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Vérité sans peur.

NEW YORK: THE SCIENCE COMPANY.

FRIDAY, JULY 2, 1886.

COMMENT AND CRITICISM.

THE BUREAU OF EDUCATION has made a valuable addition to our educational literature by its recent publication of a paper by Dr. E. M. Hartwell of the Johns Hopkins university, on physical training in American colleges and universities. '*Mens sana in corpore sano*,' is perhaps as familiar as any classical quotation to collegiate trustees and professors, but in the past they have been inclined to trust too much to time and luck to give it a practical application. The progress we are now making in organized physical education is the most significant fact brought out by Dr. Hartwell's investigations. He shows that until 1859 no college in the country possessed a commodious and well-furnished building devoted to the purposes of physical training. In that year, however, Amherst, Harvard, and Yale built gymnasia. Amherst seems to have been the most progressive in this matter; and though its first gymnasium has since been replaced by a costly and much-improved building, yet from the first, physical exercise has been required there of all able-bodied students, and it has been directed by an educated physician with a seat in the faculty.

The Hemenway gymnasium at Harvard, and the supervision of Dr. Sargent, have not only given a great impetus to physical training there, but Dr. Sargent's system of directive exercise has been widely adopted. Since 1879, forty-eight institutions have fitted up their gymnasia with Dr. Sargent's apparatus; and his directions are now followed in very many of them, including Amherst, Cornell, Haverford, Johns Hopkins, Lehigh, and Swarthmore. The same system has just been introduced into Lafayette, and is projected at Vassar and the University of Vermont. The statistics and detailed information that accompany the paper are of great value and interest, but its general tenor is more valuable and interesting still. It shows that education — physical, intellectual, and moral, as the phrase is — has become something more than a meaningless motto in many of our leading educational institutions.

THE TRUSTEES OF THE Elizabeth Thompson science fund have made the following grants for research from the income of the fund: 1°, H. M. Howe of Boston, Mass., seventy-five dollars, for investigations on the fusibility of slags from the smelting of lead and copper, to be carried on in the mining laboratories of the Massachusetts institute of technology; 2°, two hundred dollars to the New England meteorological society, for the working-out of results from the very numerous data which are now collected by the society concerning the movements of local storms; 3°, one hundred and fifty dollars to Samuel Rideal, Esq., of University college, London, for the continuation of Tyndall's experiments on the absorption of radiant heat by aromatic gases; 4°, five hundred dollars to Professor Rosenthal of Erlangen, Germany, for researches on the production and regulation of animal heat in health and disease, with special reference to fevers. As the number of applications was very large, the sums asked for amounting to about thirty thousand dollars, it became necessary for the trustees to refuse several applications which entirely commended themselves on account of the character of the applicants and the nature of the proposed work. The invidious task of selection was of course difficult in the extreme, so that it is unadvisable to give the grounds for the preferences finally adopted. On the other hand, the very number of applications increases the probability of the fund being devoted to the support of thoroughly fruitful researches. It is a somewhat unexpected turn of fortune's wheel which delivers an American endowment, even in part for the prosecution of research, at a German university; but it should not be overlooked that the fund was established primarily to further the utility of the proposed international scientific congress, and that it would violate the spirit of the trust to confine the grants to persons in this country. There is, so far as we are aware, no other endowment of science so generously wide in its scope: we hope, therefore, that it will always be employed to assist only the very best work, and that the trustees will so earn the faith of the public, that the endowment will be very largely increased by liberal patrons.

IN A RECENT NUMBER of *Science* (vol. vii. No. 160, supplement) we published several articles by Mr. J. A. Allen and others on the destruction of our native birds. Facts and figures were presented, tending to show that the killing of birds for millinery purposes and for food, together with their destruction in wanton sport, was liable to cause a serious diminution of our birds, and perhaps the extinction of some species useful to man or desirable for their song. The views thus expressed were indorsed by a committee of the Society of natural history of Cincinnati, in a report to that body; and this report has brought out a reply from Dr. F. W. Langdon in an address before the same society, in which he dissents from our conclusions. He points out that the birds most largely used for millinery purposes are those living by the seashore, such as gulls, terns, herons, and others, which are not song-birds nor beneficial to the farmer. As for the destruction of the birds in such places as the Everglades of Florida, he thinks these are doomed to extirpation in any case when the growth of population shall have led to the clearing and draining of the swamps. He admits, however, that some song-birds are made use of by milliners; but he gives some results of his own and others' observation which seem to show that the number of such birds destroyed is not very great. He adds that most of our familiar song-birds, such as thrushes, wrens, and finches, are in little demand for millinery use, owing to their being usually of plain colors, but does not seem to notice that their skins may be dyed. Mr. Allen, in his article above referred to, had estimated the number of birds required in this country to meet the demands of the milliners at 5,000,000 a year; but Dr. Langdon thinks, that, even if this estimate is correct, the loss of that number of birds in a year will have no appreciable effect on the aggregate. He estimates the total number of birds on the continent at 3,000,000,000, and the annual increase at the same number; and, allowing a second 5,000,000 for the demand from other countries than our own, he finds the percentage destroyed each year to be very small. He infers, therefore, that, even if all the birds destroyed were song-birds or birds useful to the agriculturist, the annual loss would have no practical effect on the fauna of the country at large.

