tenth of a mile, on a slightly down grade, to the point where the signal was given to apply brakes. Upon the vehicle entering the course its wheels automatically closed an electric circuit, which started a stop watch in the timing apparatus, the time for the one-tenth mile being taken for that distance, and the per mile rate rapidly figured out by an official timekeeper, with the aid of a table specially prepared by A. R. Shattuck, president of the club. The timing apparatus employed is that known as the Mors, and operated very satisfactorily.

The whole affair was carried out most successfully on schedule time, and the club is to be highly commended for its elaborate arrangements, and the practical, business-like manner with which they were conducted.

The following table gives a full record of the tests:

A SIDELI

SPEED UNDER 10 MILES PER HOUR.

VEHICLE.	Weight. Lbs.	Speed. Miles per Hour.	Stopping Distance. Feet and Inches.
Oldsmobile (gasoline)	600	8.7	8.9
White (steam)	1,350	10	17.2¼
		7.5	6 9½
Locomobile (steam)	1,000	7.8	5 9
Autocar (gasoline)	1,050	9.2	18 1⅛
		9	20.4
		9	17.8½
		8	9 10
Waverley (electric)	1,050	9.4	11.5
		8.7	4 4½
Toledo (steam)	1,400	7.6	4.9½
Panhard (gasoline)	2,500	9.4	5 11
		6.9	3.10
Gasmobile (gasoline)	2,100	9.2	10 0⅝
		6.7	5
Peugeot (gasoline)	2,100	6.4	4 2
		7.6	7 11½
Friedman (gasoline)	1,000	6 9	7
Packard (gasoline)	2,500	7 2	6 8
Long Distance (gasoline)	1,400	7.6	4.9
Haynes-Apperson (gasoline)	2,000	4.5	4.6

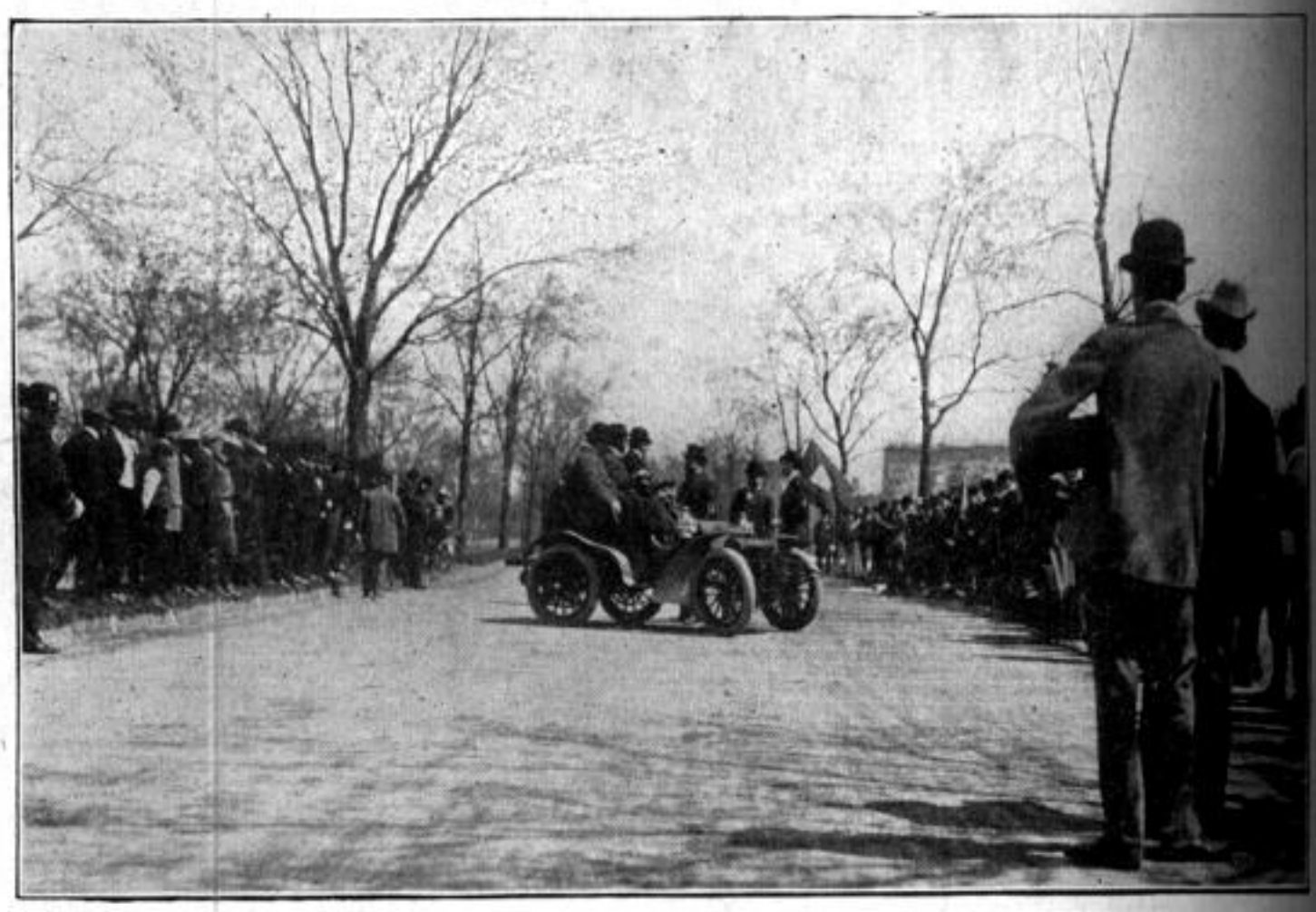
SPEED UNDER 17 MILES PER HOUR.

