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THE TIME-RELATIONS OF MENTAL PHENOMENA.

[Continued from p. 101.]

Conditions Affecting Simple Re-action Times.

REFERRING to the accompanying table for a general view of the time-relations of simple re-actions, we may pass at once to the topic of greatest interest, viz., the influences by which they are quickened or retarded. These may be considered as (A) objective, or affecting the conditions of the experiment, and (B) subjective, affecting the attitude of the re-actor.

(A, 1) *The Nature of the Impression.* The distinctive characteristics of a simple re-action being in the attitude of the re-actor, it would seem that its time could be little affected by the nature of the impression. The motor signalling process is the same, the connection between the impression and movement is about equally artificial in all cases, so that the chief variability must be in the time needed for receiving the impression. For the different senses this time is different. Taking the general average of all the observations accessible to me, I find, for hearing, 138σ; for touch, 148σ; for sight, 185σ. This order is quite constant with the different observers, the long time of visual re-actions being referable to the long inertia period of that sense, as well as to the small perceptive area of the retina, necessitating a precise accommodation, — a condition not always supplied in the above experiments. This view is strengthened by the shortening in the re-action time (by 36σ for Exner, by 24σ for v. Wittich) when the eye is stimulated electrically. In re-acting to a temperature sensation, care must be taken not to re-act to the sensation of contact with the skin. Where this has been done it has been found that the re-action to the sensations of temperature is longer than to contact, and that the re-action to heat is longer than to cold. Thus, Vintschgau and Steinach re-act to a pressure on various points of the head in 109σ, to a sensation of cold in 135σ, of heat in 146σ, similar values for various points of the hand being 121σ, 188σ, 209σ. The researches of Goldscheider agree with these in the main, but make the difference between the re action times to heat and to cold much greater. The senses of taste and smell clearly illustrate the effect of the kind of stimulation, for here the relative inaccessibility of the sense organs and the slowly acting chemical processes involved lead to a long re-action time. Though experimentation is difficult and uncertain in these senses, we may cite for smell the results of Moldenhauer on the odors of various oils, centring about 300σ (oil of roses 273σ, camphor 321σ, musk 319σ, ether 255σ, etc.), and for taste, of Hönigschmied, who re-acts to various tastes on the tip of the

Table of Simple Re-action Times.

No.	Nature of Sense-impression.	Nature of Re-action.	Observer.	Time.	Remarks.
I	Visual (various kinds)	Finger.	Average of many	185	
II	Tactile “ “	“	“ “	148	
III	Auditory “ “	“	“ “	139	
IV	Temperature (cold)	“	Vintschgau Steinach } Av.	161	Average of all parts of body.
V	“ (warm)	“	“ “	177	
VI	Light of intensity I	“	Berger & Cattell } Av.	210	The intensity in terms of a common unit were as 7, 23, 123, 315, 1000, the two highest intensities not being determinable.
VII	“ “ II	“	“ “	184	
VIII	“ “ III	“	“ “	174	
IX	“ “ IV	“	“ “	170	
X	“ “ V	“	“ “	169	
XI	“ “ VI	“	“ “	156	
XII	“ “ VII	“	“ “	148	
XIII	Touch (electric shock)	“	Exner.	139	On the hand.
XIV	“ “ “	“	“	175	On the foot.
XV	Scund (low)	“	Wundt.	175	*With* preparatory signal.
XVI	“ “	“	“	266	*Without* “ “
XVII	Sound	“	Berger & Cattell } Av.	124	Preparatory signal at regular intervals.
XVIII	“	“	“ “	165	Preparatory signal irregularly varied within 15 seconds.
XIX	Sound { Average of weak and loud sound	“	Wundt.	121	Intensity of sound known.
XX	“ “ “	“	“	203	Intensity of sound unknown.
XXI	Sound	“	Münsterberg.	162	Attention directed to sensation.
XXII	“	“	“	120	“ “ movement.
XXIII	Touch (electric shock in forearm).	By opening and closing jaw. } Av.	Orchansky.	155	Normal.
XXIV	“ “ “ “	“	“	105	8 minutes after taking 60 ccm. of rum.
XXV	“ “ “ “	“	“	225	30 “ “ “ “ “

