the error of the control apparatus is probably greater than that of the chronoscope. To obviate this difficulty I make use of a ball held in position by a magnet, and falling from any height up to seven feet, upon the arm of a well-balanced lever, thus securing an instantaneous release. By setting the magnet and ball at different distances we are also enabled to decide whether the error is absolute or relative. It is here necessary to break the current by which the ball falls, and to make the current by which the chronoscope starts at the same moment; this is effected by a key specially devised for the purpose. The chronoscope possesses a regulation for alternating its rate when too slow or too fast, but I find it most convenient to make sparing use of this, and apply a correction for each day's determinations as found with the "fall apparatus." Another form of control makes use of a falling hammer, the record being also made with a tuning-fork. A recent device of Ewald combines the two methods by mechanically counting the vibrations of a tuning-fork: a delicate armature is drawn to and released by a magnet with each vibration of the fork, moving the hand of a dial over one of its divisions as it does so. The fork is vibrating constantly, but the making of the signal sends the current into the "interruption-counter," while the re-acting movement again diverts the current away from it. It will record at the rate of one hundred per second. Galton has constructed for ordinary uses a machine in which the signal is given by the release of a rod or pendulum, and the re-acting movement mechanically arrests the fall or swing, a scale of interval being determined for the apparatus empirically. Sanford has devised a simple but not expeditious chronoscope, in which the signal and the response separately set in motion two pendulums of slightly different periods, the re-acting interval being calculated from the number of oscillations occurring before the two are again in unison.

The methods of indicating the moment at which the signal appeared and the moment at which the re-acting movement was made are simple. When the record is written on a rotating surface, a point connected with a magnet, and writing a straight line beneath the vibrations of the fork, writes that line at a different level when the signal is given, and returns to the same level when the re-acting movement is made; or the tuning-fork itself may be made to write at a different level during the interval measured. The arrangement by which the level is changed on the record, or the hands are set in motion in the chronoscope at the same instant that the stimulus appears, is equally simple. For sound, the noise of the key by which the circuit is made is generally sufficient, or other sound may be produced by bodies falling upon various surfaces and thereby opening or closing a key. For sight, the impression to which a re-action is to be made may be concealed behind a screen, and the drawing away of this screen at the same time makes or breaks an electric circuit. Frequently the re-actor sits in the dark, and the impression becomes visible only when an electric spark appears, or the spark itself may be the stimulus. For touch, temperature, and taste, a typical device is that of Vintschgau, in which the end of a rod touches the sensitive surface, and the pressure so exerted makes a contact with a delicate metallic blade inserted in the same apparatus. For smell, the movement by which the odor is set free is similarly utilized. The re-acting movement is usually that of pressing an ordinary telegraphic key. Devices have been constructed by which movements of the foot, of the jaw, of the voice and lip, may be similarly noted. For more detailed descriptions consult the references under this head at the end. JOSEPH JASTROW.

[To be continued.]

IN the *Atlantic* for September Mr. Justin Winsor considers the "Perils of Historical Narrative," Mr. J. Franklin Jameson contributes a paper on "Modern European Historiography," and Mr. Fiske adds an article on the "Disasters of 1780." These three papers furnish the solid reading of the number.

PROFESSOR A. GRAHAM BELL'S STUDIES ON THE DEAF.

IN the year 1888 the Royal Commission appointed by the British Government to inquire into the question of the care and education of the deaf called to their aid Dr. E. M. Gallaudet, the distinguished president of the National College at Washington, and later Professor A. Graham Bell, whose long interest in the deaf qualified him more than any other public man in America, outside those directly engaged in the work of instruction, to speak with some degree of authority on the questions presented to him. The information presented by Professor Bell has been published in pamphlet form, entitled "Facts and Opinions," and contains a great variety of facts concerning visible speech, heredity, day schools, articulation, and kindred subjects. The Royal Commission has recently completed its investigations, and reported to Parliament the results of its work. I mention the report right here, to draw attention to another of those singular conclusions which have characterized the opinions of men of unquestioned learning and intelligence, when undertaking to speak officially concerning the deaf. In paragraph 398 of this report we find this extraordinary statement, "The want of exercise of the lungs and throat on the part of pupils taught by the manual method is apt to produce chilblains." Two members of the Commission had the good sense to dissent from this paragraph, and officially to pronounce it "quite absurd."

