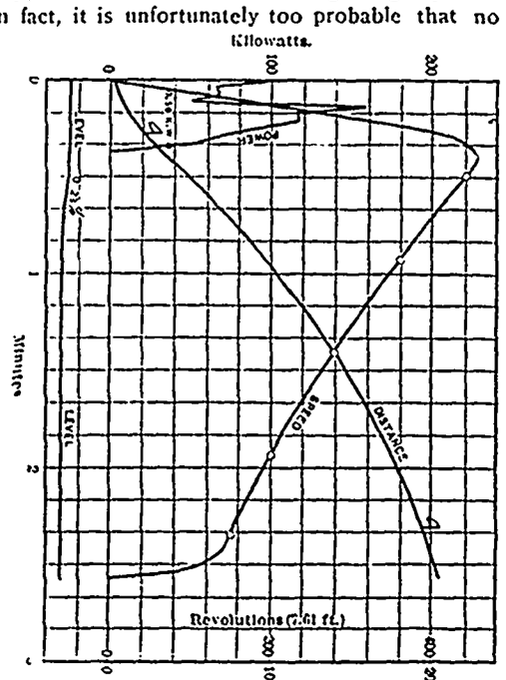
higher than the observed results. In this connection it may be noted that Mr. Lundie obtained his speed figures by positive methods, having found that speed recorders for variable speeds are not sufficiently accurate owing to the inertia of the moving parts.

These tests are all for heavy railroad passenger trains, upon which Mr. Lundie himself has made no experiments. For trains of from 20 to 100 tons, and for speeds of from five to thirty miles per hour, the Lundie formula is accurate, inasmuch as it is obtained directly from 150 or more observations made by Mr. Lundie in Chicago, as before stated. For lighter units still, the formula agrees with the results of private tests made by several of the great electric companies, and checks very well indeed the Clark formula

$$(R = \frac{S^2}{171} + 7.16)$$

bearing in mind that the latter is generally admitted by engineers to be from one to two pounds too high.

Now it need scarcely be pointed out that when a formula of this general kind, deduced on mathematical principles from a large series of experiments within a comparatively narrow range of action, is found to be equally applicable over a much wider range, a strong presumption in favor of the soundness of its underlying principle is established. It seems practically certain, therefore, that the Lundie formula is thus applicable to the whole range of passenger train traction on straight, level, exposed track in a calm atmosphere. It cannot, however, be said to be applicable to street cars running on gritty or dirty rails, and, in fact, it is unfortunately too probable that no formula whatever can be devised for street railway work for which a large factor of safety would not have to be allowed in practice to provide for great differences in condition of track.



An interesting question now arises as to whether the Lundie formula can be made, with some modifications, applicable to all kinds of train transportation, freight as well as passenger. It does not check the most recently obtained data for exceedingly heavy trains. Tests on the Chicago, Burlington & Quincy Railway, made by the old method of engine indicator diagrams, checked by dynamometer car, show that a 940-ton train of loaded freight cars, running at 20 miles an hour, has a resistance on a straight, level track of 5.5 lbs. per ton. By the Lundie formula this would have been 8.3 lbs. per ton. An extremely heavy train of freight cars on the New York Central, weighing 3,428 tons, had an average train resistance, at 20 miles per hour, of about 4 lbs. per ton, or the limiting resistance by the Lundie formula as expressed in the first constant. Other tests on fairly heavy freight train work recently made have shown approximately 6 pounds per ton as an average, when track conditions were good, but these results vary greatly with the condition of the track.

Now it being reasonable to suppose that with the heaviest freight train work the train resistance will approach the minimum, and the New York Central experiment above referred to indicating that this minimum is Mr. Lundie's first constant of 4, it would seem that the latter's first constant within the parenthesis, namely .2, must be inapplicable to very heavy freight-train work, and should be, in fact, modified by a variable, probably T. It would be interesting, therefore, to bring together and plot in diagrammatic form, reliable results of a large number of freight-train tests taken with different weights and speeds, to see if a modification of the Lundie formula cannot be made for general application to the heavy class of work as well as light, and we are inclined to believe that were this experimenting once done there might quite possibly be found a common ground of reconciliation between the two grades of service, by which a formula possessing the general characteristics developed by Mr. Lundie could be made applicable to the entire range of railroad transportation. We believe this formula to be so valuable a part of the technical equipment of a railroad engineer, that we earnestly hope it will excite the widest possible comment and criticism in the engineering press to the end of bringing out all the evidence bearing upon its reliability.

TABLE SHOWING APPLICATION OF LUNDIE FORMULA TO TRAIN RESISTANCE TESTS.

Test made by	Year.	On.	Mem.	Average Speed. Miles p. h.	Train Weight. Tons.	—Train Resistance— Observed.	Lundie Formula.
William Stroudley..	1885	London, Brighton & South Coast.	Single test	43.3	376	13.2	14.1
Angus Sinclair.....	1892	New York Central	Mean of six tests	70.	270	19.03	21.1
" "	1892	" "	Single test	69.6	270	19.8	21.2
P. H. Dudley.....	1882	" "	Single test	51.43	313	16.9	16.35
" "	1889	Philadelphia and Reading	Single test	60.	242.5	18.35	19.0
" "	1889	" " "	Single test	63.5	242.5	19.8	19.9
" "	1892	C. R. R. N. J.	Single test	63.2	213	19.0	20.2
Clark formula.....	....	.....	.....	10	100	7.74	7.04
" "	....	.....	.....	10	200	7.74	6.6
" "	....	.....	.....	10	300	7.74	6.4
" "	....	.....	.....	20	100	9.5	10.06
" "	....	.....	.....	20	200	9.5	9.2
" "	....	.....	.....	20	300	9.5	8.8
" "	....	.....	.....	30	100	12.42	13.1
" "	....	.....	.....	30	200	12.42	11.8
" "	....	.....	.....	30	300	12.42	11.3

ACCIDENTS.

E. Donald, an employee of the Record Foundry and Machine Co., Moncton, N.B., was caught while oiling some shafting about 15 feet above the floor a short time ago. His clothing was completely stripped off and he escaped without other injury than a few bruises, and a severe nervous shock.

Chas. H. Martin, some years ago of Martin & Son, iron founders, Belleville, Ont., was killed by the bursting of an emery wheel in Chicago, a short time ago.

Cornelius McGourty, contractor, St. John, N.B., was killed, January 6th, by a dynamite explosion near the Mispec pulp mills. A bag containing dynamite caught fire and Mr. McGourty tried to carry it to the stream close by, but the explosion came before he reached it, and he was blown to pieces, the workmen,