MR. FRANCIS GALTON has been devoting the last year or two to a study of stature as an hereditary trait. From a large number of family records, in which the heights of the members of at least three generations are recorded, he attempts to assign the proportionate contributions of each ancestor towards the height of the descendant. He has formulated a law which partly opposes and partly supplements the common notion that the children of parents both possessing certain qualities will probably have the same qualities in even a greater degree than either parent. This law maintains that a constant tendency to mediocrity exists; that the qualities of the parents will not summate, but the average will be the probable result. Perhaps none of his ingenious researches will meet with more criticism than this, it seems to run counter to so many well-known facts of heredity. The research with regard to stature is only a typical one. In a more recent report he has carried over the same method to the consideration of the color of the eyes as affected by heredity, and shows the validity of the law in this field. Mr. Galton has presented his views in his presidential address before the British association and in articles in the Journal of the anthropological institute; but the full paper will appear in the Proceedings of the Royal society, and perhaps a judgment ought to be suspended until all the facts are in.

SEVERAL INSTANCES have been reported in the past few months where large numbers of persons have been made sick by ice-cream. The theories which have been advanced to explain this result have been many and various. By some it has been attributed to the absorption of copper from the vessels in which the cream was made; others have thought it due to decomposition of the gelatine which is now commonly used to give stiffness to the cream; while still others have thought it might be traced to disease in the cows from which the milk was obtained. Prof. V. C.

Vaughan, of the University of Michigan, has recently investigated the poisoning of a number of persons by ice-cream at Newton, Mich., and is reported to have found tyrotoxicon present in the ice-cream which produced the sickness. This had been previously discovered by Professor Vaughan in pieces of cheese which had caused sickness, and which had been submitted to him for examination. Whether this poison is due to a germ, or to a chemical product, does not yet seem established; but it is but another proof of the possibilities of milk, either infected or decomposed, acting as a factor in disease, and it is not improbable that diarrhoeal diseases so common among the infantile population in the summer months may be caused, or at least aggravated, by milk which contains the tyrotoxicon.

THE BILL authorizing the President to appoint a commission to investigate yellow-fever and the methods proposed for its prevention has passed the senate, and, as there is now no opposition to its passage in the house, there is every probability of its becoming a law. In the mean while, Dr. Freire, who claims to have discovered the microbe of the disease and a method of inoculation to prevent its ravages, is reported to have performed the operation upon seven thousand persons living in localities where yellow-fever is prevailing in a most malignant form. Of this large number, but eight have died. During the same period, some three thousand uninoculated persons have succumbed to the fever. Should the bill to which reference has been made obtain a place in the statutes, these claims of Freire will be subjected to rigid investigation by the best American experts, and, if substantiated, will doubtless be the means of introducing his system, or a modification of it, into the United States, whenever yellow-fever shall again appear in epidemic form.

IT HAS ALWAYS been difficult to understand how the germ theory of disease could be true, and yet the diseases which are due to germs could vary so much in virulence; at times being exceedingly mild, and again malignant in the highest degree. Dr. Sternberg, in a recent paper published in the *Medical news*, makes this very clear, thus removing what has to many seemed an insuperable objection to the acceptance of the germ theory. Germs which produce disease, that is, pathogenic germs, are subject to great modification as regards this power. Germs which to all appearances are the same, and which, so far as we know, are in fact identical in most particulars, may yet differ in their virulence; being extremely so under some circumstances, and but slightly so under others. It is for this reason that virus may be 'attenuated,' as it is termed, Thus the microbes which produce fowl-cholera in a fatal form may, after two or three months, lose this virulence, and still possess some pathogenic power. It is this principle of attenuation which enables experimenters to inoculate animals with the same microbe, but of gradually increasing virulence, until perfect protection, even against the most virulent form of the disease, is assured. A mild attack of scarlet-fever is explained, therefore, not on the ground that only a few microbes of the disease exist in the body of the individual attacked, for we know that this form of life multiplies with enormous rapidity, but by the probable fact that the microbes in this individual case possess a mild degree of virulence.

The further and deeper research is made into this domain of bacterial life, the more apparent does it become that disease-producing germs are wide-spread and abundant; and, if animals susceptible to any particular variety come in contact with that variety, it is easy to understand how disease may be contracted, even when no other animal has been brought in contact with them. For instance: the bacillus which causes fowl-cholera is found in various parts of the world in putrid substances, and as a result epidemics of fowl-cholera are most frequent among fowl that are kept in unsanitary conditions. In the same way typhoid-fever and cholera may develop irrespective of human intercourse or *fomites*. Much of this may seem trite, but the tendency of the present day is to ignore filth as a factor in the production of germ-diseases, and to limit their causation to the presence of other similarly affected persons or animals, and to the articles which have been in contact with them. In helping to clear up the question, Dr. Sternberg has done good service.

THE ECONOMIC DISCUSSION IN SCIENCE.

IT is often doubted whether any good comes of polemical discussion in a periodical; and so obvious are the disadvantages under which those labor who would maintain a scientific position in popular debate, that many refuse to attempt it under any circumstances. Points are brought up which require lengthy elucidation, and that must be compressed into a single sentence which ought to be elaborated in an entire article. Then it is necessary to assume certain primary considerations ; for, should it be endeavored to begin at the beginning and prove satisfactorily to the writers themselves every step taken, it would end in the construction of a complete scientific treatise which might fill several volumes. I believe the representatives of the new school of economics who undertook to prepare a series of articles for *Science* on a number of economic topics were fully aware of the difficulties of their task, and it is certain that the invitation of the editor of this journal was accepted with hesitation. Nevertheless, I must be allowed to express satisfaction with the general course of the discussion so far, and I am convinced that the readers of *Science* have obtained new and valuable ideas from the able articles both of Dr. Seligman and of Professor James. However familiar the views so well set forth in these articles may be to Professor Newcomb, there is no evidence of an acquaintance with them on the part of what might be called the educated American public, and it is unquestionable that they differ in radical particulars from the economic doctrines current in our magazine and newspaper literature. As a matter of course, these articles have been scarcely more than suggestive. It was not intended that they should be exhaustive, for that was impossible within the limits of the assigned space.

