ten years ago, a change mainly owing to direct and indirect clerical influence; and it is therefore gratifying to find an eminent teacher like Topinard, boldly pronouncing in its favor, and declaring that it is the only possible theory adequate to explain known facts in the physical history of the human species.

The author makes frequent reference to his larger work "Eléments d'Anthropologie Général"; but the instructions for practical observations and the abstracts of the results of other investigators furnished in the present much smaller volume, will be sufficient to satisfy those students of the subject who feel themselves somewhat appalled by the nearly twelve hundred closely printed pages of the "Eléments."

Some Native Brazilian Tribes.

A model ethnographic study is that of some Brazilian tribes by Dr. Paul Ehrenreich, published in the second volume of the *Veröffentlichung aus dem Königlichen Museum für Völkerkunde zu Berlin.* He takes up the Karaya stock on the river Araguaya, and some tribes, the Paumari, the Yamamadi and the Ipurina on the Purus River. His descriptions meet all our requirements except in the important matter of language. This he no doubt designedly omits; though he mentions that among the Karaya the men and women have separate dialects, rarely, however, radically different words.

Of these little-known peoples he describes the costume, house-building, methods of obtaining food, tools, and weapons, etc. It is curious to note the love of the Karayas for taming animals. "Their villages resemble menageries." Dogs, fowls, cats, peccaries, parrots, even turtles, alligators and tapirs, meet the astonished traveller. The native does not look upon them as "lower animals," but quite on the same plane of existence as himself, and as his friends and companions.

The history and extension of the tribes are defined, and a number of admirable photogravures set forth truthfully to the eye their physical characteristics.

A MACHINE FOR CHURNING FRESH MILK.

IN Bulletin No. IX. of the Delaware experiment station (Newark, Del.,) are given the results of a series of experiments made to determine the practical value of the butter extractor, a machine with which butter may be made directly from the freshly drawn milk.

In principle this machine resembles the DeLaval separator, which has now come into general use in creameries and large dairies, by which the cream is separated from sweet milk by centrifugal motion, but the butter extractor goes a step farther, and not only separates but churns the cream.

The machine operated with was made by an American company. It was found to require considerable experience to operate it successfully, and the tests upon which the station's comparisons are based were made under the personal supervision of the manufacturers of the machine. The results were that it was found that while the separator and churn obtained 93.34 pounds of butter out of every 100 pounds in the milk, the extractor obtained but 84.60 pounds, a loss of 8.74 pounds, and the butter thus obtained was of such quality that it could not be sold in competition with butter made from ripened cream.

In summing up the results of his tests Professor Penny, the chemist of the station says: —

"As to the relative expense of running in the one case the extractor alone and in the other the separator and churn together, it is doubtful if a creamery having only one machine would save anything in the number of hands employed, while in larger establishments the loss, greater by 8.74 per cent, caused by the extractor is heavier than the saving in wages. On a daily business of five thousand pounds of milk this deficiency is equal to fifteen or seventeen pounds of butter, yet such a business with the separator and churn need not employ more than two men, and the extractor could hardly employ fewer. The expense for power, etc., is nearly the same in the two cases. It must also be considered that while the separator requires the milk to be previously heated during much of the year—a simple and cheap operation—the extractor requires it to be cooled, at least in warm weather, and this calls for a greater supply of cool water or of ice—a decided disadvantage and in some creameries an unwarranted expense.

"Hence one feels justified in concluding that, if the quality of the butter be left out of the account, the extractor at present offers no substantial advantage that is not outweighed by defects, and that it would not allow any saving in expense over the process it is designed to supplant.

"Run as a separator alone under good conditions, this machine ought to give most excellent results, though in common with the DeLaval, and doubtless others, it varies greatly in skimming power, from causes that are partly unknown. As a skimmer it may be considered strictly first-class.

"Although the extractor appears unfavorably in comparison with a much older method, it cannot but be regarded as a marvel of inventive and mechanical skill. The surprise is in the first instance that it should do its work at all, and then, even though it be found wanting, that it should do its work so well. It is brought at the start into competition with a highly perfected machine and a method thoroughly understood from many years of experience. Its shortcoming under the severe test to which it is obliged to submit ought not to be cause of disappointment; there is room rather for encouragement, because it has done so much. Its future development is probably a question of the relative merits of sweet-cream butter and sour-cream butter.

"If experience and an educated taste shall finally favor the former, the extractor may be expected to take the place of the separator and the churn. But unless the decision shall fall in that direction, it is doubtful if the new device ever comes into general use."

