engine, the Indianapolis Water Company, with great liberality, arranged for a second test which should be so complete as to admit of a thorough analysis of its action. This second test was run early in the present month (December 3, 1898), and, while all the facts to be derived from it have not yet been determined, enough is known of them to make certain the accuracy of the previous work. The exceptional performance of the engine having, therefore, been carefully established, it is evident that the engine represents a very high standard of engineering practice. It marks the engineering progress of the day. This makes it not only a machine in which its owners may take just pride, but one which lends lustre to the whole State.

Tests to Determine the Efficiency of Locomotive Boiler Coverings.

By W. F. M. Goss.

The extent of heat losses occurring by radiation from a modern locomotive boiler under service conditions has long been a matter of speculation. There have been many investigations to determine the radiation from pipes and other steam heated surfaces, usually within buildings, but until recently no tests have been made which would disclose the effect of the air currents which, at speed, circulate about a locomotive boiler.

During the past summer (1898), however, Mr. Robert Quayle, Superintendent of Motive Power of the Chicago and Northwestern Railroad Company, in co-operation with manufacturers of boiler coverings, and, with the assistance of the undersigned, undertook to determine both the heat losses from a boiler and the relative value of several different makes of boiler coverings designed to reduce such losses. The following is a brief abstract of a report of results submitted to Mr. Quayle:

In carrying out the tests, two locomotives were employed; one to be hereafter referred to as the "experimental locomotive" was subject to the varying conditions of the test; the other being under normal conditions and serving to give motion to the experimental locomotive, and, also, as a source of supply from which steam could be drawn for use in maintaining the experimental boiler at the desired temperature. The experimental locomotive was coupled ahead of the normal engine, and, consequently,

was first when running to enter the undisturbed air. The action of the air currents upon it, therefore, was in every way similar to those affecting an engine doing ordinary work at the head of a train.

The boiler of the experimental locomotive was kept under a steam pressure of 150 pounds by a supply of steam drawn from the boiler of the normal engine in the rear. There was no fire in the experimental boiler, which at all times was practically void of water. Precautions were taken which justified the assumption that all water of condensation collecting in the experimental boiler was the result of radiation of heat from its exterior surface. This water of condensation was collected and weighed, thus serving as a means from which to calculate the amount of heat radiated.

The dimensions of the experimental boiler are shown by Table I:

TABLE I.

Dimensions of Boiler.

Diameter, in inches	52
Heating surface (square feet)	1,391
Total area of exterior surface, not including surface of smoke box	358
Area of surface covered (square feet)	219
Area of steam heated exposed surface not covered	139
Ratio of surface covered to total surface	.61

The results of the tests, briefly stated, are shown in Table II:

TABLE II.

Pounds of Steam at 150 Pounds Pressure Condensed per Minute.

Bare boiler at rest	6.8
Bare boiler moving at a uniform speed of 28.3 miles per hour	14.3
Boiler covered in the usual way with approved material—61 per cent. of the total surface only being protected—at rest	3.0
Boiler covered in the usual way with approved material—61 per cent. of the total surface only being protected—moving at a uniform speed of 28.3 miles per hour	5.3

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