

## LETTERS TO THE EDITOR.

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## The Leonids—a Forecast.

In the *Proceedings* of the Royal Society for March 2, 1899 (vol. lxiv. p. 403), will be found an account of the perturbations suffered since 1866, November 13, by the Leonids which in that month intersected or passed close to the earth's orbit. This position in the meteor stream may be called station A (Fig. 1).

We have since investigated the principal perturbations affecting two other points in the stream, viz., the station Z, which intersected the earth's orbit 360 days earlier, i.e. in November

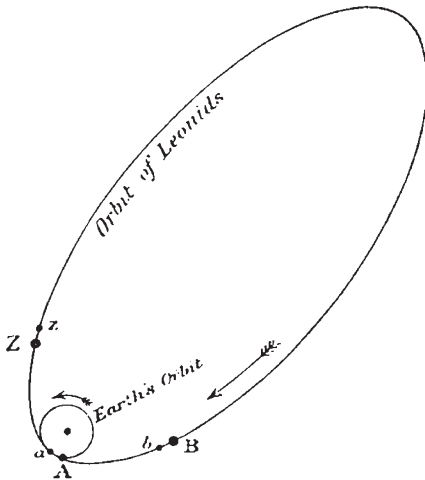


FIG. 1.

1865, and the station B, which intersected the earth's orbit 360 days later, i.e. in November 1867.

We therefore now know the principal perturbations which during the last revolution of the meteors have affected three points, Z, A and B, situated along an orbit (Adams's orbit) which, at the commencement of the revolution, lay within the stream.

The full results of the investigation will not be ready for publication till after the time when the Leonid shower of this year is due, and on this account it has been thought expedient

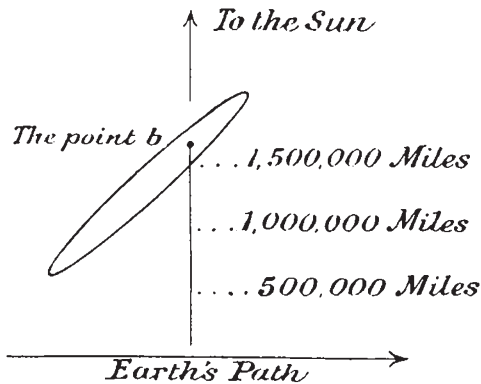


FIG. 2.

to publish beforehand such of the results as have special reference to it.

A point in the stream which in 1867 lay along Adams's orbit between A and B, but nearer B, and which we may call the point *b*, will this year reach its descending node simultaneously with the earth. This will happen approximately on 1900, November, 15d. 3h. Greenwich mean astronomical time.

Unfortunately, the orbit of a meteor situated near point *b* in

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the stream, instead of intersecting the earth's orbit as it did in 1867, will now pierce the plane of the ecliptic in a point which lies about 0.018 nearer the sun. Now, 0.018 of the earth's mean distance from the sun is 1,674,000 miles; so that, of the meteors which in 1867 intersected the earth's orbit, those which will come nearest to the earth in the present year will not approach it nearer than a million and six hundred thousand miles.

It is known from the duration of the great showers that the width of the ortho-stream, if measured in the direction which is parallel to the earth's path, is only about 300,000 miles; but there is reason to believe that the Leonids entered the solar system under conditions which have made the section of the stream much longer than it is broad, so that its trace upon the plane of the ecliptic is something like what is represented in Fig. 2. The longer axis of this cross section lay originally along the radius vector from the sun, but perturbations have acted on the Leonids for nearly 1800 years of such a kind as have probably caused the section of the stream to incline in the direction represented in the figure.

If the section is long enough to reach the earth's orbit, we shall have a great meteoric shower this year. It is, besides, just possible that a sinuosity in the stream may so displace a part of the section as to bring it sufficiently far out. But neither of these seem likely to have happened; so that the present investigation does not raise any hope of a great shower this year.

If, contrary to our expectation, the axis major of the section proves to be long enough to reach the earth's orbit, the consequent shower of ortho-Leonids is likely to occur several hours—possibly more than a whole day—earlier than

1900, November, 15d. 3h.

The number of hours by which it will precede that epoch depends upon the angle which the axis major of the section makes with the radius vector from the sun—an angle which is at present unknown. If there is this year a shower of ortho-Leonids, the time at which it occurs will enable us to determine this important datum.

Station *a* in the stream (see Fig. 1) intersected the earth's orbit in 1866, but after completing a revolution it passed the earth in November of last year at a distance of some 1,300,000 miles; and *z*, the corresponding point for the preceding year, which also intersected the earth's orbit in 1865, was on its return distant from the earth in November 1898 by about 960,000 miles. It thus appears that the displacements of the meteoric orbits which have been brought about by the perturbations of the last thirty-three years suffice to have prevented the meteoric orbit from now intersecting the earth's orbit. This accounts for our not having had any great shower in either of the last two years, and unfortunately the conditions seem still more unfavourable in the present year.

Nevertheless, as there is always a possibility that one or other of the contingencies mentioned above may carry a part of the ortho-stream out as far as the earth, and as we have no means of ascertaining whether those contingencies have arisen, it is desirable that preparation shall be made for adequately observing the shower, if it should unexpectedly come.

The perturbations during the last revolution, which have for the present carried the ortho-stream of Leonids so far from the earth's orbit, belong to the class of perturbations which act at different times with equal effect in opposite directions; so that there is reasonable ground for expecting that further perturbations must at some future time bring this remarkable stream back to the earth's orbit. It would be possible to ascertain when this will happen, by an investigation carried over a sufficient time forward upon the same lines as those which we have pursued.

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October 24.

A. M. W. DOWNING.

## Examinations in Experimental Science.

YOU occasionally do us, who are humble teachers of Elementary Science in schools, the very great kindness of giving us, through your columns, the chance of reaching the ears of those eminent men who are your frequent contributors, and who examine our pupils. Will you, in the interest of that real science teaching, so often advocated in your columns, allow me such a chance now? I will be as brief as possible. In common with a few individuals and many public bodies, I have spent a very large amount of time, money and labour in introducing the teaching of practical physics into my school, and trying to see that it shall be of the best kind possible, and I am prepared to do more.