It is impossible within the limits of this article to discuss *seriatim* the several subjects upon which Professor Bell has addressed the public, and I am therefore compelled to make a selection from those studies with which his name has become most closely associated, and from these it will be easily possible to infer the value of what he has done for the deaf. It is also necessary to add, that, in the friendly contention for methods aroused by Professor Bell's long indictment of our American schools, there is on our part a ready recognition of the honesty and zeal which has inspired him; and if we speak plainly on the studies which he has given to the public, we ask for ourselves a recognition of the same sincerity, something of that same chevalier spirit with which he has carried his lance against us.

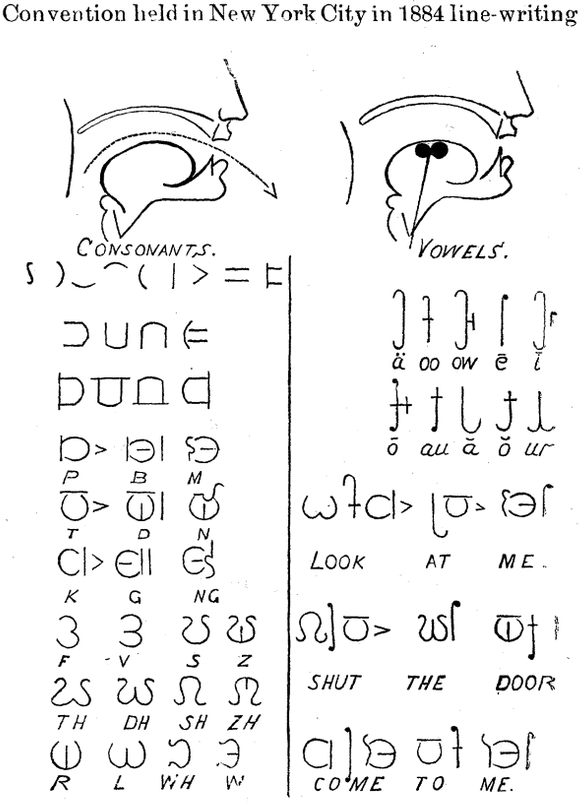
The first measure for the education of the deaf with which Professor Bell became identified was "visible speech." This is a system of universal alphabetics, originated by A. Melville Bell, and was introduced into the United States nearly twenty years ago. The first exposition of this system of vocal physiology in the city of Boston created quite a sensation in literary circles. The extraordinary statement, during the first few months of trial, that "adult deaf-mutes had acquired all the sounds of the English language in ten lessons" (Report Massachusetts Board of Education, 1871–1872), drew, at once, the attention of all those interested in the deaf to this new device. From the report already referred to, and from that of the succeeding year, we find that "the effects produced by this new system are in the highest degree remarkable—even miraculous;" and again, "Perfect and pleasing articulation is certain." To this last claim, it is enough to say that to day there is not a reputable teacher in the United States who makes any approximation to so rash a claim. In view of all that was claimed for visible speech, it is not surprising that it soon became among us a

sort of craze, and that teachers in the art were everywhere in demand. The Clarke Institution at Northampton and the American Asylum at Hartford were fortunate in securing the personal services of Professor Bell, to give special instruction in introducing the Bell method. The number of adherents increased rapidly, and at Worcester, Northampton, and Boston enthusiasts in the cause held conventions to promote the new evangel to the deaf. The sweet optimism of the first disciples was delightful. But this system, from which so much was expected, of which we believed so much and knew so little, has, after nearly twenty years, ended with the quantities inverted. For all purposes of articulation, if not already dead, it is certainly moribund. It has been tried and dropped in the following schools: the American Asylum at Hartford, the Clarke Institution at Northampton, Pennsylvania State Institution at Philadelphia, Western Pennsylvania Institution, Wisconsin Institution, Minnesota, Missouri, Ohio, Kansas, and Tennessee State schools, and at Belleville, Ontario. It is true that in the statistics presented to the Royal Commission, visible speech is still made to hold a place in our American schools, but a glance at some of the remarks accompanying the affirmative answers found in the table on page 2 of "Facts and Opinions" reveals the fact that some of the questions concerning visible speech would have been more correctly answered in the negative. "It is used," says Dr. Gillette of Illinois, "to a very limited extent. It is of advantage to teachers, as it enables them to comprehend physiological facts involved in speech; but for pupils, while it is thus helpful, it requires an amount of time and labor to acquire that can be better improved by the use of diacritical marks." The principal of the school in Florida answers "No" to the question concerning visible speech, but because he uses a method of line-writing adopted by Professor Bell, he is classed among those endorsing the Bell system. Even among those schools where the symbols are still used there is a wide difference of opinion as to its utility. The principal of the Kendall School, Washington, reports that it is used only in the initiatory steps, while in the Horace Mann School, Boston, it is used only with the older pupils. It is impossible to understand the difficulties involved in this system of "visible speech" without some examination of the characters to be studied, and they are here submitted.

