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TO OUR ENGLISH READERS.

We have received from Messrs. Deacon & Co., of 150 Leadenhall street, London, England, a standing order for a large supply of "Science," which will be forwarded weekly. We shall be obliged if our English readers will make this fact known to their friends.

The death of President James A. Garfield is regretted by the nation as a great national loss; but all friends of progress and those who desire to elevate the indifferent and ignorant to a higher grade of civilization, will mourn his sudden death as a calamity; for he was a living example of the wonderful power of education to raise a man from a humble position in society to a post of high honor and usefulness, developing powers which not only opened up a bright and brilliant career, but brought a peaceful and hopeful serenity to his mind which was evident to all who enjoyed his society.

A NEW COMET.

Mr. E. E. Barnard, of Nashville, Tennessee, announced to the Smithsonian Institute, on the 21st instant, the discovery of a comet by him on the 20th, at two o'clock A. M., Washington mean time, in seven hours forty-six minutes right ascension, and thirteen degrees twenty-eight minutes north declension, with a daily motion of three degrees northeast.

On the 23d instant Professor Lewis Swift, of Rochester, made the following announcement in regard to this comet:

The position of Barnard's comet, as telegraphed from Washington, is so widely erroneous that nobody would be able to find it. Instead of being in cancer and having been discovered at two o'clock in the morning, it was near zeta virginis, low down in the Western horizon, and can be seen but a few minutes. It was discovered on the evening of the 19th, and at 7h. 46m., Washington mean time, of the 20th, was in right ascension 13h. 28m. 2s., declination north 3 deg. 47 min., with a daily motion of 3 degrees northeast.

In consequence of smoke I have not been able to find it.

We trust in our next issue to offer some explanation of these contradictory statements.

One of the most interesting and valuable reports that has been issued by the Board of Education at Washington, is that recently printed, which describes the opportunities for instruction in Chemistry and Physics which at present exists in the United States, together with statistical tables relating to this subject.*

The Department was fortunate in securing the services of Professor F. W. Clarke, Professor of Chemistry and Physics in the University of Cincinnati, to draw up this report, based on the mass of facts and figures bearing on this matter, which had been collected in reply to circulars issued by the Commissioner of Education towards the close of the year 1878. Professor Clarke appears to possess both executive and literary ability of a high order, and being himself a chemist and a teacher of science, was clearly in a position to do justice to the excellent intentions of Commissioner Eaton. We congratulate Professor Clarke on his success in compiling the technical part of his report, and we propose, on this occasion, to refer to some of his critical remarks aud suggestions, which, in scientific circles, will be considered the most valuable result of this investigation.

Before discussing the condition of scientific instruction in public schools, it may be well to consider first, at what age such instruction shall be commenced, and whether it should be considered as a part of primary education, or be reserved for high schools and universities, where special courses of training in the various branches can be advantageously advanced.

Professor Clarke claims that oral instruction in chemistry and physics can be made intelligible to children of ten years of age. He admits, however, that there is a tendency towards over-cramming the lower schools with a too great variety of subjects, which lead to results which are undesirable. He therefore suggests a compromise, and proposes, that in primary schools a taste for science should be cultivated among children "through the medium of the reading books, which might properly contain some short extracts relating to natural science." This plan Professor Clarke considers would be beneficial, and could not be injurious.

We can find no objection to such a course, provided a suitable reading book be written for the purpose, but before any discussion can be made as to the propriety of teaching the sciences in any form in the primary schools, a more thorough reform in the

*Circulars of Information of the Bureau of Education No. 6. 1881.
A report on the teaching of Chemistry and Physics in the United States, by Frank Wigglesworth Clarke, S. B., Professor of Chemistry and Physics in the University of Cincinnati. Washington, 1881.

whole system of public school education must be made. It appears superfluous to urge the teaching of science to children of ten years of age in public schools, where the elder scholars of fourteen and fifteen years are unable to read aloud intelligently or write an ordinary letter legibly. And yet, to our knowledge, such is the situation of too many of the scholars in our public schools in regard to these fundamental branches of education.

Professor Clarke's report shows that in high schools and academies the teaching of Chemistry and Physics varies between widely separated limits; in the majority of cases mere text book work is done, and only a few experiments performed by the teacher.

In our opinion the report offers excellent advice in regard to the teaching of Chemistry and Physics to such classes of students.