It should be added to the foregoing that the comparison was made with the most perfect method of separating cream from milk now known. Had the extractor been compared with the old method of raising cream, the outcome would have been less unfavorable, as the separator gets out more cream than can be raised by gravity.

THE HIGHER EDUCATION OF THE DEAF.[1]

NATIONAL DEAF-MUTE COLLEGE,
WASHINGTON, D.C., April 1, 1892.

A. L. E. CROUTER, A.M., Principal:

My Dear Sir.—Your suggestions have received my most serious consideration. Allow me to thank you for the assurances of your friendly regard for the college and your appreciation of the value of the work it has already done. More grateful to the officers of the college than any written words could be, is the record of your

[1] Reply of President Gallaudet to the letter by Principal Crouter published in Science for April 8. Reprinted from the Silent World.

past efficient support of its work by the sending of a large company of students to it well prepared to enter and to profit by its advantages.

The proposal that the college should provide oral recitations for students that have been able to engage in such recitations in the schools in which their preparation for college has been completed, appears at first glance to be a very natural and proper one. A full study of the subject, however, discloses objections which to many minds will seem very serious. First of all should be considered the expense of carrying your suggestion into effect, not for a single year only, which would be small, but for the five years of the college course, which is quite another matter. The time and strength of the professors now at the command of the college are fully consumed with the duties at present assigned to them, and were separate oral recitations provided for orally taught members of each class, a complete duplication of the faculty would be demanded, and this not only as to numbers, but also as to ability, qualification, and experience. Such an increase of our teaching corps would involve an additional annual expense of at least ten thousand dollars.

The whole force of your suggestion rests, if I mistake not, on the statement that the pupils of oral schools "hesitate, and object, and refuse, when directed to Kendall Green, not because it is not a good school, nor because its professors are not competent men, but because of a well founded fear that that which they have spent much time and labor in gaining, namely, their speech and their ability to read speech, may be very seriously impaired" by the lack of oral recitations in the college. Now I will lay no stress, as many would, on the admission made in stating this point, that the speech and power to read the lips of others, gained only at great cost by the orally taught deaf, are possessions which may easily be lost; for my experience leads me to have much more faith in the security and permanence of these valuable acquisitions than you and Mr. Greenberger seem to enjoy, and my reasons for this stronger faith will presently appear.

It is not true, as the uninformed reader would infer from your letter, that the orally taught deaf of the country have never enjoyed the advantages of the college. Pupils from the Clarke Institution, from the Boston Day School, from private oral schools, from Mr. Greenberger's school, and last, but not least, a pupil who had for several years the special training of Professor Alexander Graham Bell, have been connected with our college for longer or shorter periods, one of them graduating with honor from our scientific course. None of these students enjoyed the advantages of oral recitations in the college. They had no special teaching in speech or lip-reading. They did, however, have considerable practice in speech while connected with the college.

No complaints came to me from these pupils, nor from any of their friends, while they were with us or after they had left us, that their powers of speech and lip-reading were even temporarily, much less permanently, impaired by their connection with the college. The father of one of Mr. Greenberger's pupils, who was for two years a student here, writes, under date of March 29, 1892: "In reply to your inquiry I desire to say that H. did not speak quite as well on his return, perhaps because that at college he had not as much chance to use his lips as he did while at school in New York, but since he is home, our conversation at home, as well as in our business with him, is so frequent, that I am happy to say he speaks as well and as understandingly as ever."

The father of another of Mr. Greenberger's pupils who pursued our full scientific course, taking the bachelor's degree, says in a letter just received: "I do not think my son's power of speech and ability to read the lips were injured in the least by his taking a course in your institution."

Four others of the orally taught pupils to whom I have just referred have informed me within a few days that, on the testimony of their friends, they experienced no permanent injury to their powers of speech and of lip-reading in consequence of their connection with the college. And the friends of two of these thought their speech improved while they were in college.

