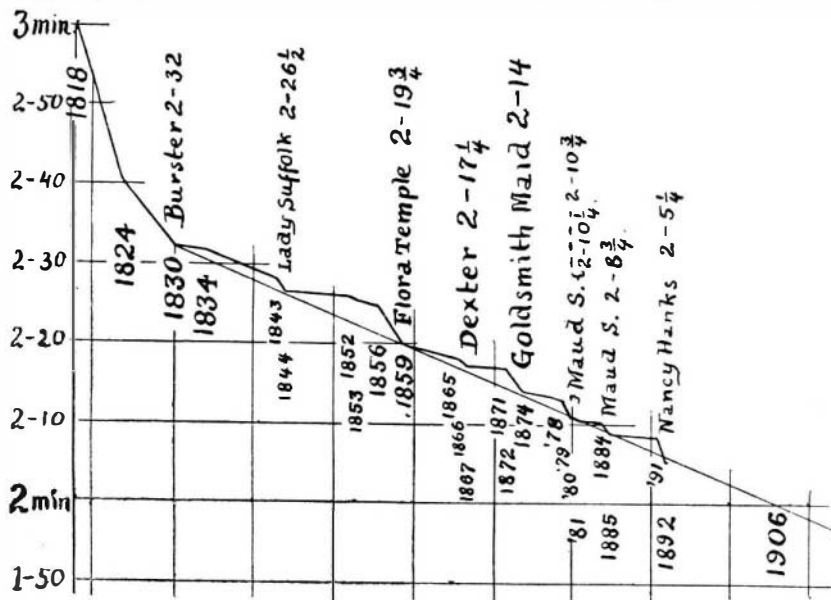


HOW HORSE TROTGING IMPROVES.

The recent lowering of the trotting record by Nancy Hanks to 2 minutes 5¼ seconds is a remarkable verification of a mathematical law that has been followed to a fraction of a second for the past sixty-two years.



This law is that the time to trot a mile is reducing at the precise rate of 11-26 of a second a year.

The accompanying chart illustrates how such a mathematical law is ascertained. The paper is first ruled with horizontal and vertical lines. The former are numbered consecutively with seconds from three minutes downward, and the latter are numbered with the years from the time when horse trotting commenced. Each noteworthy lowering of the record was next indicated on the chart, by placing dots at the intersections of the vertical lines indicating the years with the horizontal lines denoting the speeds. Only each tenth line is left on the diagram as printed to avoid too much crowding. The zigzag line in the upper corner joins the dots placed as above described. The mathematical law is ascertained by trying various curved and straight lines until the one is found which most closely follows the same general direction as the broken line. As the broken line makes an abrupt turn at 1830, and since trotting did not become an established sport until that year, it will be best to confine attention to that part of the line extending from that year forward. To it a straight line comes closer than any other, and such a line can be drawn so as to come within half a second of it at six points, beginning with Burster's record in 1830 and ending with the record made by Nancy Hanks last week. Such a line will represent the rate of improvement of 11 seconds in 26 years, and will show when extended forward what trotting speeds to expect in the future.

The trotting time for any year can be computed from this ratio as follows:

The difference is taken between the year for which it is desired to predict or verify the trotting speed and the year 1830, when the law began. This is multiplied

2 minutes 32 seconds leaves 2 minutes 8¾ seconds. In that year the record of Maud S. was taken at 2 minutes 8¾ seconds, thus agreeing with the calculation to within the fiftieth of a second. The record of Flora Temple in 1859 is equally close.

The greatest achievements of record breakers are given below in tabular form. By it the correctness of this law will be readily noted in the close agreement of the two columns headed "observed time" and "computed time."

