eyeball and flame unchanged, the upper eyelid be gradually raised a little, the uppermost of the rays coming inwards from the prismoid will fall on the upper part of the iris and will be stopped by this screen. Thus, the length of *bbb* upwards from F is diminished, until all the beams from the prismoid are stopped by the iris, and the length of the apparent beams below the flame correspondingly diminishes to zero. When the upper eyelid is wide open the flame is seen without any appearance of the beams below it. We also understand readily from the diagram how, if the lower eyelid is lifted a little without any change in the position of the upper eyelid, beams both above and below the flame are seen. We also conclude that if,

* The refracting watery liquid in the entrant corner between lip of eyelid and cornea may be called the prismoid or liquid prismoid.

Rough Sketch (*imperfect*).



with the eyelids fixed relatively to the head, the head is moved while the eyeball remains with its axis in the direction of the flame, we see beams of light above the flame when the head is turned upwards, and beams of light below the flame when the head is turned downwards. Also that if the eyelids are partially closed, as in the diagram, beams will be seen both above and below the flame when the head carrying the eyelids with it, is turned slightly up from the position shown in the diagram. Also that if the eyelids be wide open, instead of half closed as shown in the diagram, no beams, either above or below the flame, will be seen when the two eyelids are equidistant, or nearly equidistant, above and below the middle of the pupil. When the head, with the eyelids, is turned downwards, so as to bring the upper eyelid across the aperture of the pupil, beams of light are seen below the flame; and when the head, with the eyelids, is turned upwards so as to bring the lower eyelid across the middle of the pupil, beams of light produced by the prismoid of the lower eyelid are seen above the flame.]

Notes on Quasi-Ray Beams of Light from Candles, or other small Luminous Spots.

Date of Note, 29th December, 1891.

I have noticed decidedly this morning to the following effect:—

In some cases (the nature of which I intend to note further on) I found that, when seeing a small gas flame with apparent descending tail (or quasi-beam of rays), I could, by lowering the upper eyelid, cut off vision of the flame, while leaving the tail visible; and, by still further lowering the upper eyelid, I could cut off the upper part of the tail, leaving the lower part, the part remote from the flame, quite visible as before. The contrast between lowering the upper eyelid and lowering a screen (a card, for instance) in front of the eye was very remarkable. In the lowering of the card or other screen, the tail vanishes before the flame is eclipsed; but in lowering the eyelid the flame is eclipsed first.

In some attitudes I could not bring out these phenomena. I did find them when awake in bed early in the morning, head on pillow and light coming down from a gas flame obliquely to the eye. Point to which eye was directed seemed to do best when taken at an altitude (angular) somewhat above the gas flame.

Afterwards, this same morning, I found I could see the phenomenon when standing upright and looking at image of gas in mirror. Ray from image ascending obliquely; eyesight directed above image in looking-glass.

Again, looking at a gas flame a little above the level of the eye, I stood erect and elevated my face, directing my eyesight to above the

gas; then lowered the upper eyelid and saw the downward tail remaining when the gas flame was eclipsed by the eyelid. The theory of all this is clear to me, and in agreement with what I have previously devised.—J. T.

Take notice that to get the phenomena above sketched out to show themselves, the edge of upper eyelid, where roots of eyelashes are situated, must not shadow the prismoid when the eyelid is lowered enough to cover the pupil from the direct rays of the candle or gas flame. After the candle is cut off from the pupil, the direct rays from the flame must still be reaching the prismoid. This, I think, tallies with the experimental conditions under which the tail was seen when the flame was eclipsed by eyelid.—J. T.

P.S.—Same day, 29th December. On a little further consideration I notice that the elevation of the face is of no importance. It is only the elevation of the line of special direction of the eyesight [axis of the eye] relatively to the line from flame to eye that is important.—J. T.

Notes on Quasi-Light Beams.

(For paper.)

Often I fail to see the apparently ascending beam above the candle or gas flame. But I find that by very nearly shutting the eye I can see the ascending beam going up very high and the descending one at same time. On bringing my open hand down from above as if to cut off the ascending beam I see the beam as if between my eye and my hand, and the flame begins to be eclipsed before the beam is cut off, or even diminished.

Note by the President of date June 16.

I had asked many friends well acquainted with optical subjects whether they knew of this explanation of the luminous beams, and all said no until yesterday evening, at the *soirée* of the Royal Society, when Professor Silvanus Thompson immediately answered by giving the explanation himself, and telling me that he had given it to his pupils in his lectures on optics, as an illustration of a concave cylindrical lens. He did not know of the explanation ever having been published otherwise than in his lectures. I have myself also looked in many standard books on optics, and could find no trace of intelligence on the subject. It seems quite probable, therefore, that, of all the millions of millions of men that have seen the phenomenon, none, within our three thousand years of scientific history, had ever thought of the true explanation except Professor Silvanus Thompson and my brother.