Professor Newcomb's article illustrates vividly the difficulties of a discussion of economic theories in a periodical. He sweeps over an immense field, touching on the development of economic doctrines, on the functions of the state, enlarging a little more on the relations of economics to ethics, and concluding with an irrelevant allusion to the condition of American shipping.

I should desire a volume — and a large one — to expose all the errors which, in my opinion, are implied in the article of the distinguished mathematician of the Johns Hopkins university. I will nevertheless endeavor to set a few of the points involved before the readers of *Science* in such a manner as to enable them to understand better the nature of the controversy, and to help them to follow out the argument in their own thoughts.

First, I must begin with a personal explanation. There seems to be an implication, though doubtless inadvertent, in the article of my learned colleague, that I am a socialist. True, I believe that the state has its industrial sphere, and that a larger one than many have been inclined to think ; but I hold quite as strenuously that the individual has a sphere of economic action which is an equally important one. I condemn alike that individualism which would allow the state no room for industrial activity, and that socialism which would absorb in the state the functions of the individual. Doubtless I have written more or less about socialism, and I have attempted to tell the truth about socialists, for I have not believed that the generally accepted lies about them could be of any avail to society. The university of which I have the honor to be a member has adopted for its motto the grand sentence, '*Veritas vos liberabit.*' This I accept and have found a source of inspiration. I may go even further. I believe that the socialists have added to our stock of economic knowledge, and that we have a great deal to learn from them. On the other hand, it is safe to say, that, among those who are known as the new school of political economists, there is not a single one who could be called an adherent of socialism, pure and simple. It is, I believe further, safe to assert that pure socialism is advocated by no teacher of political economy in any American college or university. Professor Newcomb finds the present economic discussion — as yet incomplete, be it remembered — disappointing, and because more has not been said about the state, since "the main point in which the new school is supposed to differ from the other is that it looks with more favor upon government intervention in the processes of industry and trade." Of all the articles in this series, only one deals exclusively with the state ; and yet the topics were selected by the writers of these articles. Is not this in itself a sufficient refutation of this popular supposition? What those who consented to write these articles desired was to place before the readers of *Science* an outline of their fundamental doctrines. They wished to present their opinions as they in reality are, not as people might suppose them to be. In my article I ventured the opinion that the radical difference between the old and the new school consisted, *not* in the views held of the state, but in the establishment of a new relation between ethics and economics. Others, possibly the majority, find the main difference in method, about which Professor Smith of Columbia is to contribute an article. It is necessary in all discussion to grasp the fundamental fact that what one believes, and what one is said to believe, are two quite different things.

Professor Newcomb claims that nothing new has been said in regard to the state, because every one is willing to admit that state intervention is right if it is useful. I am glad that it is admitted that state intervention is considered as merely a question of utility. It is a great deal to have gained that point, and to be able to quote Professor Newcomb in favor of the position. This is very different from the ordinary view, which is that the state has no right to participate in economic and industrial life. Some time ago Dr. Lyman Abbott wrote an article for the *Century magazine* in which he raised the question, whether the United States would not have done better to build and manage itself the Pacific railways rather than to give vast empires of land, and millions in money, to corporations to induce them to construct those great highways. His argument was presented with a great deal of force; but, in a later issue of the magazine, space was given for an objection. In what did the objection consist? Simply the dogmatic assumption that it was not the province of government to construct and manage railways. It was not regarded by the writer as essential to prove that it would not have been useful. When the question was raised recently in Philadelphia, whether the public gas-works should be sold to a private corporation, many newspapers thought it an argument to urge that it was not the function of a municipality to furnish gas. These are typical cases; and it is, I repeat, a satisfaction to be able to cite Professor Newcomb as an authority against such dogmatism.

Again: the article by Dr. James is criticised because 'there is so little to object to in it.' This is another concession which must give satisfaction to many members of the new school. It differs widely from prevailing public opinion; and even so liberal and progressive a man as Professor Taussig thinks that Professor James 'goes too far.' A new theory of taxation is suggested by Dr. James, which is, I think, of far-reaching importance. It is not at present received either by our legislative or our judicial bodies.

Professor Newcomb's position as first stated, in regard to the development of economic thought, differs not in one whit from that of the new school. Adherents of this school all regard economics as a development, and, without exception, they value the works of their predecessors. They were the first in America to give a proper position to Adam Smith, Ricardo, and Malthus, by the introduction of courses in the history of political economy into our colleges. In the 'Statement of principles' of the American economic association, it is expressly declared that 'we appreciate the work of former economists.' Again: it is pleasant to be able to agree with Professor Newcomb; but, as a matter of fact, this is a different opinion from that which was a short time ago current. Writers, not long since, looked upon political economy as a complete and perfect science, true for all times and all places. Buckle and Lord Sherbrooke advocated this view; and even Professor Laughlin of Harvard, who probably does not regard himself at all as a representative of the extreme 'orthodox' school, conveys the impression, in his useful little work on methods of instruction in economics, that there is, after all, not much constructive work to be done in our science. When Professor Newcomb, however, begins to criticise Dr. Seligman, I am unable to agree with him; for he speaks as if political economy were a mathematical science, with a body of truth unchangeable and eternal, like the statement, "A straight line is the shortest distance between two points." It is, according to this view, only the application of fixed principles which must be changed with time and place. Now, what is this body of mathematical truth in economics? There are some truisms in economics of that nature; but a large and important body of such principles I have never been able to discover, though I have searched for it long and diligently. It seems to me that Professor Newcomb fails to distinguish between mathematical sciences and those which are more descriptive in their nature, and have to do with growing, changing bodies.