VEHICLE.	Weight. Lbs.	Speed. Miles per Hour.	Stopping Distance. Feet and Inches.
Oldsmobile (gasoline), 2 persons	800	14.4	21.7
Pierce (gasoline), 2 persons	650	13.8	24.0¼
		15.6	33.8½
White (steam), 2 persons	1,350	15.0	31
Locomobile (steam), 1 person	1,000	16.3	30.9
Autocar (gasoline), 2 persons	1,050	14.4	31.8
Waverley (electric)	1,050	13 8	21.5
Toledo (steam), 1 person	1,400	12.8	15.2
		16.3	34
Panhard (gasoline), 2 persons	2,500	16.3	25.4½
		13.8	22.8
Gasmobile (gasoline), 2 persons	2,100	12	9.9½
		15	22 2½
Peugeot (gasoline), 4 persons	2,100	15 6	40.10
Friedman (gasoline)	1,000	8.3	10 2¼
Packard (gasoline), 3 persons	2,500	13.3	26.7
Haynes-Apperson (gasoline), 3-4 persons	2,000	13 8	21 2½
		16.3	36.8
Long Distance (gasoline)	1,400	15 6	25.11½
Riker (electric)	1,500	11.2	43.5

SPEED 20 MILES PER HOUR.

VEHICLE.	Weight. Lbs.	Speed. Miles per Hour.	Stopping Distance. Feet and Inches.
Oldsmobile (gasoline), 1 person	600	20	60.6
White (steam), 1 person	1,350	21.1	75 2
Locomobile (steam), 2 persons	1,000	22.5	51 5
Autocar (gasoline), 2 persons	1,050	20	69.3
Toledo (steam), 2 persons	1,400	20	45.8
Panhard (gasoline), 2 persons	2,000	18.9	34.6
Gasmobile (gasoline), 2 persons	2,100	20	34.11½*

* Car turned completely around in stopping.



A Sideling Stop.

MILES PER HOUR.

Weight. Lbs.	Speed. Miles per Hour.	Stopping Distance. Feet and Inches.
600	8.7	8.9
1,350	10	17.2¼
	7.5	6 9½
1,000	7.8	5 9
1,050	9.2	18 1⅛
	9	20.4
	9	17.8½
	8	9 10
1,050	9.4	11.5
	8.7	4 4½
1,400	7.6	4.9½
2,500	9.4	5 11
	6.9	3.10
2,100	9.2	10 0⅝
	6.7	5
2,100	6.4	4 2
	7.6	7 11½
1,000	6 9	7
2,500	7 2	6.8
1,400	7.6	4.9
2,000	4.5	4.6

MILES PER HOUR.

Weight. Lbs.	Speed. Miles per Hour.	Stopping Distance. Feet and Inches.
800	14.4	21.7
650	13.8	24.0¼
	15.6	33.8½
1,350	15.0	31
1,000	16.3	30.9
1,050	14.4	31.8
1,050	13 8	21.5
1,400	12.8	15.2
	16.3	34
2,500	16.3	25.4½
	13.8	22.8
2,100	12	9.9½
	15	22 2½
2,100	15 6	40.10
1,000	8.3	10 2¼
2,500	13.3	26.7
2,000	13 8	21 2½
	16.3	36.8
1,400	15 6	25.11½
1,500	11.2	43.5

LES PER HOUR.