tongue in 182σ, though other subjects require about 300σ. On the back of the tongue the time is much longer, and it varies for different tastes, being longest for bitter, shortest for salt, and about equal for sweet and sour. Within the same sense the re-action time will vary according to the nature and place of the stimulus. The above cited differences for tastes and smells show this; and for different visual impressions, for different tones, for contact at different parts of the body, different results have been obtained, referable to slight variations in sensibility, length of nerve traversed, clearness of the impression, and the like. These minor differences are not easily established, but the following may be cited. Exner re-acts to an electric shock on the hand in 132σ, on the forehead in 137σ, on the foot in 175σ; v. Wittich re-acts to a point on the back of the finger in a longer time than to one on the front, 144σ and 156σ, and regards the difference as due to a difference of sensibility. Hall and Kries clearly show that the re-action to a point looked at in indirect vision is longer than to one in direct vision, 195σ and 235σ, and find further differences according as the point is above or below, inside or outside, the retinal centre. A high tone is re-acted to more quickly than a low one, and so on.

It is easier to demonstrate the influence of (2) *the intensity of the stimulus.* Within limits, intense stimuli affect sense-organs more quickly than weak ones, and, roughly speaking, an increase in the intensity of the stimulus is concomitant with a decrease in the re-action time. According to Wundt, the noise of a hammer falling respectively from heights of 1, 4, 8, and 16 millimetres was re-acted to in 217σ, 146σ, 132σ, and 135σ, and the sound of a ball falling from heights of 2, 5, 25, and 55 centimetres in 176σ, 161σ, 159σ, and 94σ respectively. Exner varied the length and therefore the brilliancy of an electric spark from 0.5 to 7 millimetres and obtained a steadily decreasing re-action time of 158σ to 123σ. More complete are the observations of Berger and Cattell, who found that as the light increased from 7 to 23, to 123, to 315, to 1,000, and to two greater but not determinable degrees of intensity (as compared with a small unit of light), the re-action times fell (average of two observers) from 210σ to 184σ, to 174σ, to 170σ, to 169σ, to 156σ, to 148σ. For sound, as the ball fell from heights of 60, 160, 300, and 560 millimetres the re-action times were 151σ, 146σ, 127σ, and 123σ. For electrical touch excitations, re-actions to four grades of stimuli separated by equally perceptible differences were made (average of two observers) in 173σ, 159σ, 145σ, and 145σ. Wundt regards the difference in re-action times of the different senses as in part referable to differences in intensity, and, when re-acting to just perceptible intensities of sensation in various senses, finds about the same long time for each, 330σ.

3. *The Mode of Re-action.* The various movements by which we may signal that a sensation has been received may differ in the ease of their execution, in the length of nerve traversed, as well as in the naturalness of association with the impression. Such differences, however, seem to be small; when once the movement is understood and anticipated, the difference in the times of its execution is slight. Thus, Münsterberg found, in testing the re-action of each of the five fingers, that while at first the thumb and little finger re-acted more slowly than the others, after some practice the times of all were substantially the same. Féré, however, has some results suggesting that the fingers making the strongest movements re-act in the shortest times. Very interesting, too, is the experiment of Ewald in which the stimulus, an electric shock, is given to the finger in the very key by which the re-action is signalled, the re-action consisting in the very natural movement of drawing the finger away. Under these circumstances he found a brief and constant time of 90σ. Both Vintschgau and Cattell have compared the time of re-acting by closing a key with the finger and by speaking a word, and find the vocal method the longer by about 16σ and 30σ respectively. Differences in re-acting from the two sides of the body have been observed by some, the right side showing the shorter re-action, but this difference can hardly be considered as constant. Orchansky has shown in one case that the movements of inhibition take about the same time as those of excitation of a muscle, and it would be possible to study the relative ease of various movements by this method. A practical example is furnished by the commands of military drill, the words, "carry," "present," etc., announcing the mode of re-action for the performance of which the following word, "arms," is the signal.