Year.	Horse.	Observed time.	Computed time.
1830	Burster	2-3200	2-3200
1834	Lady Suffolk	2-2650	2-2608
1859	Flora Temple	2-1975	2-1973
1867	Dexter	2-1725	2-1635
1874	Goldsmith Maid	2-1400	2-1339
1880	Maud S.	2-1075	2-1085
1885	Maud S.	2-875	2-873
1892	Nancy Hanks	2-525	2-577

In studying the above table it will be interesting to note the intervals between the record-breaking years. Since 1867 a remarkable smashing of records has occurred, and a record has been made in close accord with

the above law of improvement every five to seven years. From these considerations a reduction of the record to 2 minutes and 3 or 4 seconds is to be expected about the end of the century and a reaching of the 2 minute gait in the year 1906. The innovations of the pneumatic sulky and the kite-shaped track however do not leave records that are now being made on the same footing with those by which the above law was deduced, and better records than are above indicated may therefore be looked for with these helps.

That the time required to trot a mile should go right on diminishing at the precise rate of 11 seconds in 26 years, and show not the slightest sign of diminishing, by which we might be able to observe that a limit is being approached, is indeed remarkable and unexpected, but the facts clearly show it, and we are left with no other guide to the future than they afford. This guide shows that in the year 2047 the mile a minute gait will be reached, and that 297 years hence it will be in order to race trotters with the lightning's flash.

S. W. BALCH.

AN IMPROVED BRICK MACHINE.

The illustration represents an easily operated machine, patented by Mr. Howard Harlan, by which clay may be rapidly and firmly pressed into the form of bricks, which will be automatically ejected from the moulds. The driving shaft extends through a central vertical post, on the top of which is held a revoluble table having on its under side flanges extending into the path of an arm fixed to the driving shaft, by which the table is turned a fourth of a revolution at each stroke. The moulds are arranged around the table near its edge, being readily attached or removed, and in each mould is a vertically movable plunger having a stem projecting downward through the table. A vertically movable post, sliding in a guide bar, is operated by an eccentric on the drive shaft to press upward upon the stem of the plunger with a limited movement, sufficient to compress a brick, and simultaneously with this motion a vertically movable frame, operated by cams on the drive shaft, causes a cover mould to force the clay in the mould downward, so that it will be squeezed between the cover mould and the plunger.

One-fourth way farther around the table is an ejecting mechanism consisting of a sliding frame, actuated by a cam on a countershaft, and carrying a post adapted to raise the plunger to the top of the mould, whereby a brick will be ejected after compression at the next movement of the table. A greater or less number of moulds may be arranged on the table as desired, the machine being shown with four moulds, and the arm on the driving shaft striking a flange to turn the table a quarter way around at each revolution. The clay placed in the moulds is thus successively compressed and ejected therefrom.

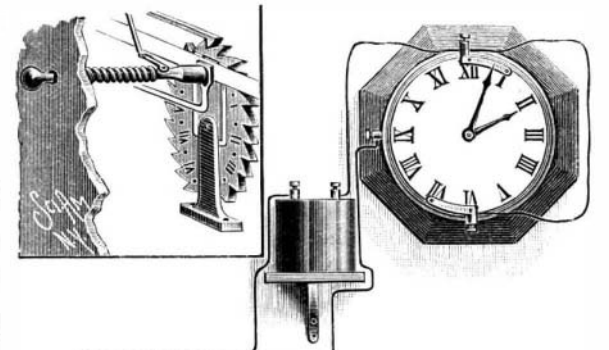
Further information relative to this improvement may be obtained of Mr. George R. McCrea, of Renovo, Penn.

Caterpillars in Pill Boxes.

Mr. E. B. Boulton, F.R.S., fascinated the Biology Section of the British Association with the results of his experiments on caterpillars hatching in pill boxes. The pepper moth was the particular insect which he experimented on, and his experiments show that if you take an egg of one of these and grow it in a gilded pill box you get a golden caterpillar. Again, if the pill box be black, so is the caterpillar; while a mixed environment produced a muddled creature, just as in man the environment of the slum or the palace pretty much determines a person's characteristics.

A WATCHMAN'S ELECTRIC TIME RECORDER.