Weight. Lbs.	Speed. Miles per Hour.	Stopping Distance. Feet and Inches.
600	20	60.6
1,350	21.1	75 2
1,000	22.5	51 5
1,050	20	69.3
1,400	20	45.8
2,000	18.9	34.6
2,100	20	34.11½*

SOME DEDUCTIONS.

The results of these trials have been plotted in Fig. 2, and it has been tried to draw a curve which should represent, as nearly as possible, the average of the results obtained. In the diagram distances along the vertical axis represent the speed in miles per hour, and distance along the horizontal axis is the distance in feet in which the carriage was stopped. Obviously this curve should pass through the origin or point of intersection of the two axes, but inspection of the figure shows that it does not, but intersects the horizontal axis at some distance to the left of the vertical axis. This indicates that either the actual speed at the time the brake was applied was on an average slightly below that calculated, or that the brake was on an average applied some distance ahead of the point from which the measurements were taken. The former error would have the same effect on the results as the latter. Theoretically the distance in which a vehicle can be brought to a standstill by means of the brakes is proportional to the square of the speed of the vehicle at the time the brakes are applied. And the results obtained in these trials prove this theory to be substantially correct. Assuming, then, that the vehicle had the brakes applied on an average a distance b feet before the point from which measurements were taken, we have for the equation connecting the speed and the distance in which the vehicle comes to a stop,

$$a\,s^2 - b = d,$$

in which a is a constant inversely proportional to the brake power of the vehicle, s the speed in miles per hour and d the distance in which the vehicle stopped according to the results of the trial.

Substituting in the equation the values of s and d as given by the curve, for s equals 10, 15, 20 and 25 miles respectively and deriving from the so found observation equations the most rational values for a and b, we find as the equation most near

SPEED 20 MILES PER HOUR.—*Continued.*

VEHICLE.	Weight. Lbs.	Speed. Miles per Hour.	Stopping Distance Feet and Inches.
Friedman (gasoline)	1,000	17.1	59 9
Mors 3 (gasoline) (8 h. p.)	....	22.5	75.9
Long Distance (gasoline), 2 persons	1,400	18.9	29.2

TEST UNDER FULL SPEED.

VEHICLE.	Weight. Lbs.	Speed. Miles per Hour.	Stopping Distance. Feet and Inches.
Toledo (steam)	1,400	27.6	122 1
Oldsmobile (gasoline)	800	20	58.6
Mors (gasoline)	....	30	125.8
Panhard (gasoline)	2,500	25.7	89 7
Gasmobile (gasoline)	2,100	27 6	114 7
Long Distance (gasoline)	1,400	21.1	60.4½
White (steam)	1,350	27.6	Failed to stop.
Locomobile (steam)	1,000	32.5	139

By comparison a test was made of the braking powers of horse-drawn vehicles and bicycles, as follows :

VEHICLE.	Speed. Miles per Hour.	Stopping Distance. Feet and Inches.
Payne Whitney's four-in-hand	9	25 11¼
Payne Whitney's four-in-hand	16.3	77.6
Payne Whitney's four-in-hand	18.0⁹⁄₁₀	90 10
Victoria and pair	9	17 7¾
Victoria and pair	13 0⁹⁄₁₀	36 10
Bicycle (policeman)	9.0⁹⁄₁₀	8
Bicycle (policeman)	20	61.6
Bicycle (policeman)	27.0⁹⁄₁₀	31.2