(*B*) We pass next to the more important *subjective* factors, referring in the main to the *expectation* and the *attention.* While nothing has been definitely said upon this point, the implication has been that the subject tries his utmost to re-act as quickly as possible, and that he knows the nature of the experiment. While the influences now to be discussed seem to be general in their effect, making the nervous system at one time a better and again a worse re-acting apparatus, they may, in certain respects, be subjected to a more definite analysis. We begin with (1) *the subject's fore-knowledge of what is to take place.* We may anticipate the outcome of experimentation on this point by formulating the law that the more definite the fore-knowledge of the subject the quicker the re-action. Apparently there is a process that must be gone through with in each re-action, and the better prepared the subject is for this,—that is, the more of this process gone through with before the giving of the stimulus,—the less of it falls within the measured interval. The precise nature of this process is a difficult and much discussed problem. It may be sufficient to note at present that the re-action to a certain stimulus cannot but imply in some sense the distinction of that stimulus from the many others by which we are constantly surrounded. If the subject be re-acting to a visual impression, he will probably not press the key should a noise occur in the room or something accidentally come in contact with his hand. To re-act to a visual impression thus implies the distinction of that from other impressions. It implies the identification of the expected with the existing impression. Just as we recognize an appearance in the heavens or under the microscope more readily when we know where and what to look for, or as we immediately recognize an almost forgotten acquaintance when expecting him, though at a chance meeting we might have passed him without recognition, so we re-act to an impression most quickly when it is most definitely expected, with regard to its nature, its time and place of appearance, and the like. This expectation may be more or less specific, and an interesting series of experiments consist in varying the fore-knowledge of the subject while still leaving it definite enough to call the result a simple re-action. (*a*) We may leave the precise *time* of the appearance of the stimulus undetermined. This may be done by experimenting with and without a preparatory signal, preceding the stimulus by a regular interval. Wundt re-acted to the sound of a ball falling from a height of 25 centimetres in 76σ with a preparatory signal, but in 253σ if no such signal preceded; to a ball falling five centimetres, in 175σ in the first case, and 266σ in the second. The time between the signal and stimulus is here regular, and the most favorable time seems to be about two seconds. Lange found the time with an interval of two seconds less than with one of one or three seconds. If the interval be irregularly varied within two seconds the effect is hardly noticeable, but if irregularly varied within fifteen seconds the time is increased (Cattell). With a normal re-action to sight of 149σ and to sound of 124σ, the re-action to sight with the interval varying within two seconds was 148σ; when varying within fifteen seconds, to sight, 174σ, to sound, 165σ (average of two observers). (*b*) If the time and nature of the stimulus be known, but its *intensity* be varied, the time is increased. When re-acting to a uniform change between a feeble and a loud sound, the re-action time to the former was 127σ, to the latter, 116σ; but when these changes were made in an irregular and unexpected manner the times were lengthened to 208σ and 198σ.

Similarly the attention may be prevented from being effectually directed to the making of the re-action by a variety of circumstances. Some of these we may group under the term (2) *distraction*. By a constant noise or other means we may be creating a stimulus to which the attention is involuntarily drawn, and thus withdrawn from the process of re-action. Wundt re-acted to a sound of mean intensity in 189σ, to a strong sound in 158σ, but when a disturbing sound was going on in the room these re-actions required 313σ and 203σ. On the other hand, with Cattell, when in good practice, so that the re-action became almost automatic, the effect of a disturbing sound both upon sight and sound re-actions was insignificant,—normal for sight, 149σ, with disturbing noise, 155σ; normal for sound, 124σ, with disturbing noise, 124σ. It is quite probable that what acts as a disturbance to one person hardly affects another. In some individuals the re-action time seems to be extremely sensitive to any mental disturbance. One of Obersteiner's subjects, with an average re-action time of about 100σ, requires 142σ to re-act when music is heard, and another's re-action time is lengthened by 100σ when talking is going on in the room.

A more general and thorough form of distraction may be effected by imposing a task requiring distinct mental effort at the same time that the re-action is to take place. Thus Cattell attempted to add 17 consecutively to a series of numbers, and found that re-actions taken while this was going on were longer by 28σ (average of two observers). All such effects seem to be much more marked when the re-action in question is new than when it has become familiar and partly automatic. The disturbance seems to act by delaying the association between stimulus and movement.