This brings us naturally to Professor Newcomb's objection to my conception of economics as a science concerned with what ought to be, — an objection which it seems to me, though very natural in a mathematician, is not valid. I believe all sciences which treat of concrete organisms consider what ought to be as well as what is. The scientific physician treats of the perfect body as well as of the diseased, imperfect body. The biologist observes living forms, and expresses approval and disapproval. Natural sciences treat continually of purpose and adaptation to ends. Who can so well treat of social remedies as he who has studied society? Why stop when we have reached that point which first renders our science useful?

Professor Newcomb implies the argument, formerly a favorite one and still too common, that selfishness and enlightened philanthropy lead to the same ends. Observation does not confirm this. To a certain extent their courses will be parallel; but in important particulars there will be a divergence, and that divergence will be the difference between health and disease. His illustration of the treatment of the servant 'Cuffee' is pertinent. A careful observer will note a very different treatment of him by a selfish lady, and one who applies the dictates of ethics to her everyday life. This difference will affect the welfare of 'Cuffee' materially. I dismiss the question "Would he (Professor Ely) have Cuffee trained into a novelist, a chemist, or a metaphysician?" as not pertinent to the discussion, and as being, in fact, the exact opposite of what I did say. Not to weary the readers of *Science*, and not to make too large demands on the available space of this journal, I will conclude with one further general consideration.

Professor Newcomb closes his article with the statement of an objection against state intervention, based on the observation that our congressmen, and I suppose our rulers in general, are not a very wise body of men, and presumably do not know better than others what is for our good. This shows, it seems to me, a total misapprehension of the question involved. Nobody wants to intrust certain things to the government because the government is very wise and very good. Nobody desires paternal government. Even the extreme socialist does not desire it. What he wishes, and believes practicable, is a fraternal commonwealth. The question involved is not, "Shall we let wiser and better people than we attend to our affairs for us?" but "Shall certain functions be performed by co-operative methods, or by individual methods?" for the state is only a certain kind of co-operative institution. Then, if we decide on co-operative methods, shall we adopt voluntary co-operation, possibly that of a corporation, or shall we adopt the compulsory co-operation of the state?

Now, inquiry shows that certain functions are adapted for individual effort, that certain others will be best performed by voluntary co-operation, while still others can be accomplished most advantageously by the compulsory co-operation of the state or of some subdivision thereof. What these are, space does not permit me to say in this place.

I have, however, laid down a few simple rules elsewhere;[1] Prof. Henry C. Adams has gone into the subject far more at length in his paper, "Principles that should control the interference of the states in industries;"[2] while valuable suggestions may be found in the admirable monograph of Dr. James, on the "Relation of the modern municipality to the gas-supply," just published by the American economic association. It is enough, if in this series of articles the general points of view of the new school can be impressed upon the readers of *Science*. It may be remarked, however, that 'interference' is not so good a word as 'participation' to denote the activity of the state; for it is not opposed to, but, if wise, in the line of the desires of the people, and precisely on that account it is not generally noticed how large is its sphere.

Finally, the case is not nearly so hopeless as one would gather from Professor Newcomb's observations. Experience, sooner or later, teaches the people many wise things. It is the function of the economist to help the people by more careful observation, and thus to shorten the term of unfortunate experimentation, and to lessen the cost of that dear teacher 'experience.' Take the case of the post-office. Experience and science have decided that its functions should be performed by public authorities, trial having been made of private enterprise. That question is settled, and the benefits of correct practice are inestimable. Take the case of letter-carriers in cities. They are a great saving and convenience. I suppose, in a city like Baltimore, the time they save to citizens must amount to hundreds of years in each year. The benefits derived from letter-carriers are equal to those of great inventions, but they have been demonstrated, and are secure. I think the railway problem, now prominent, will be settled in the same way; that is, by experience, aided largely by science.

It is not necessary that the majority, or even a great many, — that is, compared with the entire population, — should have special and profound knowledge in economics in order to secure intelligent economic action. The influence of two or three men 'who know' is enormous when exerted at the right time and in the right place. I suppose six men in congress who thoroughly understood public finance could, at the beginning of our late civil war, have shaped the financial policy of government for years to come.

I wish again to call attention to the forcible illustration to which allusion has already been made. A few months since, the question was raised whether the gas-works of Philadelphia should be sold. Few understood the question; and it is said that a systematic agitation in favor of private works was conducted by a vast corporation, which had its eyes fastened on them as a mine of wealth. But there was one man in Philadelphia who did understand the question in all its bearings, and that was Dr. James. He came forward and set the matter in its true light, and I have been told that his influence was decisive. At any rate, it had weight, and the gas-works remain to-day the property of the municipality. That decision was worth many millions of dollars to the city of Philadelphia, and is an illustration of the value of the higher education. All that the University of Pennsylvania ever cost the citizens of Philadelphia, either in their private or public capacity, is a small matter compared to the value to that municipality of a single man who occupies a chair in that institution of learning.

Richard T. Ely.

[1] In my 'Introduction to the labor problem,' published by Harper and Brothers, 1886.

[2] A lecture printed in pamphlet form by the Constitution club of New York.

THE EXISTENCE OF A MAGNETIC SENSE.

