

K. Aichi and T. Tanukadate, post-graduate students in physics, with the following results:—

Considered as Power Series of ϕ :

For $n=6$: $A_1=2.6512$ $A_2=1.3704$ (Tanukadate)
For $n=7$: $A_1=2.6512$ $A_2=1.3704$ (Aichi)

Considered as Power Series of \sqrt{q} :

For $n=4$: $A_1=2.6509$ $A_2=1.3750$ (A. and T.)
For $n=7$: $A_1=2.6511$ $A_2=1.3704$ (A. and T.)

It thus appears that the number of points for $n=4$ is insufficient, but for $n=6$ or 7 the approximation becomes very close, so that the values of these two integrals are:—

$$A_1=2.6512 \quad A_2=1.3704.$$

Maxwell's value of A_1 is about $1/300$ too large, and that of A_2 is about $1/600$ too small. Such small differences will not materially affect the theoretical results in which these two integrals enter, but it will be worth while to notice that the actual values are slightly different from those usually given in works on the kinetic theory of gases.

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October 8.

Leonid Meteor Shower, 1903.

THE return of the Leonids was clearly observed here on the night of November 15. The night of November 14 was also clear, though at times a dark belt of cloud, which concealed the lower part of Orion, extended itself along the eastern horizon to the foot of Leo, and occasionally also small patches of cloud dimmed or caused a momentary disappearance of stars in or around Gemini. These slight impediments to observation continued also on the next night until between two and three o'clock on the following morning. It had been intended to commence observations here as early as the night of November 11, as the writer had anticipated that the Leonids would put in an early appearance in the present year; cloudy skies, however, prevented the possibility of knowing if these anticipations were realised. During a watch from 10h. 20m. to 12h. 30m. on November 14 (local time) eleven meteors were observed, almost half of which were Leonids as bright as stars of the first or second magnitude. The radiation from Leo was regarded as surprisingly good, considering the hazy or clouded appearance of the horizon, which rendered that constellation invisible until after midnight. In a forecast made by the writer for the present year he found that, so far as the Leonid epoch of November 14–16 was concerned, the maximum would fall between the hours 13 and 14 on November 15; but it was considered that the display on the latter night would be weak, owing partly to the reported insignificance of the Leonid shower on the night of November 15, 1902, the preparations for the due observation of which were generally frustrated by unfavourable atmospheric conditions. When, therefore, the radiation from Leo was found to be so pronounced during the early hours of the night of November 14, the writer found that he had entirely underestimated the probable strength of the shower for 1903. The watch, however, was not prolonged beyond 12h. 30m. on the night of November 14, as there was no possibility of a star shower taking place on this night, though, no doubt, there were manifest signs that the Leonids might be unusually numerous. The first watch on the following night lasted from 9h. 15m. to 10h., during which time four meteors were seen, one of them being a Leonid as bright as a first magnitude star. Its appearance was revealed by the rich streak it left in its wake as it slowly rose from the invisible radiant. The watch was resumed at eleven o'clock, and whatever misgivings might have been felt for abandoning the lookout on the previous night were quickly dissipated by the appearance of as many Leonids in the first quarter of an hour's observations as had been seen during a period about five times as long on the preceding evening. Between 11h. and 11h. 30m. the meteoric rate was twenty-two per hour for one observer facing due east, but by midnight it had fallen to sixteen per hour,

though sporadic meteors were included in the count. Between 12h. and 13h. drifting patches of cloud probably prevented several meteors from being observed, and the rate did not rise above thirty per hour, but at 15h., when the sky had become quite clear, Leonids were appearing at the rate of one per minute. During the next half hour forty-one shooting stars were counted, and this high rate was more than maintained for the next two hours; indeed, it was estimated at one time that the meteoric rate was easily 200 per hour for one observer. The brilliancy of the display was as remarkable as its numerical strength. When the shower was at its maximum, few of the shooting stars seen were less bright than the second or third stellar magnitude; indeed, most of them, if observed apart, would have merited individual description, and almost every third or fourth meteor might be called a bolide. To an observer looking eastwards the radiation from Leo was very marked, but a few instances were characterised by a centripetal rather than the usual centrifugal motion as regards the well-known radiant. The most noted of these exceptional cases occurred between one and two o'clock, when a bolide of surpassing splendour passed slowly downwards, leaving a rich trail across the stars ϵ and ζ Leonis. When close to the "Sickle" it exploded with a vividly white flash that imparted to it an almost startling brilliancy, and an instant afterwards a meteor as bright as Sirius made its appearance about twenty degrees further on, shooting down towards the horizon in a path that seemed to be a production of that of its more brilliant predecessor. Another meteor brighter than Jupiter shortly afterwards moved slowly downwards from within the "Sickle," passing between γ and η Leonis one-third nearer the latter than the former star, and pursuing a course parallel to the line joining η and Regulus. This west-to-east motion of the most brilliant members of a meteor display (for it has been noticed on other occasions by the writer) appears very significant. Several shooting stars shot from ϵ Leonis to β Canis Minoris, or slightly below the latter star. There seemed to be a second centre of emanation much lower down in the "Sickle" than that indicated by the foregoing meteors, and there was certainly another radiant altogether far away from Leo, and situated probably in or near Perseus. Several bolides passed out of sight overhead, arresting the attention only by their exploding flashes that momentarily illuminated the whole heavens. The pear-shaped appearance of meteors in the morning hours was very remarkable. These left rich trains which, like the meteors themselves, appeared of a yellowish tinge in the light of the waning moon or in the increasing twilight. Other members of the star shower dissolved in bright streaks, or made their appearance as vivid flashes of light, in the latter case generally at a great distance from Leo, bursting forth at one moment near the Great Bear, and in the next in the neighbourhood of Sirius. The largest number of meteors visible at one time was four. At six o'clock the activity of the shower, though considerably diminished, was still, even in the morning twilight, very noticeable.

The somewhat prolonged duration of the meteor shower affords some measure of its intensity, and it is probable that it has been widely observed, notwithstanding the fact that the notion of the supposed connection of the Leonids with the comet of 1866 precluded the possibility of such a striking meteoric occurrence in 1903, for the present is unquestionably the brightest Leonid display that has been subjected to European, and very probably also American, observation since the brilliant star showers of 1866–8. It is noteworthy that the present shower resembles very much in intensity and also in other particulars a bright display in 1865, in which year it was estimated that one thousand Leonids might have been counted by observers in England on November 13. A lapse of thirty-eight years separates the two events, and this interval suggests the nineteen year-period which has already been noticed (NATURE, April 23) in the case of all the April meteor-displays of the past century, and has also been shown (*English Mechanic*, April 3) to connect several important Leonid star-showers extending over the same time. If this be so, it is possible that the years 1904 and 1905 may be marked by even richer meteoric occurrences than that which has taken place on the present occasion.

JOHN R. HENRY.

Dublin, November 18.