These characters, deaf children of eight and nine years of age, coming to school for the first time, never having heard a word of sound in their lives, with minds a complete blank to all the world of sonal thought, were obliged to master and at the same time begin the work of reading and writing English. The wonder is not that the best schools have given it up, but that it was permitted to hold its place among us so long.

The former advocates of visible speech now fall back upon the consolatory reflection, that, although impracticable for children, yet every teacher ought to have a knowledge of it; but unfortunately our best authorities on vocal physiology are not agreed even on that point. There is no one better qualified to speak on questions of this character than Mr. David Greenberger, principal of the New York City School for Improved Instruction, and this is what he says of the Bell symbols: "These hieroglyphs could no more assist a mute in his attempts at vocal utterance, than the signs of the Zodiac." The directive power of the symbols, upon which so much stress was laid, Principal Greenberger declares to be a myth. Every one is willing to admit that a knowledge of vocal physiology is an absolute pre-requisite to all successful teaching of articulation, but this attainment is in no way contingent upon the study of visible speech. If there are those who care to study phonetics, freighted with an alphabet of visual mnemonics, they cannot do better than take up the system propounded by Professor Bell, but that there is any logical connection between the two things, is a contention that has not a foot of ground to stand upon.

The second distinctive educational device which Professor Bell advocated for the deaf was a system of line-writing, a form of visible speech put into short-hand. An experimental school was formed at Washington by the Professor, and at the Convention held in New York City in 1884 line-writing was



explained by one of his teachers, and great things claimed for it. Line-writing was, in fact, a system of short-hand. It is possible that those versed in visible speech may find some connection between the uncials of that system and the strokes used in line-writing. It must be set down to the credit of the six hundred teachers of the deaf in the United States, that, with the exception of one case already noted, all have united in rejecting the use of stenography for young deaf-mutes. The experimental school lived a very transitory life; and in the literature of teaching, only one writer has ventured to utter a word on this last expedient advocated, but not originated, by our enthusiastic friend.

On the question of heredity, Professor Bell has collected a large number of interesting facts. Men may differ as to some of the conclusions drawn from the statistics he has gathered, but there can be no question in regard to the industry and care with which he has devoted himself to this particular line of inquiry. So thoroughly has the danger of deaf-mute offspring from deaf-mute marriages been preached, that

wherever I have heard the question discussed among the general public, there is the greatest surprise expressed that the deaf should have hearing children. The discussions of the past few years have left upon the minds of many intelligent people the impression that the marriages of deaf-mutes are the prolific cause of the increasing number of deaf people in the United States. In considering the sociology of the deaf, it is necessary to bear in mind the following facts:—

The Clarke Institution at Northampton, Mass., opened in 1867. There have been several marriages among the pupils of the school, but none of them have had deaf-mute offspring.

There have been seventeen marriages of the pupils of the Horace Mann School, Boston, but none of the children of these marriages are deaf.

Principal Hutton of Halifax reports thirty marriages of pupils from his school, but only in one case do the children share the infirmity of the parents.

Mr. Mathison, Superintendent of the Bellville Institution, Ontario, says: "Six hundred and sixty-one children have attended, or are in attendance, at this school, and from the records I find that not a single parent of these children is deaf." The principal of the Minnesota School, after an experience of twenty years, and those of California, Alabama, and Mississippi, report a similar state of things in their respective states. But perhaps the most satisfactory statistics concerning the deaf are found in the reports of the Irish Commissioners. In 1881 these commissioners report as follows: "An inquiry having been carried out in the censuses of 1851, 1861, and 1871 as to the children of congenital deaf-mutes, and the result being in each case of a negative character, it was not considered necessary to repeat this investigation, as it appears evident that deafness and dumbness in the parents have no influence in propagating the defect."

