variance with Ameghino's. When he places the marine Cretaceous beds of the lower Rio Tarde section in the Neocomian, while Stanton declares them not older than Gault, and when he places the marine Patagonian beds in the Eocene, while I assign them to the Lower Miocene, he can do so only if he introduces new evidence, and shows that our determinations are incorrect. But he has not done this, and has never attempted to do it, and therefore his personal opinion on this question is without any scientific value.

Ameghino may claim that my final report on the Tertiary invertebrates had not come into his hands when he wrote the present paper. But he must have seen Stanton's report, as well as the preliminary notes by Hatcher and myself in the *American Journal of Science*. These should have induced him to wait for the publication of my final report.

Dr. A. E. Ortmann.

Princeton University,
September, 1902.

VELOCITY OF LIGHT IN AN ELECTROSTATIC FIELD.

To the Editor of Science: In a paper, 'Determination of the Electric and Magnetic Quantities,' *Phys. Rev.*, January, 1900, I pointed out that light should be accelerated in an electrostatic field. I have to announce that preliminary experiments made last year show that this is the case, though the velocity actually observed is only eighty per cent. of that predicted in the paper referred to.

The tests, however, were rough and can be made more accurately with improved apparatus. I am desirous of repeating them, and obtaining a closer result. I would be glad to know of any one who has worked on interference phenomena who would be willing to collaborate with me, I of course bearing all expense.

In a recent note to the Toronto Astronomical Society, I refer to a paper to be published in Science, in which I show that by a development of the vortex theory described in the above-mentioned paper, the difference between positive and negative electricity is explained. By some mishap this paper was lost in the mails, about last December, and merely the letter forwarded with it reached the editor. I hope to rewrite it, but at present would say that I found that the difference is merely one of circulation, *i. e.*, that the simple vortex singularity must be taken as the negative electron, and that when a number of the vortex singularities are so grouped that their circulation is closed, they behave as positive electrons. Hence the positive electron is simply an agglomeration of negative electrons, so grouped as to have a closed circulation.

Reginald A. Fessenden.

## *SHORTER ARTICLES.*

### THE FORMATION OF DEWBOWS.

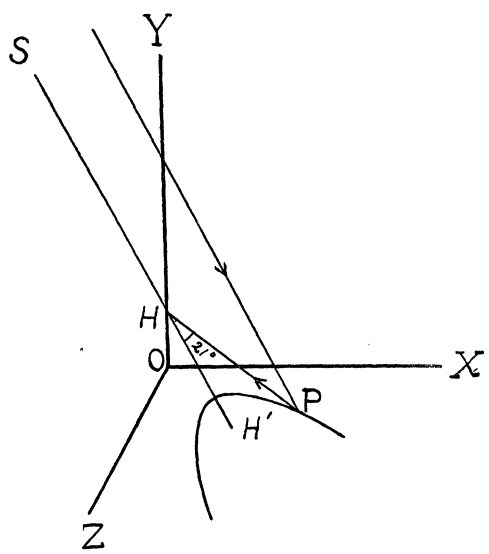
If an observer standing on a mountain top should view below him, under suitable conditions, a horizontal stratum of falling raindrops on which the sun was shining, he would see a rainbow. This bow would appear as a true circle, or a segment of it, depending upon the area of the stratum and the position of the sun. If, however, he could view this bow with reference to its *space* relations, he would no longer see a circle, but some other conic section. This latter condition was recently observed to be satisfied by the reflection and refraction of sunlight in the drops of dew on a lawn. The phenomenon appears to be unique, and furnishes another interesting modification of the familiar rainbow.

The space in front of one of the Government buildings had been recently harrowed and then carefully leveled and rolled, and finally seeded thickly with Kentucky blue grass. At the time the observations were made this grass was about one and a half centimeters high, covering the ground thickly, and very uniform in height, the fine spears being surmounted with drops of dew.

On standing with one's back to the sun, one could see the bow on the grass very distinctly, which at nine o'clock A.M. was at a distance of about one meter at its nearest point, and then extended on either side in the form of a conic, to a distance of from ten to fifteen meters. The red color of the outer portion of the bow and the blue of the inner side were well de-

fined, although the boundary between the two was somewhat indistinct. There was, however, no question whatever about the existence of the definite colors.

The appearance of the bow may, perhaps, be better understood by reference to the accompanying figure in which the $XZ$-plane represents the ground, while the observer is standing at the origin, his head being at $H$. The shadow of the observer's head would then fall upon the plane at $XZ$ at $H'$, and the bow appeared on the ground between the feet of the observer and the shadow of his head, and extended on either side in the manner indicated in the sketch.




Assuming the simple explanation of the rainbow to apply in this case, the figure of the bow would be given by the intersection of the $XZ$-plane with the 42° cone (red rays), generated by the rotation of the line $HP$ about $SHH'$ as an axis, at an angle of 21°. The form of the bow is, of course, dependent upon the altitude of the sun. With the sun at the horizon, and for altitudes up to 21°, the figure would be a hyperbola; at 21°, it would be a parabola. At altitudes of the sun above 21°, we would have an ellipse, becoming a circle at the zenith with its center at the origin of coordinates.

The phenomenon was readily observed on the morning succeeding the first observations, but three days later, when another heavy dew appeared, no trace of the bow could be seen. During this time the grass had grown considerably, and the irregularity in height appeared to prevent the reflection of a sufficient amount of light. The existence of the bow has not yet been noted on any lawn on which the grass has attained considerable size.

LYMAN J. BRIGGS.

WASHINGTON, D. C.

## *NOTES ON INORGANIC CHEMISTRY.*

### CENSUS BULLETIN OF CHEMICALS AND ALLIED PRODUCTS.

THIS 'Bulletin,' prepared by Professor Charles E. Monroe and Dr. T. M. Chatard, which has just been issued, is extremely interesting reading and is full of valuable information. It is in effect a brief review of the chemical progress of this country in the last decade, with glimpses of the progress elsewhere, when this would seem to have a bearing upon possible future development here. Thus are treated at some length the catalytic production of sulfuric acid, the manufacture of soda from the natural soda of the West, wood distillation, fertilizers, explosives, and particularly chemical substances produced by the aid of electricity. It is interesting to note that the value of the principal products reported in this 'Bulletin' is $221,217,217 as compared with $163,547,685 reported in the census of 1890. Except in the potash industry, which is insignificant, there has been an increase in every department, but hardly as great as might have been looked for, considering the greatly increased attention given to the application of science to industry. Possibly this is more readily understood from the statistics of chemists employed in the establishments treated of in this report. From this it appears that the total number so employed in the United States is 276, about half the number employed by six coal-tar color firms of Germany. The largest number employed in any one industry is 52, in paints and varnishes. Those in the coal-tar products number 7, to which should prob-