Since the day when Thales, about twenty-four hundred years ago, rubbed a piece of amber on silk and found that it attracted light particles, the phenomena of magnetic action have been regarded with feelings of awe and mystery. The strange entrancing of animals brought about by an intense fixation of their gaze was referred to 'animal magnetism,' because nobody understood either the one or the other. The discovery of the magnetic needle, and its mysterious constant pointing towards the north, added another element to the wonders of magnetism. Mesmer was keen enough to see, that, by explaining the hypnotic phenomena to which he gave his name as due to 'magnetism,' he was treading on safe ground. That elastic cabinet of mysteries could easily be made to accommodate another series of peculiar facts, and the theory had thenceforth a habitation and a name. The mere mention of so-called magnetic cures is sufficient to suggest a host of alleged facts and wonders. Although all such phenomena assume that the human body is susceptible to the influence of the magnetic field, Baron Reichenbach, in a series of experiments since become famous, was the first to attempt a scientific proof of such an influence. He thus described his 'sensitives,' who were variously affected by the presence of a magnetic field: some saw flames issuing from the poles; some had disagreeable organic sensations; some were benefited by it; and so on. These experiments were repeated by Professor Barrett of the English Society for psychical research, but altogether with negative results, until the young men who had done such good service in the thought-transference department were called in to describe the effects of a magnetic field upon them. They saw the lights issuing from the poles, and felt the pains in the temples when very near the magnet. Before these experiments, Sir William Thomson had expressed the opinion that it would certainly be strange if no magnetic sense existed. The fact that nothing happened when he put his head between the poles of a powerful magnet, he regards as very wonderful. Finally, French observers have recorded the fact that hypnotics who have responded to the suggestion that one-half of the body is affected in a certain way (e.g., one arm is insensitive) will have the affection transferred to the other side of the body, and removed from the first side (i.e., the other arm will become insensitive), by the application of a magnet on the opposite side of the body.

The above hasty sketch of what has been done towards solving the question of the possible effect of a magnet on human nerves seems to suggest that a rigid scientific test upon normal persons is highly desirable. It was to supply this want that the experiments about to be described were undertaken.[1] The special points which were borne in mind were, 1°, to exclude the action of chance; and, 2°, to rule out all possible modes of suggestion as to what was going on. We believe that we accomplished these objects by using the following method and apparatus. A large and powerful electro-magnet was tipped on its side and supported between two tables. The head of the person to be tested (to be called 'the subject') was placed between the poles of the magnet, with the forehead and back of the head all but touching the poles. He was seated upright in a chair, with his head in a normal and fairly comfortable position. The magnet and the subject were on the third floor of the building. In the room on the ground-floor there was a dynamo-machine, which, when turned by the operator, generated the current. The magnet was connected with the dynamo by heavy insulated wires passing out of the windows and along the wall of the building. The subject and the operator communicated by a system of telegraphic signals: otherwise they were completely isolated from one another.

At the first stage of the experiments the following method was employed. After the operator had received the signal that the subject was ready, he did one of two things: 1. He turned the current on, and when, after a short interval, the subject signalled 'Change,' he turned it off, turning it on again when the second 'change' was signalled; 2. He began by doing nothing, turned the current on at the first 'change,' and off at the second. In either case he received a signal from the subject when the observation was concluded. In each observation the subject knew that the condition of the magnet at the beginning and at the end of the experiment was the same, but that in the middle, between the two 'changes,' the time of which he himself directed, the condition was different. His object was to tell whether the magnet was on or off at that intermediate time. His opportunities for judging were extremely favorable, for he knew exactly when to expect the sensation of a change from one condition to another; and he knew that in one case it would be change from magnetization to demagnetization, and in the other case a reverse change. He had simply to tell which was which. It is evident that by mere guess-work he would answer correctly one-half the time,

[1] The experiments were conducted in the psycho-physical laboratory of the Johns Hopkins university. Dr. G. H. F. Nuttall was associated with me in the work.

for he had only a choice between two things, one of which was right and the other wrong. The number of correct answers above one-half the total number of answers would measure the magnetic sensibility.

Experimenting in this way, we were surprised to find that considerably more than one-half the answers were correct. Apparently the magnetic sense was there. But it was soon observed that we more or less consciously judged by the sound that the turning of the dynamo transmitted along the wire, and thus to the magnet. When the attention was once directed to this point, the doings of the operator could be correctly told every time. After many failures, we succeeded in eliminating this sound by cutting the wires, and inserting one end of each into a mercury-cup, and connecting the other by a binding-screw with the cup. The wires were suspended from the ceiling by silk threads, and inserted freely in the mercury: in this way the sound-vibrations were transmitted to the mercury, and only very weakly taken up again by the wire. This arrangement was inserted in the circuit once in the basement room, and again on the sill of the window, as the wires passed the second floor of the building. The turning of the dynamo was thus rendered inaudible; and for a time the results were negative, the number of correct answers being just about one-half of the total number of experiments. But soon the correct answers became more and more frequent. This time the indications were more subtle. As is well known to physicists, the magnetization and demagnetization of a powerful magnet produce a molecular crepitation throughout its mass, which gives rise to a very faint but audible click. It was this click, and not the magnetic sense, that told us when the current was being turned on, and when off. It is remarkable that we used this click as an indication of the condition of the magnet long before we were distinctly conscious of its existence. This click could not be heard every time, but, with the attention sharply focused, almost every time. But it will be objected, as the click accompanied each 'change,' it could not guide the judgment of the subject. This objection would hold were it not that the click accompanying demagnetization is much more pronounced than that accompanying magnetization. In fact, the latter could rarely, if ever, be distinctly heard.