The following extract will explain Professor Clarke's views:

"That chemistry and physics are desirable branches to teach in schools of the grade now under discussion is pretty generally admitted, although a few educators still hold that such studies are fit only for technological institutes and colleges. But the greater number of pupils cannot go out into these higher grades, and must therefore either study the sciences now or do without them altogether. The latter alternative is clearly the wrong one to choose; at least, if we admit that education is anything other than a mere system of mental gymnastics. If subjects are to be learned quite independently of their relations to active life, then there is no ground for present argument; but if culture and utility are both to be considered we must recognize that some scientific training is indispensable. Nearly every pupil goes out of school into one of the great industries; and, whether he becomes a mechanic, manufacturer, railroad man, telegraph operator, farmer, miner, or tradesman, he is likely to encounter practical applications of the two sciences. In every avocation some knowledge of either physics or chemistry is almost certain to be directly useful; and this utility is often so great that the schools can better afford to err on the side of over-thorough teaching than in the opposite direction."

In answer to the inquiry how far these sciences can be carried in such schools without detriment to other interests, the report states:

"One high school has three years and another four years in its total course of study; the latter is plainly able to give more time to any particular subject than the former, Every variation in the character of a school must involve corresponding variations in the treatment of these two sciences. It may be safe to put half an academic year as the minimum time assignable to either subject. A year can usually be given to each without difficulty."

While as to the detail of such instruction Professor Clarke says:

"Instruction should be general rather than special. The attempt is too often made to teach applied science when there are no foundations of science to apply. Such foundations should be thoroughly laid in the high schools and academies, so that the pupil who passes on to a university or polytechnic course may have a genuine preparation for advanced work. Fundamental ideas, like those of the conservation of energy, the correlation of forces, the conceptions of atoms and molecules, &c., ought to be clearly inculcated. The scholar should be made to realize that each science is a coherent whole with definite relations to other sciences, that all its parts are vitally connected, and that certain general principles are universally applicable in all of its branches. In chemistry it is better to concentrate all efforts upon the inorganic portion of the science, leaving the complicated organic side for more advanced study. Along with the merely descriptive work should go a solid drill in chemical problems and chemical notation. Experiments made before classes ought to bear as far as possible upon main questions, and unavoidable details should be handled so as to illustrate clearly the great central ideas. When these have been fairly grasped, the scholar has gained something of both practical and intellectual value. His studies will have brought him not knowledge only, but also increased power."

For success, much depends on the teacher.

"He must have a vivid sense of what needs to be accomplished and enough special knowledge to render him in a measure independent of text books."

Text books, the report says:

"May be useful or injurious, according to circumstances. If they have been chosen by an average school committee, influenced by some publisher more energetic than his rivals, they are likely to be worthless, and the teacher must be prepared to make good their omissions and correct their blunders. No text book can be taken as sole guide and followed without variation; but a good treatise upon either science, prepared, not by a professional school-book maker, but by a trained specialist, may be of great help to teacher and pupils."

Professor Clarke wisely urges the value of laboratory work:

"In addition to classroom drill, laboratory practice should be an essential and prominent feature of every chemical or physical course. In the recitation or lecture, general principles are taught; in the laboratory, the student becomes familiar with methods and details. Three months of laboratory work will give more real insight into any science than a whole year's study of the printed page. To study chemistry from books alone is like learning a language from its grammar only, without attempting to translate or to write exercises. The pupil must learn to observe and to experiment for himself, in order to acquire any clear scientific knowledge."

One recommendation of the report is strongly in accord with our own views, and that relates to the advice to teachers and pupils, to construct as far as is practicable all apparatus used in the laboratory.

"The apparatus which a teacher contrives for himself with the aid of his scholars is oftentimes the most useful for purposes of instruction. Many and many a school has invested in trifling electrical playthings a sum of money which would have gone far towards the establishment of a simple working laboratory.

"In physics the laboratory practice must needs be somewhat limited. The pupils may handle whatever apparatus happens to be available, learn its manipulation, and assist the teacher in the construction of simple appliances. The magnetization of needles, the electrolysis of liquids, the verification of the fixed points upon a thermometer, and rough determinations of specific gravity, boiling point, and melting point are among the many experiments which ought always to be possible.

"In the chemical laboratory a much greater variety of work is easily attainable. There are the ordinary experiments in manipulation, such as the bending of glass tubes, filtration, precipitation, distillation, &c., the preparation of the commoner gases, acids, and salts; the verification of the more obvious properties of the chemical elements; and lastly, the simpler reactions of qualitative analysis. To the last named subject some time may always be profitably assigned. No other class of exercises will do so much towards impressing the average beginner or towards making him realize the nature of chemical reasoning. At every step it calls his powers of judgment into play. It involves the use of no costly apparatus, and enough can be done for all school purposes with a very moderate supply of the cheaper chemicals. At an expense of a hundred dollars a year a great deal can be accomplished; and an outlay of only one-fifth of that sum may yield results which are by no means to be reckoned as trivial. Again let it be said that success depends upon the teacher and not upon the cost of materials."

