ART. XLII.—*Evolution of the American Trotting Horse*; by
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THE two articles which have appeared on the above subject in the July and August numbers of this Journal have but just come to my knowledge, as I have been absent from the city for several weeks. Mr. Nipher has dealt with the question in a somewhat different manner from myself (see *Science*, May 4th), and has arrived at quite different results.

According to my calculations the value $\frac{ds}{dT}$ (s = seconds, T = years), instead of diminishing was nearly constant, with a slight tendency to increase. Or, in other words, horses were improving their speed slightly more rapidly now than they were a few years ago. This of course might readily be explained by the greater care bestowed in breeding and by greater attention being paid to the subject now than formerly. This could not last for many years, however, and the value of $\frac{ds}{dT}$ must finally diminish to zero. But in the mean time we have no means of saying how soon this will take place, or what will be the value of s . According to my work we could only predict what speed would be made in the course of the next few years, and it was concluded, for example, that two minutes would be reached about the year 1907.

Instead of taking his dates directly from the races, Mr. Nipher prefers to interpolate them from some curves which he has calculated. If all the observations contributed by Mr. Brewer could be included in this scheme, it would undoubtedly be the best method. As it is, it limits our author confessedly for accurate work, between the dates 1854 and 1873, whereas, the direct method is capable of including all observations from 1824 up to the present time. It therefore seems to me that the greater number of observations more than compensates for the greater accuracy of the few. And indeed I think this is indicated by the fact that we shall be able to draw quite a different conclusion from our author, though using the results obtained by his own method, while, by using all the observations as in my former article, I think but one conclusion can be drawn.

At the top of page 22 (July number), Mr. Nipher gives a table, the third column of which $\frac{ds}{dT}$ he calculates from alternate differences in the first two columns. Now where there are so few observations I think this method is hardly of sufficient accuracy, and that it is somewhat better to divide the

first differences of the first column, by those of the second, directly. By so doing the figures in the third column will read 59, 55, 54, 46, 55, 35, 75. This method does not smooth down the curve at all, but shows it with all its original irregularities. Plotting now a curve with these figures as ordinates, and the corresponding values of s as abscissae, we get the following figure:

These results could evidently be represented by a curve. And they show what mine did, only I think in an exaggerated way, the increasing value of $\frac{ds}{dT}$ within the last few years.

Mr. Nipher, however, prefers to represent them by a straight line. This line N is shown upon the plate, calculated from his values of a and b . Following him in this respect, two lines of my own A and B are also given. Now there are two methods by which we may determine approximately the accuracy with which a line represents a series of observations. First, that while the line coincides as nearly as possible with the points observed, the algebraic sum of the ordinates should be zero; and second, that the sum of the squares of the ordinates should be reduced to a minimum. Making these calculations we obtain the following results:

	N	A	B
Sum of the ordinates	72	15	1
Sum of the squares.....	1900	1073	931

In both particulars we find that B best represents the results, and it is the line having the least inclination. We therefore conclude that $\frac{ds}{dT}$ is diminishing very slowly. Calculating its equation we find $\frac{ds}{dT} = .084 + .0033 s$. According to this, $\frac{ds}{dT}$ can only become zero when $s = -25$, or in other words the speed of the trotter will only cease to improve when he trots a mile in minus twenty-five seconds, or in less than no time at all.

I therefore maintain that Mr. Nipher's method, if correctly interpreted, gives in general the same result as my own. By it we may foretell what will be the speed attained for a few years in advance, but we cannot tell what will be the ultimate speed, nor when it will be reached.

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