Astronomers Watch for the Wandering Asteroids

WILL the great Leonid swarm, expected last year and the year before, come this year? For two years past all devotees of astronomy, professional and amateur, have had their hopes followed by disappointment, as they watched during the nights of November 13, 14 and 15 for the coming of the most famous shower of shooting stars known to science. Will this year witness another and a final disappointment? Certain astronomers believe not; they think that the Leonids will appear this month in all their original splendor.

All observing people have seen shooting stars, but not till within a few decades was it known that every shooting star followed the laws that govern all heavenly bodies, pursuing each its appointed path, so that, if we had a complete knowledge of them, the flash of each one, or at least of every considerable group of them, might be as certainly predicted as the appearance of the planets.

Of all the shooting stars, the Leonids, as the November swarm is called, are by all odds the most striking to the eye, the most numerous, have filled the largest place in history, and, it is believed, offer the astronomer the most fruitful field for research. A few of the swarm were seen on November 14, 1808, and a few days before and after, and at that time about 800 were noted. November 14, 1899, the astronomers again awaited their coming, armed with the latest photographic weapons of our photographic age. From one hundred to two hundred were recorded. Last year again, though with diminished hope, the watchers of the sky made ready, but again there were no substantial results. Something over a hundred were noted altogether in northern latitudes, principally at Yale and Harvard. Prof. W. H. Pickering of the Harvard observatory, favored with a clear sky at the station which he was then maintaining at Jamaica, West Indies, saw over a hundred on each of the two nights on which he observed them. But this was nothing to the glorious records of the swarm in the past. In the ninth century the Arabs recorded its appearance in their annals as a "rain of stars." The Chinese have it in their astronomical records as early as 913 and again in 1002, the last time by "thousands," with two of the meteors as large as a "quart measure." From that time to this they have been noted with fair regularity every thirty-three years or so—though with gaps here and there—and always in terms that bespoke a sight of splendor and sublimity.

The last first-class shower in this country was on November 14, 1833, though on November 13, 1832, there was a considerable display in Europe. On November 14, 1866, they appeared again, the largest display coming in November, 1867, however, when the astronomers and newspapers of the time write of them as a wonderful and glorious phenomenon. But the year for their recurrence has been variously fixed by astronomers, depending on the year assigned as the last of a small group of years. Referring to the last appearance, 1866 has been chosen by some as a starting point, and a period of thirty-three years between the swarms would bring them back in 1899. The year 1867 appears, however, from contemporary accounts, to have produced the best display. A thirty-three-year period would therefore bring them back in 1900. But, on the other hand, it has been shown that the period of the swarm has been lengthening and must now be close to thirty-four years—a calculation which would assign the present month as the proper time of their reappearance.

CAMERAS AT HARVARD UNIVERSITY READY FOR THE LEONID SHOWERS EXPECTED THIS WEEK.

Prof. W. H. Pickering of the Harvard observatory claims that the estimate of thirty-four years, reckoning from 1867, is sustained by the best data. His present statement is as follows:

"Computing from 902, the first certain date, and omitting, for convenience, all mid-century appearances, they had a period of thirty-three and one-fourth years, appearing in 1002, 1101, 1202, 1302, 1402, 1502 and 1602. A change seems to have come in the orbit at that juncture and instead of 100 years later, they appeared, not every thirty-three years, but every thirty-four years.

"Beginning from 1833," Prof. Pickering continues, "the last year of an unquestioned maximum, we get 1867 as the next appearance in considerable numbers, and the accounts of the last appearance of the swarm assign 1867 as the last year, though 1866 had a considerable display. Continuing the computation, then, 1901 would be the end of the next thirty-four-year period.

"A hope of seeing the shower, supposing the perturbation is as outlined above, lies in the probable shape of the swarm. The meteors are strewn along the orbit for millions of miles, long enough at least so that the earth may make two or three revolutions around its own orbit before getting clear of the swarm. It is not supposed that the meteors, which are small, dark bodies, are distributed in space in a cylinder-shaped figure, but more like a strap, and this strap is wavy or zigzag in outline, each wave being the record of a perturbation due to the passing of one or more of the planets near the swarm. The somewhat remote chance of the earth intercepting a crest of one of these waves is to be regarded as one of the hopes of the astronomer.