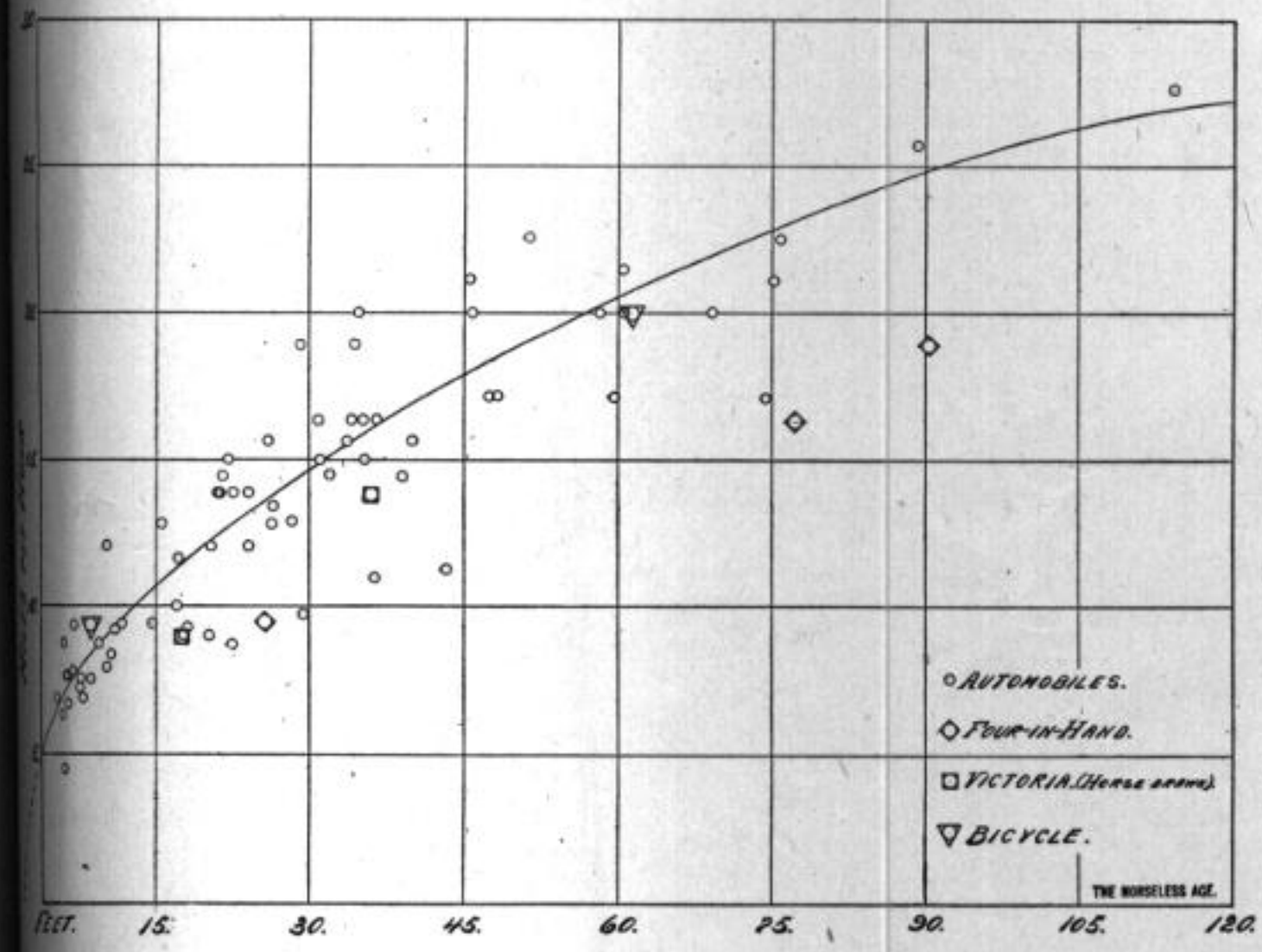


FIG. 2.—GRAPHIC REPRESENTATION OF RESULTS.

representing the average results of the trials:

$$.15\ s^2 - 2.56 \text{ feet} = d.$$

In other words, on an average the brakes were applied ahead of time and the actual speed at the time of passing the line was lower than that calculated in such proportions that the combined effect corresponded to applying the brake 2.54 feet ahead of the line, with the vehicle going at the speed calculated.

