altered, the minor axis is least." Miss H. says: "This is equivalent to saying that the mean distance of the earth from the sun is a function of the eccentricity of the earth's orbit, . . ." and then she proceeds to find an expression for this mean distance, first from the standpoint of geology, and, second, from a consideration of the kinematical element of velocity. The result in the first case is that

$$r' \text{ (mean distance)} = a\sqrt{1-e^2},$$

and in the second case that

$$r' = a\sqrt[4]{1-e^2}.$$

From what is said in introducing the second case it appears as if the kinematical result were only an "as it were" mean distance, and not the actual average of all the different distances. If this were so, this part of the article would scarcely supply an interlinear reading for the passage from Ball, for it seems evident that he means the real average distance and not a virtual average. The geometrical result should give the real average, but does it — I mean does Miss H.'s geometrical result give it? This makes it equal to the semi-axis minor, but that surely cannot be true. Of course, it is quite true, and, as Miss H. says, it is easily shown that

$$\frac{1}{\pi}\int_0^{\pi} r\,d\theta = a\sqrt{1-e^2},$$

but she does not show how it is shown that the mean distance

$$= \frac{1}{\pi}\int_0^{\pi} r\,d\theta.$$

As an assumption it does not seem to be convincingly reasonable.

The assumption made in the kinematical discussion seems much more reasonable. It is that the mean distance is the radius of a circle, in the circumference of which a point travels with the same areal velocity as that of the earth in its orbit. If the idea of velocity be dropped, we shall get back from kinematics into geometry, and the same assumption will give us for mean distance the radius of a circle whose area is equal to that of the given ellipse.

Thus $$\pi r_0^2 = \pi a b$$

and $$\therefore\quad r_0 = \sqrt{ab} = a\sqrt[4]{1-e^2}.$$

This is the same as Miss H.'s kinematical result, and, like it, agrees with the dynamical result in her equation (4).

ALICE PORTER.

Yarmouth, N.S., May 15.

A Beautiful Spectacle.

I GIVE below a description of a phenomenon seen here on the evening of May 9 and wish you or some of your readers could tell me if it is rare or common, and what is the cause or its relation to other phenomena

On Tuesday evening, May 9, between 9.15 and 9.45 (north latitude 44°, west longitude 66°, but *time* is 60°), we were treated to a curious and beautiful spectacle. Right across the sky from west to east stretched a magnificent arch of luminous radiance. On the west it seemed to spring from a solid mass of black cloud which extended along the whole northwest horizon. Its width was nearly uniform from the western base up beyond the summit, and measured about two degrees. The summit was among the stars of Berenice's Hair, and was 15 to 20 degrees south of the zenith. The eastern branch narrowed as it neared the horizon, and tapered off to a point before quite completing the semi-circle. The color was fairly uniform throughout, and of a grayish or pale-bluish white, some say "yellowish." Except for the cloud-mass in the northwest the sky was beautifully clear, and the brighter stars along each side of the arch seemed to shine out with unusual brilliancy and sparkle. Those covered by the arch were not obscured, but twinkled through it as through a transparent veil. To some observers the summit seemed for a time to move very slowly a little farther south, and near the time of breaking up there were narrow, dark rifts crossing it obliquely; but, on the whole, the entire structure stood remarkably steady, without any of the swaying, or shooting, or shimmering, or wavering motion generally seen in auroras. There had been some auroral outbursts about half an hour earlier, and this phenomenon was probably connected with them. Whatever it was due to, it was a splendid sight — such a sight as the rings of Saturn must be as seen from the surface of that planet — and it was much admired by all who saw it. It broke up and melted away before 10, and in another quarter of an hour the sky was clouded all over.

ALICE PORTER.

Yarmouth, N.S., May 12.

A Fall of Colored Snow.

ON Jan 8 1892, between one and five o'clock P.M., there fell about one inch of colored snow throughout the northern half of La Porte County, Ind.

Mixed with the snow was a large percentage of mineral and vegetable matter giving the snow a reddish-brown hue. Every flake of snow had a particle of this matter, that served as its nucleus, from which the mass became granular. The mass was moist enough to form a crust within twelve hours.

At the time it fell there were six inches of clean snow very evenly distributed over the surface, probably not any surface bare within fifty miles of the above-named area. This old snow was quite compact.

During the next twenty-four hours following the fall of colored snow about four inches of clean snow fell on top of it, and became a crust within a few days, thus embedding the colored snow between two compact strata of ordinary snow, by which it was kept free from contamination for about a month. During that time several persons procured samples of it for examination.

The meteorological conditions at the time of its fall were: Wind from west-southwest; all clouds moved in same direction. Temperature, about zero at 8 A.M. Jan. 8, 12 to 3 P.M., rising; 8 P.M., zero. Thermometer stood at zero Jan. 9. At Chicago from 4 until 4 30 there was light snow, too light to measure. At Grand Haven, Mich., it snowed almost continuously from Jan. 5 to 10; and on Jan. 8, thermometer fell from 18 to 8 above zero (the coldest of the season); while at Chicago it went down as low as 5 below from 12 above zero. That station reports a high-pressure area for the whole northwest country, weather cold and clear. This area closely followed an area of low-pressure, which was central over Upper Lake Michigan during the morning of Jan. 8, moving rapidly northwestward during the succeeding twenty-four hours, general snow marking its passage. The Chicago observing station records wind from west to northwest Jan. 8–9.

Having had my attention called to some of these facts by an article in a local newspaper by Honorable G. H. Teeter of Rolling Prairie, Ind., I began to collect samples, and procured one from that gentleman. I sought to make a survey of the area covered by its fall, but was unable to locate bounds in any direction, although I traced it over an area 25 by 45 miles.

To avoid uncertainty in an analysis of the matter, I drove several miles into the country with Professor F. M. Watters, then science teacher in La Porte High School, to procure samples of it that should not be affected by dust from chimneys and railroads.

I made three analyses of it, besides carefully examining it under the microscope, using both low and high powers. Meanwhile, Mr. Teeter procured an analysis by Professor H. A. Huston, chemist of Indiana Agricultural Experiment Station, at Purdue University, Lafayette, Ind., as follows: —

"Loss on ignition (water and other volatile matter)	15.04
Silica	65.64
Alumina and oxide of iron	15.50
Lime	2.19
Magnesia	1.38
Phosphoric anhydride	.10
Oxide of titanium and undetermined	.15
Total	100.00 "

Professor Huston adds: "The composition of the material is such that one is led to believe it to be of volcanic origin, as it approximates very closely to some of the analyses of lava from the