In the census of 1871, a minute investigation was made respecting the marriage-state of congenital deaf-mutes, and from 115 unions there were found to be 315 children, of which number only three were deaf. Compare now this result with the number of deaf children from consanguineous marriages, and we find 141 cases of congenital deafness from the inter-marriage in 85 instances of first cousins; in 63 instances of the marriage of second cousins there were 100 deaf children; there were in all 324 cases of deafness from 194 intermarriages among relatives. One striking instance will illustrate the fact that consanguinity in the parents is responsible for a large percentage of deafness.

The Irish Commissioners report that No. 6 in their returns consisted of a family of five children whose parents were second cousins, two of the five children were born deaf. The father married a second time, but this wife was not related to him, and the six children resulting from the union were perfectly developed in all their faculties (Annals, Vol. xxx., No. I., p. 51). In the discussion on the papers read by Professor Bell before some of our scientific associations, he expressed the opinion that consanguineous marriages were not so productive of deaf-mute offspring as people generally supposed. How accurate this opinion is, the facts already quoted will show. No one claims that the mere fact of relationship is in itself a cause for deaf-mute offspring. It is quite probable that some lurking disease, some hereditary taint, becomes intensified in the offspring of consanguineous parents, and the children in consequence become deaf, though why it should affect the hearing is a problem no one yet has been able to solve.

Professor Bell's indictment of the sign-language has been completely answered by Dr. Williams, the principal of the American Asylum at Hartford. By thirty-two cases from schools where signs are prohibited, he has shown that the pupils taught there have all the peculiarities which mark the diction of children educated by means of the sign-language.

Permit me, in conclusion, to cite an instance which indicates a tendency to be guarded against on the part of the Professor, a tendency, too, which has marked the literature of our deaf-mute press in their animadversions on the published addresses which he has given to the public, but, wherever found, the practice is indefensible.

In his address at the Gallaudet Centennial in Philadelphia, the sweeping statement was made that there were 15,000 children of school age not receiving any education. This statement was at once challenged, but the Professor quoted in his defence statistics given in advance by F. D. Wines of Illinois. There would be some justification for this error, if Mr. Wines had not publicly stated, before Professor Bell at the convention in New York in 1884, that the number of children of school age not under instruction was 5,000. The number of deaf-mutes in the United States at the time of this charge was 33,000. Of these, 15,000 were under twenty years of age. The number of children between ten and twenty years of age was 10,000, and of these 6,900 had been under instruction during the period here considered, so that the claim of 15,000 children not receiving any instruction was very wide of the mark. (See Report to British Government, p. 51.)

W. G. JENKINS.

NOTES AND NEWS.

THE railway tunnel under the St. Clair River, between Port Huron, Mich., and Sarnia, Ont., is rapidly approaching completion. Communication between the headings from the opposite sides of the river was effected on Aug. 25. This tunnel is considered the greatest engineering work of the kind in this country.

— On Saturday, Aug. 23, the remains of John Ericsson, the eminent engineer and inventor, were removed from the vault where they were deposited at the time of his death, in March, 1889, taken aboard the United States man-of-war Baltimore, amid imposing ceremonies, and are now on the way to Sweden, the place of his nativity.

—Some habits of crocodiles have been lately described by M. Voeltzkow. Travelling in Wituland, says *Nature*, he obtained in January last seventy-nine new-laid eggs of the animal, from a nest which was five or six paces from the bank of the Wagogona, a tributary of the Ooi. The spot had been cleared of plants in a circle of about six paces diameter, apparently by the crocodile having wheeled round several times. Here and there a few branches had been laid, but there was no nest-building proper. The so-called nest lay almost quite open to the sun (only a couple of poor bushes at one part). The eggs lay in four pits, dug in the hard, dry ground, about two feet obliquely down. Including eggs broken in digging out, the total seems to have been eighty-five to ninety. According to the natives, the crocodile, having selected and prepared a spot, makes a pit in it that day, and lays about twenty to twenty-five eggs in it, which it covers with earth. Next day it makes a second pit, and so on. From the commencement it remains in the nest, and it sleeps there till the hatching of the young, which appear in about two months, when the heavy rain period sets in. The egg-laying occurs only once in the year, about the end of January or beginning of February. The animal, which M. Voeltzknow disturbed, and saw drop into the water, seemed to be the *Crocodilus vulgaris* so common in East Africa.