(3) We have now to notice a distinction which, though but recently brought to light (by N. Lange, 1888), is of fundamental importance. A re-action may be made in two ways. In the one form of re-action the attention is directed to the expected impression: it is identified as the expected impression, and thereupon is initiated the impulse resulting in the re-acting movement. The several processes are performed serially, the attention being concentrated upon the sensory part of the process. In the other form of re-action the attention is directed to the movement: the impulse is ready, and is set off by the appearance of the signal almost automatically, the identification of the actual with the expected impression being omitted. The first is spoken of as the "complete" or "sensory" mode of re-action, the second as the "shortened" or "motor" form. In the experiments of Lange the simple sensory re-action time to a sound (average of three persons) was 227σ, motor 123σ; to a visual impression (average of two persons), sensory 290σ, motor 113σ; to a tactile impression (one person), sensory 213σ, motor 108σ. These differences, however, seem to be extreme. Münsterberg finds for sound, sensory 162σ, motor 120σ. A further characteristic of the motor form of re-action is that its average variation is smaller, i.e., the process is more regular; and that false re-actions occur, either anticipations of stimulus or re-actions to some accidental disturbance. The distinction becomes still more important when the re-action is not simple but complex, and we will return to it later. The distinction is important as aiding in the explanation of individual differences, as well as of the path of practice. The somewhat conflicting results obtained before this distinction was taken into account might very well be due to the fact that the one observer re-acted in the one way and the other in the other. Thus the re-action times of Kries and Auerbach are motor; for they are brief, false re-actions occur, and it is noted that the simple re-actions following re-actions involving distinctions were longer by 41σ and 31σ than before,—a change probably due to a return to a partially sensory mode of re-action. Again, there are doubtless transitional modes between the two, and there are reasons for believing that the path of practice is from the sensory to the motor form of re-action.

The influences that remain to be discussed may be considered under the heads of "practice," "fatigue," "individual differences," and "abnormal variations." (4) *Practice*. As just noticed, the effect of practice is intimately connected with the mode of re-action. It is noticed by almost all writers, but the extent to which it influences the time is very various. The observations make it probable that the effect of practice is most marked at first, and that when once the initial stages are over, the effect of continued practice is small. It is greatest in those persons whose time is longest at first, and seems most influential in acts that are complicated and lie somewhat beyond the realm of daily experience.

When the action is once thoroughly learned, an interval of disuse seems not to affect the time seriously. After not re-acting for three months, Cattell found no essential difference in the time. On the other hand, with some there is a slight newness on beginning each day's work, making the first re-actions of a series rather long (Trautscholdt).

(5) A similar statement may be made of *fatigue:* it has greatest effect upon the complicated, less thoroughly learned processes, and varies with the individual and the mode of re-action. With an automatic simple process its effect is very slow to appear (Cattell). It may enter at any stage of the process, sensory, motor, or central; but the last seems to

be the most serious. It appears as a difficulty in keeping one's attention upon the experiment, and thus lengthens the time, and especially the average variation of the experiments. By fatigue is meant the fatigue brought about by the experimenting itself. The time is also affected by general fatigue preceding the experiment. Some individuals are extremely sensitive to influences of this kind.