An improved apparatus designed to afford a simple and effective watchman's time check, to indicate the presence or absence of the watchman at a given point at certain intervals of time, is shown in the accompanying illustration, and has been patented by Mr. Emanuel R. Heyser, of Leon, Mexico. Electric contact strips are secured to the dial of a clock at opposite edges to cover a space equal to five minutes of time by the clock, the strips being in the path of the minute hand, and having binding posts connected with one pole of a battery, the other pole of which is connected with the electro-magnetic check mechanism, electrically connected with the movement of the clock. This check mechanism, in a casing beneath the clock, has a ratchet wheel on the side of which are characters corresponding with those on a clock dial, and intermediate projections for the half hours. The armature lever, which is prolonged above the armature, carries a hooked pawl to engage the ratchet wheel, and carries also an angled arm, the end of which is enlarged to form a platen adapted to cover the characters on the side of the wheel. A printing bar adapted to press upon this platen is shown in the small view, the bar being drawn out by its knob against the pressure of a spring, which throws the bar inward when the knob is released. A forked arm carries an ink ribbon in front of the wheel, opposite the characters, and in front of the ink ribbon is carried a strip of paper taken from a reel at one end of the casing and wound upon a reel at the opposite end, the latter reel being operated by means of spur and ratchet wheel connections to draw the paper along in connection with the pulling of the printing bar. A spring normally holds the armature lever against a limit screw, but when the minute hand of the clock



HEYSER'S WATCHMAN'S ELECTRIC TIME CHECK.

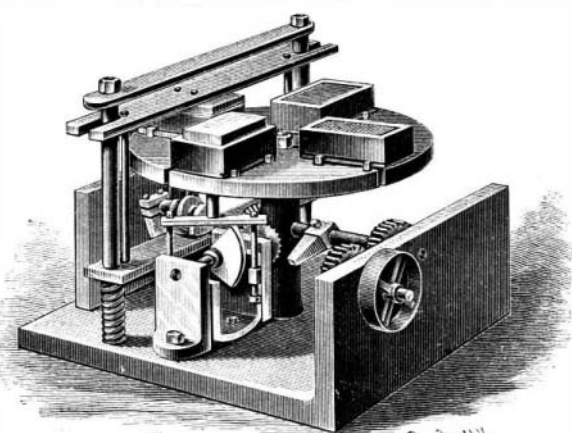
makes a contact with one of the contact strips on the dial, which occurs every half hour, the circuit of the battery is closed and the magnet in the casing is energized, drawing forward the armature, and moving the ratchet wheel one notch, bringing a dot or character opposite the printing bar, and moving the platen to position between the bar and the paper strip. By the pulling of the knob at any time in the five minutes while the circuit of the battery is thus closed, a corresponding record will be made upon the strip, but when the circuit is broken the armature lever is thrown back and the platen carried out of the path of the printing bar, so that no record can be made and the paper strip will show a neglect of duty on the part of the watchman.

Progress of the Telephone.

In Census Bulletin No. 196 is presented a preliminary report on operating telephone companies for the year ended December 31, 1890, prepared by Mr. Allen R. Foote, expert special agent for the collection of statistics of the electrical industries, under direction of Mr. Frank R. Williams, in charge of the collection of statistics relating to all branches of manufactures.

This report is deemed of special interest because of the great advance shown in this industry and the enormous increase developed in the demand for telephone service.

	1880	1890
Number of companies, firms, and persons reporting.....	148	53
Total investment.....	\$14,605,787	\$72,341,736
Gross earnings.....	3,098,081	16,404,583
Gross expenses.....	2,373,703	11,143,871
Net earnings.....	724,378	5,260,712
Number of exchanges.....	437	1,241
Number of telephones and transmitters.....	108,638	467,356
Miles of wire.....	34,305	240,412
Number of employees.....	3,338	8,645
Number of subscribers.....	48,414	237,357
Number of conversations.....		453,200,000



HARLAN'S BRICK MACHINE.

by the fraction 11-26, and the product is the number of seconds to be deducted from the time, 2-32, made by Burster. Thus if it is desired to compare the record made in 1885 with this law, the difference between this year and 1830, that is 55, is multiplied by 11-26, or what is the same thing, multiplied by 11 and divided by 26. This gives 23.27 seconds, which deducted from