

Assuming a rate of steam consumption by engine, and an evaporative efficiency of the boiler which represent results obtained in fair, average practice, the heat losses disclosed by the preceding figures may be transformed into power losses, which are as follows:

TABLE III.

Horse-Power Equivalent of Heat Radiated from Boiler.

Bare boiler, locomotive at rest.....	12
Bare boiler, locomotive running 28.3 miles per hour.....	25
Boiler covered with approved material in a manner common to good practice, locomotive at rest.....	4.5
Boiler covered with approved material in a manner common to good practice, locomotive running 28.3 miles per hour	9.3

Again, the results obtained afford a basis from which calculations may be made to show the extent of losses which will occur when the locomotive is run at higher speeds and under lower atmospheric temperatures. For example, it can be shown that had the boiler tested been run at a speed of eighty miles an hour under a steam pressure of 200 pounds, when the atmospheric temperature is 0 degrees, it would, if bare, have radiated an amount of heat which is the equivalent of sixty-seven horse power, and if covered in the most approved manner it would have radiated an amount of heat which is the equivalent of twenty-five horse power.

It will be seen that the radiation losses are quite sufficient to merit the earnest attention of those interested in improving the performance of locomotives.

THE LEONIDS OF 1898. BY JOHN A. MILLER.

As the results of the observations of the Leonid shower of 1898, made at various places in the United States, are accessible, this note shall only have to do with the observations made at Bloomington, Indiana.

We limited ourselves chiefly to two classes of observations. First, the determination of the number of Leonids that fell during certain periods of time between November 12 and November 19. We hoped from this data

to determine the density and the width of the stream at this point in its path. We had prepared a circular map of the sky with a radius of about 32° and a center near γ Leonis, and confined our watch to this portion of the heavens. The following table exhibits the results of these observations. It should be added, however, that these observers were making their first meteor observations and that their judgment as to whether a given meteor was a Leonid or non-Leonid was probably in many instances prejudiced in favor of the former. Hence I am inclined to believe that about eighty per cent. of the meteors observed were Leonids; the remainder belonged to other streams.

Date.	Period Begins.	Period Ends.	Number of Meteors.	Condition of Sky.	Remarks.
November 12.	4.00 a.m.	4.30 a.m.	15	Cloudless	No distinction as to class of meteors
November 12.	4.30 a.m.	5.00 a.m.	21	Cloudless	No distinction as to class of meteors
November 12	11.00 p.m.	12.00 m.	Cloudy	
November 13.	11.00 p.m.	12 00 m.	Cloudy	
November 14	12.01 a.m.	4.00 a.m.	Cloudy	Not a break in the sky.
November 14	4.00 a.m.	5.00 a.m.	2	Cloudy	Only a small patch of sky visible.
November 14.	11.00 p.m.	12.00 p.m.	41	Cloudless	
November 15	12.11 a.m.	12.30 a.m.	20	Cloudless	
November 15.	12.30 a.m.	12.45 a.m.	18	Cloudless	
November 15.	12.45 a.m.	1.00 a.m.	14	Cloudless	
November 15	1.00 a.m.	1.15 a.m.	14	Cloudless	
November 15.	1.15 a.m.	1.30 a.m.	22	Cloudless	
November 15.	1.30 a.m.	1.45 a.m.	22	Cloudless	
November 15	2.00 a.m.	2.15 a.m.	20	Cloudless	
November 15.	2.50 a.m.	3.05 a.m.	27	Cloudless	
November 15.	4.10 a.m.	4.30 a.m.	28	Cloudless	Of these, 25 were certainly Leonids.
November 15.	10.30 p.m.	11.20 p.m.	None	Cloudless	
Nov. 15-16.	11.50 p.m.	12.25 a.m.	1	Cloudless	This was a Leonid.
November 16.	4.30 a.m.	5.00 a.m.	6	Cloudless	These were Leonids.
November 19.	1.00 a.m.	1.30 a.m.	1	Cloudless	This was a Leonid. It was as bright as Regulus.

On November 15, at 3:02 a. m., a green point of light appeared in the sickle at about right ascension 10h and declination 22° . Gradually the point of light seemed to spread until it covered an area. In a few seconds

this area faded slowly and disappeared. It was the only stationary meteor that we observed.

Many meteors were observed that appeared outside the region covered by the map. These are not included in the foregoing table. For example: I watched the region surrounding Orion (not in the map) from 1:45 to 2:00 a. m., November 15. Fifteen bright Leonids were observed.

The meteors were rarely as bright as the first magnitude stars. The longest trail that we saw was about 110° long, but the average length was not more than 20° . The accompanying figure is that of a normal Leonid as I saw them.



The head of the brightest meteors seemed globular, and to be slightly separated from the tail as if it were surrounded by an envelope of non-luminous gas. The globular appearance was doubtless due to irradiation. The color of the head was generally yellowish red, a little more yellow than Mars, suggestive of a heated iron passing from a white-hot to a red-hot temperature. The tail or train was blue or green. The brighter the tail the greener it appeared. It seemed to me, also, that the brighter trains had a bright, narrow, perfectly straight streak or spine, exactly in the middle of the tail, and in the path described by the head. That whatever cause produced the tail was more intense in the broad part, is shown by the fact that the broad part faded out last, and in case of a very bright meteor some seconds after the head had disappeared.

Our second object was to obtain a permanent record of the paths described by the meteors, and to determine the radiant. To this end we platted the paths on the maps as the meteors fell. In all about 225 paths were platted on four different maps. The paths were then produced. Many of them intersected in a comparatively small area. The average of four determinations for the radiant gave Right ascension= $9^h, 45^m$; Declination= $21^\circ, 40^m$.

The number of Leonids that fell during the last shower was not so large as anticipated. This augurs well for a large shower November 13-16, 1899. The observations also show that the stream is wider than formerly supposed.