(6) *Individual Variations.* The fact here to be investigated is the general one that different persons require different times for the performance of the same operations. The difficulty of drilling a company of men to act in concert, whether in military drill or otherwise, springs in part from this difference. It was from this point of view, too, that the time of mental processes was first studied. So long ago as 1795 Maskelyne, the astronomer royal, discharged his assistant because the latter recorded the transit of a star across the wire of the telescope half a second or more later than he himself. Some twenty-five years later Bessel, another astronomer, had his attention called to the point, and upon investigation established the fact that no two observers recorded such transits at precisely the same time. The difference in time between any two observers was usually expressed as an equation, and hence the term "personal equation," which, though strictly applicable only to the differences so found, has assumed a much wider meaning. The individual differences become greater as the process to be performed increases in complexity, and this explains in part why the personal equations as determined by the complicated eye and ear method were so large: with the simpler method of electrical record these differences are much reduced. Besides the differences due to practice and the mode of re-action, there are a large number of minor sources of variation, which as yet are not sufficiently understood to justify a correlation of quick or slow re-action times with definite individual qualities. We may, however, note (*a*) that the time is longer in children than in adults, as has been shown, amongst others, by Binet, who found that children from $3\frac{1}{2}$ to 7 years re-acted in from 440σ to 66σ, when adults required but 140σ. In the very old the time is longer than in the prime of life. Under the influence of mental or physical fatigue, worry, or slight indisposition, the time has been increased. Obersteiner, Vintschgau, Goldscheider, and others, have incidentally observed these effects, showing an increase of 30σ to 40σ. These variations are related to others, shading over into the abnormal. Under this head may be considered (7) *the action of drugs and re-action times in the insane.* Several of the earlier experimenters made a few observations concerning the effect of drugs. Exner found quite a marked lengthening of the time after drinking wine. Vintschgau and Dietl found that the effect of coffee was to decrease and of morphium to increase the time for a considerable period. The more elaborate researches of Kraepelin show that the effect of amyl, ether, and chloroform is a sudden lengthening of the re-action times, reaching a maximum in a very few minutes, and followed by a rather long period of times slightly shorter than the normal. If a strong dose of the drug be used the lengthening is more considerable and the secondary shortening slighter. Thus Kraepelin, whose normal re-action was 183σ, after a strong inhalation of ether re-acted in 298σ, and in the period of shortening in 170σ; while with a light narcosis the maximum re-action was 223σ, and the shortened re-action 150σ. The effect of alcohol, however, is a brief period of shortened times followed by a long period of lengthened times. This is also found by Orchansky, who, with a normal re-action of 155σ, re-acts in 105σ eight minutes after taking a dose of alcohol, and in 225σ after thirty minutes. The observations of Warren do not yield equally positive results, but do not conflict with those of Kraepelin. Changes in the extent of the average variation have also been observed. On what psychological factors these differences depend it is difficult to say, but the subjective feelings accompanying the lengthened times are a difficulty in keeping the attention upon the matter in hand, and an unwillingness to exert one's self. The evidence afforded by the action of drugs upon these processes is important as indicating the dependence of the re-actions upon physiological conditions. A change of re-action times in insanity has been frequently observed, but the field for individual variation is here very large. It seems probable that in most forms of mental disease, and particularly in melancholia, there is a considerable lengthening of the re-action time, amounting in extreme cases to one-half or three-quarters of a second. In the excited forms of disease, such as mania, a shortening has been observed. Obersteiner cites a case of general paralysis in the incipient stages of which the time was 166σ, in a more advanced stage 281σ, in a most advanced stage 451σ. Stanley Hall has found a marked shortening of the time in the hypnotic condition, but his result is not corroborated by others.

Methods of Experimentation.

The chief requisite in these experiments is an apparatus for accurately measuring small intervals of time. The earliest method, still in use, records the vibrations of a tuning-fork upon the quickly-moving smoked surface of a rotating drum, and beneath this the moment of giving the signal and making the response. If a fork making one hundred vibrations per second be used, whole hundredths can be directly counted and smaller fractions estimated. Wundt has constructed a more accurate and specialized instrument in which a fork making five hundred vibrations per second is used. A very much simplified form of apparatus has been devised by Obersteiner, in which the slide holding the record is moved by hand, and the movement of re-action draws the fork off the record; and by Bowditch, in which the fork itself carries the record, and the signal and re-action are indicated by a shifting of the writing point. In the astronomical records clock-work takes the place of a tuning-fork. The objection to these methods is that they necessitate tedious counting of curves. If the rate of the rotating-apparatus is very uniform and frequently tested, one may substitute measuring for counting, but the most convenient apparatus for the purpose is the Hipp chronoscope. This instrument contains a fine clock-work, set in motion by releasing a spring and running for about half a minute. The hands of the two dials, the one indicating tenths and the other thousandths of a second, do not move until drawn away from a set of cogs by the opening or closure of a magnetic circuit, and are stopped again in the same way. By making the usual arrangement whereby the production of the stimulus sets the hands in motion and the re-acting movement brings them to a stand-still, we can read off directly the interval of the re-action time. Unless we can afford to sacrifice accuracy for convenience, a means of controlling the chronoscope is indispensable. This may be done by timing the fall of a ball from a given height and comparing it with theoretical time. In the apparatus for this purpose supplied with the chronoscope the ball is mechanically released, and the mode of making the circuit is equally defective, so that 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