# Note on "The Possibility of a Collision between the Earth and another heavenly body."

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A learned paper by the Mathematician Lalande, entitled "Réflexions sur les cométes qui peuvent S'approcher de la Terre," which was read before the Acadamic des Sciences early in the year 1773, caused a serious panic throughout France. The mistake arose from a garbled account of his paper, which appeared in the "Gazette de France." An explanation from the pen of Lalande himself did little to restore calm, and the Archbishop of Paris was solicted to appoint a forty hours' prayer and fast to prepare for the Judgment Day. The real purpose of Lalande's paper was to find by calculation the distances of the nodes of sixty-one comets from the Earth's orbit, and also the distances of these comets from the plane of the ecliptic, at the moment when the comet's radii victores were equal to unity. By means of these elements, he showed which of the comets could most nearly approach the Earth. Two comets have approached the Earth's orbit to within a distance of half a million and 850 thousand miles respectively, namely, the comets of 1680 and 1684. But in both cases the Earth was at the time far from the points where the comets cut the ecliptic plane. But the comet of 1770 passed through the ecliptic at a point only 168 thousand miles distant from where the Earth passed but five hours later. The comet of 1680 is of peculiar interest, in that according to the calculations of Halley and Newton it was the comet which produced so world-wide a sensation in 1106 and 531 of our era, announced the death of Cæsar in B.C. 43, appeared at the taking of Troy, and still earlier, in the time of the Minoan King Ogyges in B.C. 1769, who according to ancient Greek traditions Herodotus tells us was contemporary with a second Deluge. But the most interesting point in connection with this comet is that it probably appeared in 2344 B.C., the date fixed by chronologists for the Mosaic Deluge. Whiston would have it that this comet was the *cause* of the Flood. According to him, it

caused a prodigious tide, not only in the waters of the sea, but also in those beneath the solid crust, in the region of Armenia, which was nearest the comet at the moment of its close passage to the Earth. A considerable scare was created by Olber's prediction that Biela's comet would intersect the Earth's orbit at 10 o'clock on the night of October 29, 1832. The distance of the comet's node from the Earth's orbit was 4·66 radii of the Earth or 18,600 miles, and since the radius of this comet's atmosphere was over five such radii, it was evident that the Earth's orbit would intersect some portion of the comet's atmosphere. The scare-mongers had, however, overlooked Olber's statement that at the moment when the comet would be crossing its node, the Earth could not then be less than forty-nine millions of miles distant from it! Lambert in 1765 wrote :—"The near approach of comets might occasion the most dire catastrophies to our Earth—cover it again with the waters of a deluge, cause it to be consumed by fire, crush it to atoms, or at least divert it from its orbit, carry away its moon, or, worse still, carry away itself, and bearing it off to remote regions, compel it to endure a winter, which neither man nor animals would be capable of resisting." And Lalande has calculated that "if a comet of the same mass as the Earth approached to within a distance of one quarter of that of the Moon, it would suffice to raise the waters of the oceans 2,000 fathoms, submerging the Continents." But we hasten to point out, that this calculation ignores the important fact that it would take many hours of proximity for a comet (independently of its mass) to be able to raise such tides. Whereas, if a comet be, say, 40,000 miles distant at perigee, it would have passed [if moving (as is a reasonable supposition) at parabolic velocity], 50,000 miles distant only one hour later, and would then be over 23 degrees vertically distant from the position it occupied over the Earth when at perigee. Or to take an extreme case, in one-half hour only, a comet could have changed its vertical position in respect to our globe by over 80 degrees. Comets pass indeed, with such rapidity in the vicinity of the Earth, that the effects of their mere attraction need occasion no alarm. It is only by actually striking against the Earth, that they could be the cause of serious or fatal injury to our globe. On the supposition that the mass of the heavenly body were comparable to that of the Earth, very serious results for our globe might ensue. The axis of the Earth and its rotational motion might be altered. In this case the seas would quit their ancient positions, in order to precipitate

themselves towards the new equator. A great proportion at least of the human race would be destroyed in the deluge, or by the shock of the terrible collision. All monuments of civilization would be in a moment annihilated. Indeed, it is not impossible that such an event has actually taken place in a not very remote past. This would explain why the oceans have receded from the high mountains, upon which they have left incontestable marks of their sojourn. It would explain the comparative newness of the moral world of rational beings, whose monuments date back but for a few thousand years. The human race, reduced by such a catastrophe to a small number of individuals, and solely occupied for a length of time with the care of its own preservation, must have lost entirely the remembrance of the sciences and arts. And when the progress of time made these wants felt anew, it was necessary to begin again, as if man had been newly placed upon the Earth. To obtain, however, a truly correct view of the effects of a collision with a heavenly body of a supposed mass about equal to that of the Earth, we must not ignore the great principle of the "law of the conservation of energy," by which the kinetic energy of a body can be transformed into heat. Thus, knowing the weight and velocity of the Earth, we can calculate the exact amount of heat that would be generated, were the Earth to be suddenly stopped in its course. This heat would be sufficient not only to fuse the entire globe, but to reduce it in great part to vapour. This collision between the Earth and another body of equal mass and velocity would result in the annihilation of all movement of translation, and the Earth and body together, fused into one single-heated mass, would fall into the Sun within two months after the catastrophe.

# Memoranda for Observers.

## Standard Time of India is adopted in these Memoranda.

*For the month of October 1915.*

### Sidereal Time at 8 p.m.

| | | H. | M. | S. |
|---|---|---|---|---|
| *October* | *1st* ... ... ... | 20 | 36 | 58 |
| ,, | *8th* ... ... ... | 21 | 4 | 34 |
| ,, | *15th* ... ... ... | 21 | 32 | 10 |
| ,, | *22nd* ... ... ... | 21 | 59 | 45 |
| ,, | *29th* ... ... ... | 22 | 27 | 21 |