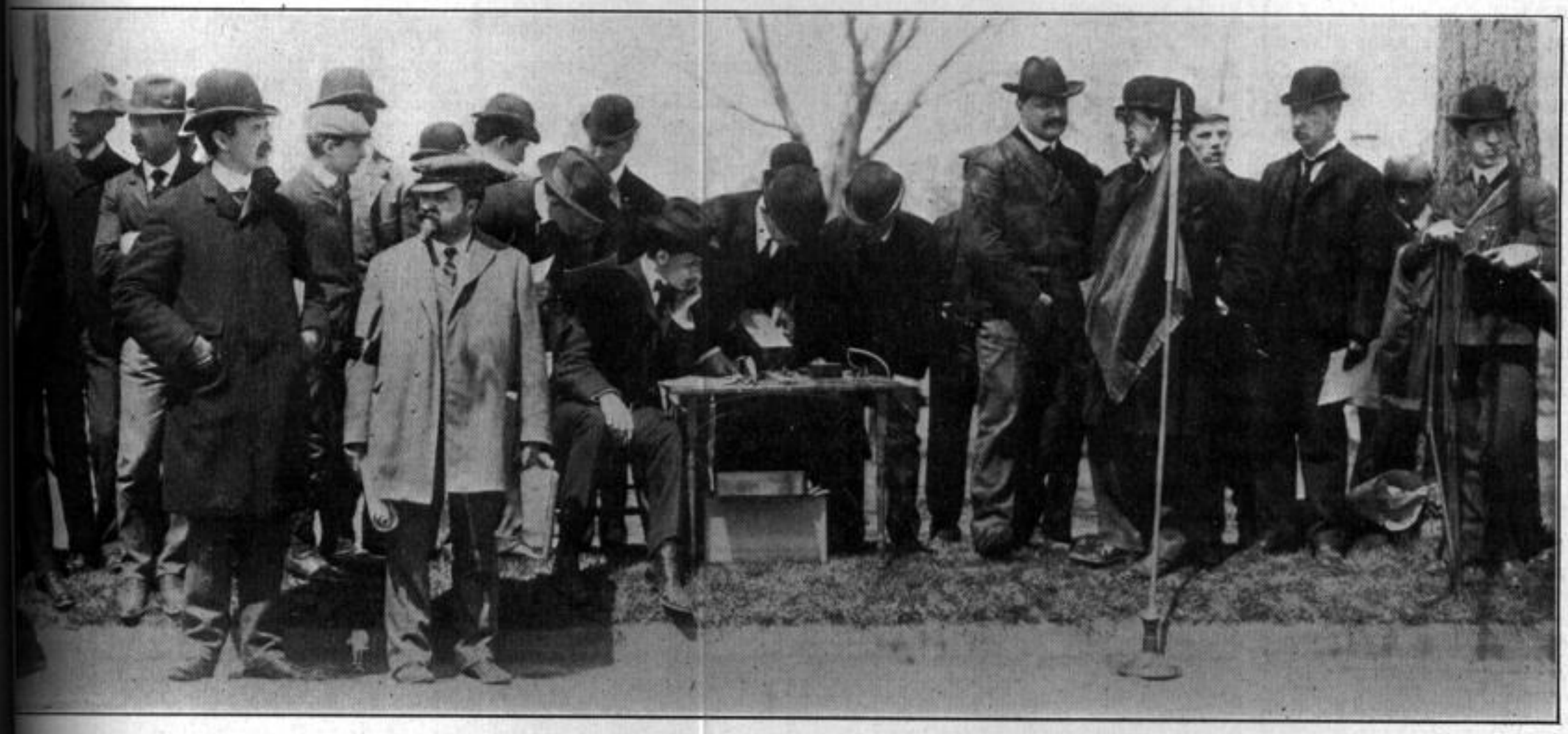
Further, the distance traveled before a vehicle with average braking power comes to a stop is given by the expression $15 \times s^2$. That is, for a speed of 10 miles the distance is 15 feet; for 15 miles, 34 feet; for 20 miles, 60 feet, and for 25 miles, 94 feet.

The coefficient a, as stated, depends upon the brake power, and varies therefore with different machines. Five observations on a Toledo carriage gave it as .162 for that machine. Four observations on a United States Long Distance machine show it to be .194 and two observations on a Packard .16.

In the diagram the points representing the stopping power of the horse vehicles that participated in the trials are in every case below the curve, showing that their stopping power was less (considerably) than the average of the automobiles.

Consul C. B. Harris, of Nagasaki, Japan, writes as follows to the State Department: "It is likely that a cheap automobile, holding one person, to take the place of the jinrikisha (made of the same width) would find a ready sale in Japan. There were, on April 1, 1901, 206,848 jinrikishas in use in the empire, 193,249 being made for seating one person and 17,339 for two."

E. T. Birdsall has closed a contract for the American agency of the Decauville cars, and will soon have the latest 10 horse power model to show at 121 West Thirty-first street, New York.



THE TIMING APPARATUS