Now, in considering the cases of these orally-taught pupils to whom reference has been made, it must be kept in mind that they were all connected with the college at periods when no instruction in speech and lip-reading was afforded to any student. And yet it appears that not one of these young people, representing as they did the leading oral schools of the country, suffered any permanent injury to their powers of speech and lip-reading while students here. What more convincing proof could be given that the "fears" of the oralists voiced in your letter are not "well-founded?" And if these fears are justly dissipated by the records of times when no articulation teaching was afforded in the college they surely need be accorded little weight at present, when ten instructors are actively engaged in giving daily lessons in speech and lig-reading to the students of the college. There are those whose opinions are entitled to respect, who believe that the plan put in operation the present year by the college for preserving and improving the speech of all its students, including the orally taught, will produce more satisfactory results than the one proposed by you, which would involve, inevitably, an increase of ten thousand dollars in the annual expenses of the college, and this for the sake of a number of students not likely to be more than twenty-five. And should the alternative you press in your letter as, apparently, an ultimatum, be followed, of establishing a college especially for the orally-taught deaf, the increase in the expense of their higher education would be much greater than even the figure I have named. We are trying an experiment, the results of which are thus far encouraging, to continue which will involve no increase of expense, while you urge a scheme certain to be very costly, and by no means sure to give better results. In view of the unprecedented facilities for oral teaching newly offered in the college the present year, and which will be continued next year, will it not be safe to intrust orally-taught pupils to us for a year or two, or at least until it can be demonstrated that our way of preserving and improving their speech is a failure? For if it prove a failure, no one will be readier than I to accept such a result, and to advocate what you believe to be "the more excellent way."

The officers of the college are gratified at the prospect of receiving a greater number of students from the oral schools than have come to Kendall Green in the past, and while they cannot feel justified in acceeding to the particular demand of your letter, at least until their own experiment has proved a failure, they are ready to give the most earnest assurance that, with every orally-taught pupil who may seek admission here the coming year, no pains will be spared to preserve undiminished whatever powers of speech and speech-reading such pupils may bring with them.

The force at present available for articulation teaching in the college will make it possible for us to give special individual training to such orally-taught pupils as may seem likely to derive more benefit from instruction so afforded, than when given in a class.

Some editorial comments on your letter, which appear in the *Silent World* of yesterday, leave me to say, in closing, that nothing could be further from the truth than an assertion that the present attitude and existing arrangements of the college as to oral teaching put the stigma of governmental condemnation upon the oral method. The fact that ten instructors are devoted to the work of speech teaching in the college is a sufficient refutation of any such claim. It by no means follows because a certain manner of using a certain method is found helpful to certain deaf children in primary schools, that the identical way of making use of this method is necessary, or will even lead to the best results, with these same persons under the changed conditions of collegiate instruction. And it would be a most distorted inference to conclude that because the college gives oral teaching to its students in a manner somewhat different from that employed in the pure oral schools it is thereby placing a stigma on the oral method.

The editor of the *Silent World* is quite right in acquitting "the authorities at Washington" of any such intention, and I trust the statements of this letter will give wings to all his apprehensions on the subject.

Our directors feel that the existing arrangements of the college, under which the essential features of the two leading methods of instruction are combined in a manner calculated, as they believe, to produce the best results, ought to satisfy the friends of both methods.

They have great confidence that results in the near future will

prove the wisdom of these plans. And whether this confidence be misplaced or not, they think they have a right to expect that no unfriendly attitude will be taken towards the college while the important experiments only recently begun are being pressed steadily to a decisive conclusion.

Very sincerely yours,

E. M. GALLAUDET.

THE TEACHING OF SCIENCE.[1]

THE subject chosen for this paper, The Teaching of Science, is a broad one; far too broad for more than a very superficial treatment in the time allowed, but it is my purpose rather to call attention to certain general ideas in which too much of our modern science teaching seems to be at fault, and to try to suggest lines in which we may hope for improvement, While I use the term "Science," I have particular reference to the so-called natural sciences, though perhaps the ideas are capable of a wider application.

Among these natural sciences there are certain ones to which my attention has been more closely drawn, but I believe the principles which should be at the basis of instruction in them will apply equally well to all.

Why do we study the sciences? how far do we attain our ends in this study? and is it possible for us to attain them more completely than by our present methods? These are the three questions I desire to consider.

1. Why do we study the sciences? Were we to judge from the great mass of science teaching of the present day, we would be obliged to answer unhesitatingly that the natural sciences are taught chiefly at least, for the purpose of acquiring certain facts which are supposed to be of the necessary stock in trade of a well educated man or woman, or perhaps I should speak more correctly, were I to say, facts which every well educated person ought once to have known sufficiently well to have passed an examination in them; in as much as, for better, for worse, most have forgotten a great share of these acquired facts. I say were we to judge by the way science is taught, though few teachers would admit this mere acquisition of facts to be their aim in teaching. If we should inquire of these teachers, they would undoubtedly tell us of the "disciplinary value," that vague expression often heard and so unsatisfactory to the pupil, as he repeats his *amo, amas, amat*, or pauses to rest on his *pons asinorum*.