These difficulties were obviated by a slight alteration in the mode of experimentation. At the beginning of each experiment the current was off; at the signal of 'Change,' the current was either turned on or left off. The subject had then simply to decide whether, on the whole, something had been going on during the experiment, or whether the dynamo had not been turned at all. In this way, only the magnetization, and never the demagnetization, occurred in the experiments, and the click was thus avoided. Moreover, to completely guard against the very slight click of magnetization, the current was not made as formerly, by the closing of a key; but, with a key always closed, the dynamo was turned with gradually increasing speed. It is the suddenness of the magnetization that produces the click. It is evident, that, as before, the chances of a correct guess are just one-half. The opportunities for judging are perhaps not as favorable when only one change is made, but it is doubtful whether even this difference is appreciable. It is this latter method that was used throughout the rest of the experiments. In all, ten persons, all students in good health, were experimented upon, including Dr. Nuttall and the writer. The results are given in the following table: —

Subject.	No. of experiments.	No. of correct answers.	No. of correct answers by the action of chance.	Divergence.
J. J.	550	286	275	+11
G. H. F. N.	550	287	275	+12
M. S.	150	76	75	+ 1
L. B.	100	50	50	0
C. F. H.	100	47	50	− 3
D. B.	100	47	50	− 3
M. E. C.	100	44	50	− 6
W. H. B.	100	53	50	+ 3
E. C. S.	100	51	50	+ 1
H. B. N.	100	50	50	0

This table makes it evident, that, in the case of those experimented upon, no sensibility for a magnetic field existed. This still leaves the question open, whether there may not be a morbid sensibility for such an effect; but it makes such a possibility less probable, because the sensibility for a magnetic field ascribed to 'sensitives' is so intense, that some slight remnant of it might be expected to exist in normal persons. It was intended to test persons who were good hypnotic subjects both in the normal and the hypnotic conditions, but no opportunity offered itself. Our conclusions refer only to the question of a normal magnetic sense.

On what ground the alleged magnetic phenomena are to be explained is another and more delicate question: that the imagination is a powerful and important factor is beyond doubt; and when, as is generally the case, morbidly sensitive patients, especially hysterical girls, are experimented upon, the merest trace of a suggestion, unconsciously given, of the desired or expected effect, is enough to bring about all the phenomena of '*transport*,' etc., for which the magnet has been held accountable. Only when tested under rigid and scientifically controllable conditions can the evidence of such abnormal sensibility be relied upon. Even the precautions against indications as above described would probably have to be added to, if hypnotic subjects were experimented upon.

In conclusion it is desired to lay stress not only on the negative character of the results, but on the method employed, and especially on the fact, that, as the precautions were rendered more and more effective, the negative character of the conclusions became more and more evident.[1]

JOSEPH JASTROW.

[1] The above is simply a general account of the experiments. For a detailed account, the reader is referred to the full paper on the subject, to appear in the next number of the Proceedings of the American society for psychical research.

LONDON LETTER.

No more interesting and valuable report has been presented to parliament during the recent session than that of the inspectors of explosives for 1885. Colonel Majendie and his colleagues have been engaged for ten years in protecting the public against the most terrible dangers to which modern science has exposed it. A list of twenty-nine men is given who have been caught and punished for complicity in what are usually known as dynamite outrages. In 1885, 133 ordinary explosions due to accident came under the notice of the Home office, and some almost incredible stories are told of carelessness in connection with explosives. The explosion of tablets of chlorate of potash in the pocket of a gentleman in Brookline, Mass., who dropped his watch upon them quickly, is characterized as the most curious explosion of the year. Among other 'explosive medicines' is mentioned nitro-glycerine, which is made up with lozenges, etc., for use in cases of angina pectoris and other complaints. In the United Kingdom, 22,268 houses are registered for the keeping of explosives. It is the duty of the local authorities to see that the provisions of the act are complied with. Sometimes, however, they are very remiss, and the inspectors act as a useful check upon them. In 1885, 392 places where explosives were kept for retail sale were inspected, and in some cases they were found to be 'about as bad as they could be.' London, Liverpool, Bristol, Birmingham, Sheffield, Huddersfield, and Bath are selected for special commendation in this respect.

At the last meeting of the London section of the Society of chemical industry, a very valuable paper was read by Dr. Meymolt Tidy on the chemical treatment of sewage. Premising that he had for many years read every thing he could get hold of on the subject, and had also gained practical personal experience therein, he defined sewage as "the refuse of communities, their habitations, streets, and factories." Its very complex nature was commented upon. Two elements were constant, and 'the rest nowhere:' viz., 1°, excreta (every thousand people gave, on a very large average, 2,640 pounds of liquid, and 141 pounds of dry, sewage daily); 2°, roads (if wood-paving be excluded, road-washings contained, on an average, 280 grains of solid matter per gallon, of which 120 were in solution). The extreme difficulty of obtaining fair samples was amusingly commented on; and the salutary effects on sewage, of air and of dilution, as shown by the appearance therein, or otherwise, of comparatively high forms of microscopic life, such as the Vorticella, Rotifera, etc., was pointed out. An unfailing characteristic of sewage was the presence of hairs of wheat, and of *free* spiral cells, their casing having been dissolved in digestive processes. Authorities were agreed upon two points; viz., that the valuable matters were in solution, and the offensive in suspension. Irrigation could not be relied on for giving absolutely continuous purity. Of the precipitation processes, those in which lime and alumina were employed successively, gave the best general results; and the smell still remaining might be entirely got rid of by causing the effluent to flow over a little land. This combination was probably the best method of dealing with liquid sewage; but, in Dr. Tidy's opinion, the whole system of water-carriage of sewage was a mistake. It was absurd to take expensive and elaborate precautions about purity of water-supply, and then only to use one-ninetieth of this for drinking, allowing the rest to be polluted. The dry-earth system of dealing with human excreta was the only proper and scientific method.

