

they began late, and they had not yet caught up some other nations, and much had still to be done in this country in order to provide the facilities that were needed to furnish their sons with the knowledge that was necessary to enable them to carry on the commercial business of the country. The City and Guilds Institute had in the most munificent manner spent on its technical colleges in the course of the past eighteen years about half a million out of the funds over which it had control; but could they go on relying upon private munificence so much as they had done for the purposes of technical education? He ventured to think that the time had come when there should be some system supported by funds, if necessary, of some public nature by which colleges should be founded in the great centres where they were needed, and branch colleges of a similar description in smaller places where they were wanted. The whole scheme of technical education seemed to him to have come to the point at which it required some further consideration. In connection with this subject one had often to speak of Germany and Switzerland, but he was quite sure that they did not speak of them in any spirit of jealousy, but, on the contrary, in a spirit of admiring emulation of their work. They must take what they could that was best from those countries and adopt it, and leave the latter to act in a similar manner towards this country.

SCIENTIFIC SERIALS.

*American Journal of Science*, January.—A new harmonic analyser, by A. A. Michelson and S. W. Stroud. This is an instrument designed to sum up as many as eighty terms of a Fourier series, or to analyse a given curve into its original series. The pen which traces the curve is worked up and down by a lever controlled by a spring. This spring is stretched by an eccentric, which imparts a "simple harmonic" variation to the force. The stretching is resisted by another spring. Eighty such elements are connected together, with one resisting spring to counterbalance the sum of the elementary springs. The pen therefore moves in accordance with the sum of the elementary periodic motions. The authors obtain by this machine the mathematical series representing the profile of a human face.—A new form of physical pendulum, by J. S. Stevens. The error introduced into the ordinary physical pendulum by the fact that the knife-edges and clamp affect the moment of inertia may be eliminated by boring a hole into the rod and screwing the knife edges a little way in, so that they offset the mass of brass bored out.—The Protostegan plastron, by G. R. Wieland. This is a restoration of the plastron of two specimens of the turtle described before as *Archelon ischyros*.—Phosphorescence produced by electrification, by J. Trowbridge and J. E. Burbank. When a piece of fluorspar is first exposed to the action of X-rays, and subsequently heated, it shows a bright phosphorescence. The same phenomenon may be produced by exposing the mineral to an electric brush discharge, and subsequently heating it. It is probable, therefore, that the X-rays produce an electrification of the fluorspar.—On iron meteorites, as nodular structures in stony meteorites, by H. L. Preston. It is an important fact that of over 100 falls and finds of siderites or iron meteorites but nine have been seen to fall, while of the acrolites or stony meteorites of over 400 falls and finds, more than one-half have been seen to fall. The author gives several reasons in support of the view that the siderites are merely the crystallised metallic nodules contained in the larger and more conspicuous stony meteorites.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 13, 1897.—"An Examination into the Registered Speeds of American Trotting Horses, with Remarks on their Value as Hereditary Data." By Francis Galton, D.C.L., F.R.S.

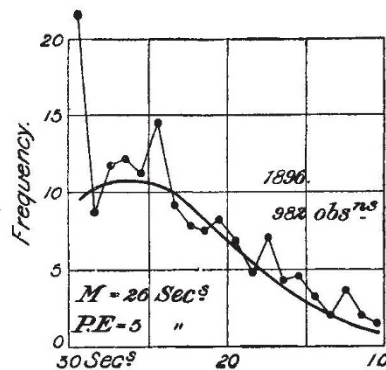
It is strange that the huge sums spent on the breeding of pedigree stock, whether of horses, cattle, or other animals, should not give rise to systematic publications of authentic records in a form suitable for scientific inquiry into the laws of heredity. An almost solitary exception to the disregard shown by breeders and owners, of exact measurements for publication in stud books, exists in the United States with respect to the measured speed of "trotters" and "pacers" under defined conditions. The performance of one mile by a trotter, harnessed

to a two-wheeled vehicle, carrying a weight of not less than 150 lbs. inclusive of the driver, in 2 minutes 30 seconds qualifies him for entry in the "Trotting Register," giving him, as it were, a pass-degree into a class of horses whose several utmost speeds or "records" are there published.

The system of timing was first put into practice more than fifty years ago, and has since been developed and improved. In 1892 a considerable change was made in the conditions by the introduction of bicycle wheels with pneumatic tyres, which produced a gain of speed, the amount of which is much discussed, but which a prevalent opinion rates at 5 seconds in the mile. Thenceforward the records are comparable on nearly equal terms. All trotting performances up to the 2' 30" standard are registered in the large and closely printed volumes of "Wallace's Year Book," published under the authority of the American Trotting Association. Vols. viii.-xii. refer to the years 1892-6, and it is from the entries in these that the following remarks are based.

The object of my inquiry was to test the suitability of these trotting (and pacing) records for investigations into the laws of heredity. I had to determine whether the observations fell into a tolerably smooth curve; and, if so, whether that curve was a tolerable approach to the normal curve of frequency. In the latter event the observations would fall into line with numerous anthropometric and other measures which have been often discussed, and which, when treated by methods in which the arithmetic mean is employed, yield results that accord with observed facts.

I had 5705 extracts made from the entries published in the Year Books for the five years 1892-6. It was tedious work, and I thought it unnecessary to repeat it to check the results, being satisfied after some examination that they were quite accurate enough for general conclusions. They were arranged in columns; the first to the left contained entries of all observations recorded as 2' 29" 0", 29 1/4", 29 1/2", or 29 3/4"; that is of all under 2' 30" down to 2' 29" inclusive. The second column referred to 2' 28" 0, 28 1/4", 28 1/2", and 28 3/4", and so on with the rest. These were then reduced to percentages and diagrams were drawn from them, of which the following, for the year 1896, is one; it will serve as a fair sample of the other four.



If divided by the eye into imaginary columns corresponding to those in the tables, the point representing the sum of the observations of 2' 29" 0", 29 1/4", 29 1/2" and 29 3/4" will be found in the middle of the first imaginary column, that is to say it stands vertically above the point that lies half way between 29 and 30 on the scale along the base. The dots are connected by thin lines to show the trace or curve of the observations. The smooth curves are those of normal frequency, calculated from the values of the mean (M) and of the probable error (P.E.), which are given in the diagrams.

Leaving aside for the moment the strange pinnacle that rises on the extreme left of every diagram, we see that the traces of the rest of the observations run very roughly, but not intolerably so. In each diagram they seem to be disposed about a fundamentally smooth curve. Considering the smallness of the interval, namely, only one second, that separates the observations assigned to each pair of successive columns, together with the experience derived from other kinds of statistical curves, it seems to me that the run of the observations is good enough to certify their general trustworthiness. As regards the pinnacle it is a different matter, and is one which when beginning work, as