"The Leonid swarm is, nevertheless, well worth watching for, even if not as numerous as on its former appearances. For one thing, they are among the brightest of meteors and offer the best probable chance of securing a spectrum, leading to a knowledge of their constitution. They are moving in a contrary direction to the motion of the earth in its orbit, and, when intercepted by our atmosphere, their velocity is the sum of their own and the earth's. They are thus readily identified, being quick, bright flashes across the sky, usually with a bluish light, but sometimes yellow. This brightness of the light is what the spectroscopist would desire in his researches, though it is obtained at the expense of the length of exposure."

The great eclipse of the Leonid orbit has a long diameter—some 1,800,000,000 miles—and the swarm has completed this enormous circuit fifty-two times, next month, if it occurs, being its fifty-third appearance. The best considered theory of the appearances of the Leonids as shooting stars in our terrestial atmosphere supposes that the orbit of the earth crosses the orbit of the meteors and that once in thirty-three or thirty-four years the earth runs into the swarm—that is, into the place of their greatest frequency—taking three or four days to cross it. The point on the earth's atmosphere where the swarm is intercepted is in line with a point in the constellation Leonis (or the Lion), whence the name of Leonids. The determination of this radial point is an important consideration with astronomers. The paths made by the shooting stars, though appearing to be very much at random, will, if carefully placed on a chart of the sky, be found to meet at a certain point—the so-called "radiant." This has a movement of its own, the measurement of which is an interesting subject of research. The paths of the shooting stars—a "meteor," as has been said, being a dark body in space, that is, a "shooting star" only when it collides with the earth's atmosphere and becomes luminous—will also be found to grow shorter as one approaches the radiant, due to the effect of perspective. A railroad track, for example, will appear shorter or longer, in itself, as one looks at it in perspective or from one side. The paths of the meteors are parallel, and as we look at them those near the radiant will be "head-on," and however long in reality will appear as points only to us. We see the paths more and more sideways moving away from the radiant and meteors very much to the side of our axis of vision will sweep through great arcs of the sky.

The constellation Leonis rises shortly before midnight on November 14, but is not well in view till 1 a. m. It can be found readily by using the "pointers" in the Dipper in a reverse direction from the customary use in finding the North Star. Leonis will be identified about as far off as the North Star is the other way and as a very good outline of a sickle, with the bright star, Regulus, at the outer end of the handle. A better way is to use the two stars forming the side of the Dipper nearest the handle for pointers. These point, again in the direction opposite to the North Star, directly at the Sickle. The radiant of the Leonids is within the curve of the blade of the Sickle, near the center. The whole of the constellation, however, does not come into good view till about 2 a. m.

In observing meteors the important things looked for by astronomers are the number and brightness. Color, length of path and other things are useful, but with the number and brightness something of importance can be done, and, what is of more general interest, one need not be a professional astronomer to do one's part in that something.

In a circular issued by the Harvard observatory and designed to secure world-wide co-operation in the work of observing the expected Leonids, it has been recommended that the observer note how long it took for ten shooting stars to appear. On the record made should appear the place of observation; the observer's postoffice address; the astronomical date, which is obtained by using the date of the previous evening for the morning observations also, since the astronomical day begins at noon; the time used, whether Greenwich, standard or local; the beginning and ending of observations, which were to be made usually with intervals of rest between; when other special observations might be made; and finally any interruptions by clouds or from other causes. If the shooting stars have long paths or marked characters a less number than ten might be chosen. If they are numerous, a larger number could be counted. The observations need only care, system and perseverance to be of real value, so that the resulting record can be sent to Harvard, if one chooses to accept the formal invitation of the observatory to do so, with the assurance that it can there be usefully correlated with other similar records.

The estimate of magnitude should be made between the periods of counting. The counting, it is recommended, should engage

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GEORGE R. MOYER, FORMERLY OF WYOMING, HIS BRIDE, SENORITA MARIA CONCEPCION ESCOLAR, AND THEIR BRIDAL PARTY ATTENDANTS—Photograph taken in Manila.