The second, and ladies', *conversazione* of the Royal society was held on the evening of June 9. Many of the objects of interest exhibited at the former one were on view again. Among the novelties were the following: some microscopic sections, diagrams, and specimens illustrating the alteration artificially produced in vitreous rocks by the action of heat alone, by Mr. F. Rutley; floral studies in Chili, of orchids, nests, etc., by Miss North; illustrative diagrams of and specimens from Roraima; some rare earths from Samarskite, Gadolinite, etc., with illustrations of their phosphorescent spectra, by Mr. W. Crookes; pumice, volcanic ash, drawings, diagrams, etc., illustrative of the great volcanic eruption, by the Krakatoa committee of the Royal society; apparatus employed in the examination of air for micro-organisms, by Dr. Percy Frankland; and a remarkable collection of gems, by Mr. Bryce Wright. Photographs of celestial phenomena and microscopic sections of devitrified rocks were exhibited in the lime-light-lantern, and demonstrated by Mr. Norman Lockyer, Mr. Common, and Mr. Rutley; and the United telephone company had established temporary communication with the Savoy theatre, where 'The Mikado' was being performed.

The annual meeting of the Marine biological association was held on June 8, Professor Huxley, the president, in the chair. The council's report mentioned a small increase in the number of members during the year, and the progress that has been made with the plans for the new laboratory at Plymouth, which will be commenced immediately. It is hoped that it may be in working order by the autumn of next year. Much interest is taken in it by the residents of Plymouth, one of whom, hearing that the council of the association were contemplating the omission, for pecuniary reasons, of certain desirable features in the building, has generously offered to provide the five hundred pounds necessary for the purpose.

A large amount of valuable zoölogical work has been recently carried out by the Liverpool marine biology committee, which was established some two years ago. The shallow water off the coast of North Wales and round the Isle of Man has been systematically explored with the dredge, with the following very gratifying results: whereas only 270 species of marine invertebrates were known from this neighborhood before 1853, 913 species are recorded in the report of the Liverpool committee. Of these, 235 were not previously known in the locality; 16 are new to British seas; while 7 species and 3 varieties are new to science. W.

London, June 14.

NOTES AND NEWS.

THE Lackawanna institute of history and science, recently founded at Scranton, Penn.. has taken steps for the purchase and preservation of the two great glacial pot-holes found in the Lackawanna valley at Archbald. An illustration of one of these pot-holes was published in *Science* for Dec. 19, 1884. The second one has not yet been cleared out, but will be cleared by the Lackawanna society. These holes are described by Professor Branner in his recent paper upon the glaciation of the Wyoming and Lackawanna valley.

— The destructive effects of poisoning by phosphorus are narrated in a paper read at a recent meeting of the Ohio state medical society by a physician whose practice has been large in one of the most extensive match-factories of that state. He finds that the head of each match contains about a seventieth of a grain of phosphorus, and that the injurious results of the process are most marked among those who work in the dipping and packing rooms. The affection is a disease of the bones of the jaw known as necrosis. In some it appears within two years after they enter the factory; in others its appearance is more delayed. Operatives with unsound teeth are the most susceptible. He recommends that only persons possessing sound teeth be employed in these two rooms; that thorough ventilation be provided in all parts of the factories; that the operatives be not permitted to eat their meals within the factory or with soiled hands; and, finally, that mouth-washes of the alkaline carbonates be freely used.

— O. P. Jenkins was elected, June 23, professor of biology, and curator of the museum at DePauw university, Greencastle, Ind.

— The *Sanitarian* records an instance of flies acting as sanitary inspectors. In one of the rooms of a residence in an eastern city, offensive odors were detected, but their exact source could not be located. The carpets were raised, and a carpenter engaged to take up the entire floor. At this moment a friend who chanced to come in, suggested that an appeal be made to the instinct of the fly. Two blue-bottles were brought from a neighboring stable, and the doors and windows of the room closed. The flies soon settled upon one of the cracks in the floor, and, when the boards were raised at this point, a decomposed rat was found.

— The Japanese disease beri-beri, or kakké, is now regarded as a contagious disease, having for its cause a microbe. The infection enters through the intestinal canal, and locates itself at this part of the economy.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The flight of the flying-fish.

THE question, among naturalists with whom I have been associated, as to whether or not the flying-fish flaps its wings during its flight, was at first a great surprise to me. My years of sea-service, without hearing a single doubt upon this point, had been exclusively among seafaring men, who are generally positive: naturalists seldom are. Nevertheless, association with the former teaches one that their 'opinion' on a subject is, as a rule, a confirmed belief.

In the region of the Cape de Verde Islands, where a very large species of flying-fish is abundant, it is easy to observe the beating of the creature's wings;

but on our own coast, where the fish — and wings — are small, the vibration is so rapid, that, at the usual distance, one cannot well distinguish the motion.

Viewing the question from an engineering standpoint, the problem resolves itself into a simple calculation, the only element of error being in the correctness of observation; for the flight of the fish can only be observed from the deck of a vessel, and the direction of the creature's flight must, at best, be an approximation. The mean of a large number of observations, however, should give a result very close to the truth. Though the flying-fish usually starts directly to windward, it seldom continues in that direction; and, because of this erratic flight, the observation is still more difficult.

The opinion of the naturalists was that the creature projected itself out of the water with great velocity, in a direction opposite to that from which the wind was blowing, and, by placing its wings (pectoral and ventral fins) at an advantageous angle, so pressed them against the atmosphere as to lift its body, while its inertia carried it forward over the surface of the sea like the projectile from a gun. In this event two forces would be acting upon the fish: that of gravity, to pull it to the water; and the resistance of the atmosphere, to retard its forward velocity. Its motion of translation would essentially be uniformly retarded. As its velocity diminished, it would be obliged to alter the angle of its wings, in order to preserve its horizontal line of flight; and this movement would present a greater projected area of wing to the direction of its flight, and therefore its motion would be retarded in a greater ratio than that of a fired projectile having a constant plane of resistance. Artillerists, both on land and sea, are satisfied that they can distinguish the retardation of a cannon-shot: indeed, I doubt if one can be found who would question it; and yet seafaring men are positive the flight of flying-fish is uniform.