In all education we have two aims; the direct furnishing of the mind with a store of facts and the development of the mind so that it can utilize these facts and attain others; we teach, and we teach how to learn, Now there are undoubtedly, a vast multitude of facts in the natural sciences, which are of practical value in every-day life; but after all these are of little importance compared with the tremendous development of the mind which may be and ought to be gained by this class of studies.

The natural sciences are pre-eminently the studies to develope the reasoning powers; every step has been and can be logically worked out from the preceding; nowhere else do we find that gathering of facts, perhaps very few in number, under an hypothesis, and then, by gaining new facts by study and experimentation, the development of the hypothesis into a theory and, it may be, a law. The best instruction in logic I ever had was in a class of a dozen or so, where we had each made quite a series of apparently unconnected experiments in physics, then were given the task of arranging our descriptions of these experiments in their proper sequence, discussing in the class room our arrangements and defending each his own choice.

The chief aim in the study of science should be this development of the reasoning power; the teaching of independent thought; and the acquisition of facts in themselves, however important some of them may be, should invariably be made subordinate to this. I ought in this connection to refer to what is often spoken of as a very important aim of science teaching, that of training the power of observation. Of course when rightly studied, science does train this power, and even the most superficial elementary course in any science cannot fail to make the scholar now and then a little more interested in observing what goes on around him than he otherwise would be; nevertheless the training of this power is of value only just as far as it is a means of training the reasoning power. A man may have a marvellous gift of seeing everything and seeing it accurately; but this gift is of value to him only as far as he can utilize it as a basis of thought; and therefore I would hold that the training of the power of observation is embraced under the all important aim of science teaching, the development of the mind, the development of the power of thought.

This should be the chief aim of all instruction in natural science; all else is of little use.

2. Now how far does the instruction given in our institutions of learning, our schools, academies, colleges, and universities, tend to carry out this idea?

Until until quite a recent time there has been little or no instruction in natural science given in our lower schools; in our cities at the present time there is more or less of an attempt being made to introduce the study of chemistry and physics. I leave out of account for the present the kindergarten, where there seems to have sprung up a germ of the true idea of science teaching. The most that is expected in our common schools is that the teacher shall hold a few recitations from a text-book, from which the scholar is supposed to familiarize himself with a large or small number of facts and possibly to learn the statement of a few laws or theories. In the higher schools, the academies, and some of the colleges, a somewhat greater task is attempted; here the text-book is supposed to cover practically the whole science and a correspondingly great number of facts is sought to be memorized; with a couple of recitations a week, the student is expected to go through "fourteen weeks in chemistry," or physics, or geology, and to have learned the gist of the whole science. Here we have a mere feat of memory, of just as much value, perhaps, as the committing to memory of so many lines of "Paradise Lost," certainly no more. In many, perhaps most, cases the teacher is as ignorant of the subject as the scholar, and must have the text-book continually open in order to recognize if the answers are correct. One college in Kentucky advertises to give complete, thorough, and practical courses in each of the sciences in a term of ten weeks; think of acquiring chemistry, physics, geology and astronomy in less than a year, and not neglecting other studies in the meantime! Of late, however, it is coming to be very generally recognized that scientific instruction cannot be imparted without experiment, and so the teacher performs before the class some of the simpler experiments. This is indeed a step in the right direction, but in most cases only a very short step. An experiment merely as something for a class to look at or be entertained by is valueless; indeed the only value of an experiment is in making clearer the principle it is intended to illustrate. If it fails to do this, it fails to accomplish any thing. I remember asking a young lady, who had a few months previously passed a fine examination in chemistry in one of our higher institutions, if she remembered how oxygen was made, "Oh yes," she said, "why! the professor took something black and something white, and that was oxygen." Some features at least of the experiment had made an impression. In most of the colleges and academies for ladies, I think it is no exaggeration to say that science study as usually conducted is of no value; the only science which there is an attempt to study at all thoroughly is botany; and even here it is questionable to my mind if the student get from this any thing which justifies the time put upon it, except that incidentally the fresh air exercise obtained in gathering specimens provides that which is much needed by all young ladies. The end usually sought is ability to analyse, by the aid of tables, the common plants, rather than the study of these plants. In no other science is the absurdity of this method of study so apparent. In the chemical laboratory it is true that the use of analytical tables is a prominent feature, but there seems to be at least a practical end attained. Imagine a study of zoology or of mineralogy which should find its end, not in studying the animal or the mineral, but in merely finding out by a set of artificial tables what it is, and we see the fallacy in calling it science. I believe it would be better for all students of botany, and I think

[1] Read before the Kentucky College Association at its latest meeting.