We shall in our next issue continue our notice of this interesting report.

ON COMETARY APPEARANCES.[1]

By M. Jamin.

[Translated from the French by the Marchioness Clara Lanza.]

The question of comets seems at present to occupy the attention of all *savants*, and as M. Faye has prevailed upon physicists to take up the subject also, I have decided to enter into the discussion, not with the intention of creating any novel hypothesis, but rather to oppose that which M. Faye imagines to be the correct one. In the first place, it appears to me unnecessary. It contradicts in my opinion, the theory of the vibration of the ether. Besides, it deprives the law of gravitation of its generality and simplicity. In his first work, M. Roche determined, by means of calculation, the form of the horizontal strata of cometary atmospheres subject to the sun's attraction, but he omitted to note the variations of temperature occasioned by the solar rays on the two sides of the comet. In this way he was led to think that the latter must have two tails, one turned towards the sun, the other away from it, which supposition is contrary to reality, as it should be, in fact, inasmuch as it overlooks the cause which manifestly determines the unsymmetrical forms of the two sides. In a second paper, however, he makes a correction, by supposing the existence of a repulsive force diminishing the solar attraction about 1—to 1. ϕ, ϕ, being a force acting unequally upon different substances, and which is in reverse ratio to their density. This hypothesis admits of the calculation being achieved with facility, but it has no physical actuality. It is confined to replacing the warmth of the cometary atmosphere, which should be included in the calculations, but which has been forgotten, with a wholly imaginary action whose existence no experiments have ever confirmed. I shall endeavor to re-establish the effect due to the unequal warmth of the two sides by referring to analogous conditions which should exist between the Earth and comets.

Upon the Earth, every day throughout the year, the solar rays one after the other in regular succession strike normally all the points of a circle perpendicular to the axis of rotation and near the equator. These points on all portions of the globe are those that receive the maximum of heat at noon. They constitute what is termed the *ring of aspiration*. The air there really becomes rarified and ascends, advancing towards the north or the south, as the case may be, determining two gaseous currents called trade winds. These currents are permanent and regular; they come from temperate climates, grow warmed progressively in their course, carry with them an intense evaporation, are slightly deviated towards the west in consequence of the Earth's rotation, and finally meet obliquely upon the ring, to rise to the highest atmospheric limits. There they spread, then taking a contrary course, return, one towards the north, the other towards the south. These are the *counter trade winds*. There are, therefore, on the two sides of the ring of aspiration, two closed atmospheric currents completely enveloping the globe, coming cold from the poles, grazing the Earth, and then returning warm, by a higher route. There is no occasion to dwell upon the chief *role* played by this circulation. It is sufficient to merely demonstrate its necessity, its constancy and its extent, besides recalling the theory due to the famous Halley, which has never been contested.

This circulation would still exist although under changed conditions, if the Earth instead of turning on its axis always presented the same side to the Sun. The ring of aspiration would be reduced to a single point, the trade winds would converge in all directions, while the counter winds would diverge in the same way. All points of the Earth would send to this summit cold air which would grow warm there, *rise in the form of a cone toward the Sun, spread, become bent upon the edges like the chalice of a cyrathiform flower*, leave the Sun by a high route and after a more or less prolonged journey would return to the point of departure grazing the Earth's surface. It is very evident that this double movement would possess an increase of force proportionate to the Earth's approach to the Sun; that its atmosphere would be more extended, and that there would be a greater mass of water to be evaporated. This does not imply any particular repulsive force.

But let us get to the comets. In the long journey which they perform slowly until they are beyond the Solar world, they have plenty of time to lose all the heat received from the Sun, and to efface all traces of perturbation. The tail disappears, the matter is knit together by its own attraction and assumes a nebulous, spherical form. In the centre are the dense, solid substances, the nucleus, then the liquids and finally the gases. An enormous atmosphere and a very small nucleus. In Donati's comet the nucleus measured 1600 km., while the atmosphere was 20,000 km. The comet of 1881 was still more extraordinary. Its aureole measured 2,000,000 km., the nucleus was reduced to 680. This is just contrary to the Earth whose diameter amounts to 12,000 km., while its atmosphere is merely a thin pellicle of 18 or 20 leagues. Comets are so constituted that the most tremendous atmospheric movements are developed be-

[1] See *Comptes Rendus*, August 16, 1881.