

thirds of its time, and utilising also, as I have above explained, the more rapid of the descending currents, the bird can more than sustain itself. It can at will glide to windward at the rate of fifteen miles an hour against the breeze, losing of elevation only one in twenty.

R. COURTENAY

L'Ermitage, Hyères (Var), France, April 28

Flight of Crows

I CAN corroborate the observation of Mr. Murphy as to the oblique flight of crows. When I have seen them so flying there has always been a cross current, and they have merely kept their heads a little to the wind.

Cambridge

THOS. MCKENNY HUGHES

Sheet Lightning

Du choc des opinions jaillit la vérité. I still adhere to your assertion that sheet lightning is not, at least in most cases, the mere reflection of a common but distant storm. On the highlands of Ethiopia, in the years 1842 to 1848 I was diligently engaged in investigating the electrical phenomena so frequent in that region. The details of my observations were printed in 1858 by the French Institute, and I have published again my results in my "Observations relatives à la Physique du Globe" (Paris, 1873). The following cases may be of interest:—

Near the zenith eight successive flashes of lightning were seen 21 seconds before their thunder, which lasted exactly 12 seconds. Another day it lasted 24.45. thirty successive times, and, as previously, without any rain. My greatest observed interval was 111.2s., corresponding to a distance of 38,500 metres, &c.

I have seen more than once straight or zigzag lightning unaccompanied by thunder. One afternoon it went to and fro twice between two horizontal cloud banks, and ended in sheet lightning which illuminated, not the lower dark bank, but only the under surface of the upper cloud. I have observed frequently thunder without lightning and lightning without thunder.

When in Adwa I recorded silent sheet lightning towards Gondar, 240 kilometres distant, where a violent storm was raging at the same time. Before leaping to a hasty conclusion, let us hear a case bearing pointedly to the opposite opinion: in 1845, at Saga (latitude 8° 11'), a semi-transparent fog which had mantled over the valley, and could not be more than 3500 metres distant, gave out a flash of sheet lightning without thunder.

Although my numerous observations have given me a strong bias in favour of your opinion, I do not wish to impose it on reluctant philosophers, but suggest the following system to clear up the question:—Let two observers, A and B, 40 or 50 miles asunder, mention instances of lightning seen in each other's true bearing. If they can also secure the help of a third observer located on or near the straight line from A to B, and who can watch in two opposite directions, many important results may be obtained.

ANTOINE D'ABBADIE

Paris, May 5

The American Trotting-Horse

MR. BREWER'S memoir on the evolution of the breed of the American trotting-horse (NATURE, vol. xxvii. p. 609), and the statistical tables that accompany it, are full of interest, but I only propose now to concern myself with the latter, which may be easily and usefully discussed by employing a statistical method that I have long advocated. In explanation I will begin by extracting the final terms of four of the lines of his table, as follows:—

Year.	2.27 or better.	2.25 or better.	2.23 or better.	2.21 or better.	2.19 or better.	2.17 or better.	2.15 or better.	2.13 or better.	2.11 or better.
1871	99	40	17	12	6	1			
1874		98	40	16	11	5	1		
1877			105	51	19	8	2		
1880				106	41	14	6	2	1

The meaning of these entries are, that in the year 1871 there were 99 horses that could trot a mile in 2 minutes 27 seconds, or less; that in the same year there were 40 that could trot it in 2 minutes 25 seconds, or less; and so on. Their significance is

that the rate per mile of the hundred fastest American trotting-horses has become 2 seconds faster in each successive period of 3 years, beginning with 1871, and ending with 1880; also that the relative speed of the hundred fastest horses in each year is closely the same, though their absolute speed differs.

We may read the table in another way. If the number of horses that can run a mile in 2 minutes 27 seconds or less is 99, we may infer without risk of sensible error that the 99th horse in the order of running accomplishes a mile in *that time exactly*, because the 100th horse certainly takes a longer time, and it is statistically incredible that the rate of the 99th and of the 100th horses should differ by more than a barely perceptible interval. For the same reason we may infer that the 40th horse in that same year runs a mile in 2 minutes 25 seconds, and so on. We can now draw curves, and by graphical interpolation find with the greatest facility the mile rate of the horse in any order of running in any year that we please to select. I have selected the 100th, 50th, 20th, and 10th horse respectively for each year beginning with 1874, when we are informed that the returns first begin to be accurate, and have thrown the results into the following simple table. The curves obviously required a little smoothing here and there, and in three or four places the readings have been thereby modified by one or two tenths of a second. Otherwise they are given directly from the rough plottings.

Number of Seconds and Tenths of Seconds in Excess of Two Minutes that are required for Running One Mile by the Horses whose Order in the Rate of Running in each Year is given at the Top of the Columns

Year.	100th.	50th.	20th.	10th.
1874	25.1	23.4	20.5	18.8
1875	24.1	22.5	19.9	18.2
1876	23.5	21.6	19.5	17.7
1877	22.9	21.0	19.0	17.4
1878	22.1	20.2	18.5	17.0
1879	21.3	19.6	18.0	16.6
1880	20.8	19.3	17.6	16.0
1881	20.4	18.8	17.2	15.7
1882	19.9	18.4	17.0	15.4
Anticipated 1890	16.8	15.5	14.4	13.4

Mem.—The first horse runs the mile in about 5 or 6 seconds less than the tenth horse.

It will be found on plotting the figures in the vertical columns into curves, that they run with much regularity and differ little from straight lines. The general conclusion to be derived from them is that the improvement of the running shows as yet little tendency to slacken, though no doubt if the number of horses bred for trotting ceased to increase yearly at the same large rate as hitherto, it might do so. Supposing, however, the conditions to be maintained, I should anticipate that in 1890 there will be about 15 horses that will run a mile in 2 minutes 15 seconds or less, and that the fastest horse of that year will run a mile in about 2 minutes 8 seconds.

FRANCIS GALTON

The Shapes of Leaves

MR. GRANT ALLEN'S papers in NATURE will evidently serve to direct attention to a most interesting subject which hitherto appears to have been much neglected. Every contribution of observed facts may tend to throw further light upon it, and I therefore venture to remark that one cause of the frequently filiform character of the leaves of water-plants appears to be the elongating action exercised upon the cells by the pressure of a rapid current of water, since it is obvious that growth must take place in the direction of the least resistance. With a radiate-veined leaf the tendency must be towards lateral pressure, which would compress and elongate, and so give a linear form to the leaf-cells. I have been much interested to observe that on the seashore, in places where Fuci are exposed to this action by the ebbing tide, as when growing on the edge of a large boulder or hanging over its sides, the fronds and even the receptacles become unusually elongated.