

Class	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8
						att. rt.	att. rt.	att. rt.
1914	100	85	69	77	150	12 12	19 17	8 7
	41	42	31	29	93	4 4	14 4	3 2
1915	100	102	75	83	150	11 10	19 18	8 7
	51	40	40	40	82	8 2	13 3 5	2 1
1915	112	78	70	82	150	10 10	19 18	7 7
	40	32	37	35	80	4 1	9 3	2 0

It will be seen from the above data that the efficiency of the lowest record in terms of the highest record will average not over forty per cent.

In 1914 the two sections seemed to have nearly the same efficiency at the beginning of the year but the class (8:00 section) showed an efficiency of only 85% of that of the other section at the end of the year and exactly $\frac{1}{2}$ as many students from this section elected calculus in 1915 as from the other section.

The wide variations in efficiency in fundamental operations continued throughout the year and in general, not always, was indicative of the rank of the students as determined by the semester grade. The two results were, in general, in too close agreement to be mere coincidence.

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TIMES OF WRITING EACH OF THE ARABIC NUMERALS DETERMINED BY THE REACTION TIME METHOD.

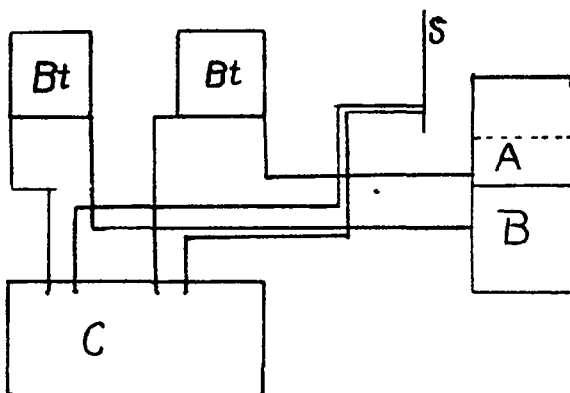
In constructing any arithmetic test in which all possible factors are to be controlled it is important that the time for making the figures to be written by the pupil should be evaluated. We know in a general way that it takes longer to make a "5" than it does to make a "7." If we are to construct examples upon a scientific basis, the relative difference between the times for making the ten Arabic numerals must be known more accurately.

Through the courtesy of Dr. James P. Porter, head of the Department of Psychology of Clark College, the above mentioned determination was made possible by the use of the Bergstrom Pendulum Chronoscope. In determining the times for making the different figures the following method was used:

A steel stylus S (Fig. 1), and two thin pieces of copper, A and B, partially superposed but separated by a sheet of tissue paper were introduced into the circuit with the chronoscope, C. The figures were made upon the surface of the upper piece of copper, A. When the stylus touched this surface the pendulum carrying the indicator of the chronoscope was started. The figure was made in such a way that the end of the last stroke brought the stylus off of the first surface on to the surface of the second piece, B. When the steel point made contact with the second copper surface the indicator of the chronoscope was stopped by its magnet and the time for making the figure could be read in thousandths of a second.

FIGURE I.

Diagram showing Chronoscope with connections used in determining time of writing Arabic numerals.



A and B --Copper plates
 S -- Stylus
 C -- Chronoscope
 Bt -- Batteries

After preliminary trials each figure was made twenty-five times on the first day. In order to corroborate the results of this first day's work, the experiment was repeated on the next day in exactly the same way. The following table gives the results:

TABLE I.

Median Times, Standard Deviations, and Probable Errors in 1000ths of a Second for Writing Each of the Ten Arabic Numerals.

Numerals	First Day			Numerals	Second Day		
	Median	S. D.	P. E.		Median	S. D.	P. E.
1	40.1	3.3	2.23	1	46	2.9	1.96
2*	224.5	8.6	5.8	2*	261	14.7	9.92
2	140.2	5.3	3.57	2	161.5	9	6.07
3	260	13.3	8.97	3	262.5	14.2	9.58
4	241	11.3	7.62	4	236	9.3	6.27
5	295	8.1	5.46	5	298	8.0	5.39
6	172.5	8.0	5.39	6	160	9.2	6.20
7*	259	16.3	10.99	7*	220	12.9	8.70
7	114	7.9	5.33	7	98	9.9	6.68
8	185.3	7.0	4.72	8	210	10.5	7.08
9	170.4	7.0	4.72	9	184	10.7	7.22
0	118	3.9	2.63	0	110.2	6.5	4.38

Although the manner of making the figures by the children in their school work cannot be controlled, it was thought advisable to make the figure "2" and the figure "7" in two different ways. The figure "2" was first made by using the preliminary loop which is sometimes used in the making of the figure. In the second case the preliminary loop was omitted. The figure "7" is also sometimes made with a preliminary stroke. The time for these figures was taken with and without such a stroke. The results show that this added movement increases very materially the time for making the figure.

In these experiments, the writer was the only subject. It is highly desirable that many more subjects of differing ages be used. This brief account is offered in the hope that some suggestions may follow leading to a more scientific construction of test examples to be used with out school children.

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*Preliminary stroke is used.