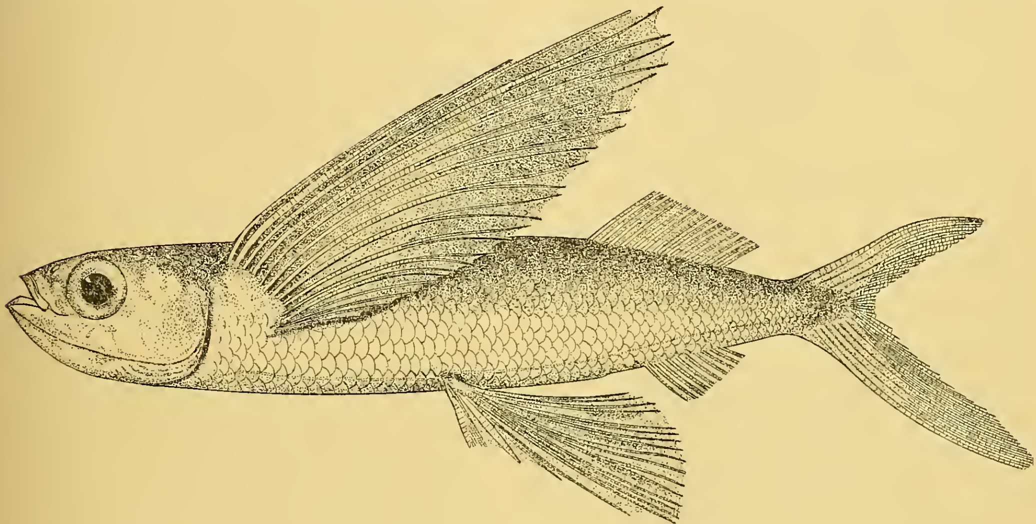

FIG. 1. — FLYING-FISH (EXOCOETUS ROBUSTUS).

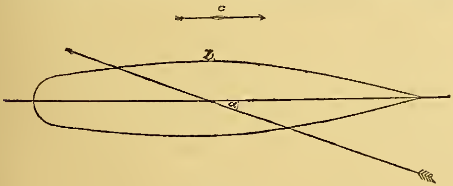

FIG. 2.

A school of flying-fish will keep together in the air quite as well as a flock of ducks. As nearly as one can judge from looking at them, they move at the same velocity. Now, if they continue to move at equal velocity, and do not flap their wings, it follows that they must have projected themselves from the water with equal velocity, and that there must be a constant ratio between the area of their wings and the weight of their bodies. That this is not true is evident, from the following measurements made early in April of this year, from three live specimens of Exocoetus robustus[1] as soon as they were taken from the water.

Number of the specimen.	Length of pectorals in inches.	Length of ventrals in inches.	Area of each pair of pectorals in square inches.	Area of each pair of ventrals in square inches.	Total area of wing-fins in square inches.	Weight of the fish in ounces, avoirdupois.	Ratio of area to weight.
1	5 1-4	2 1-2	21.328	6.797	28.125	5	5.625
2	3 5-8	2 5-16	8.700	5.261	13.961	2	6.9805
3	3	1 7-8	7.314	3.896	11.210	1.5	7.473
Mean	3.958	2.1458	12.447	5.318	17.765	2.833	

[1] Specimen identified by Dr. Tarlton H. Bean.

The writer was fortunate enough to observe a flying-fish (on the 9th of April, 1886) moving in a direction apparently parallel to that of the ship, and with equal velocity. By means of a Casella anemometer the velocity of the wind across the ship's deck was found to be 13.6 feet per second, and its direction was 20 degrees from ahead.

Referring to fig. 2, b represents the ship; c, the fish; and a, the angle of the wind. The true velocity of the fish through the air was then $13.6 \times \cos a = 12.78$ feet per second.

Let us take, for example, a specimen whose wings and weights would be a mean between the three specimens recorded.

Let A represent the area of its wings in square feet $= \frac{17.765}{144} = 0.1234$; V, its velocity in feet per second $= 12.78$; A′, the projected area of the wings; W, the weight of a cubic foot of air in pounds $= 0.075$.

In experiments with flying-machines (R. C. Buel, in Appleton's Cyclopaedia of mechanics, vol. i. p. 53), it has been ascertained that an angle of 54° 10″ is the most advantageous angle at which the vanes can be placed (these vanes are similar to the wing-fins of a flying-fish). Therefore $A' = A \times \sin 54° 10'' = \frac{1}{10}$ of a square foot, nearly.

The force with which the air will be pressed downward, or, what is equivalent, the lifting-power of these wings moving at V velocity, will be $\frac{V^2 A' W}{2g}$.

Substituting the numericals above recorded, we have $\frac{(12.78)^2 \times 0.1 \times 0.075}{64.3} = 0.0190507$ pounds, or about $\frac{0.019}{0.177} = \frac{1}{9}$ the weight of the fish in question.

The method of catching flying-fish on board the Albatross affords a means of observing some of their motions. When our submarine (Edison's) lamp is lowered a few inches below the surface of the water, these fish often approach it gradually. On such occasions they invariably have their pectorals and ventrals extended, but do not appear to use them as organs of locomotion: on becoming alarmed, they close these fins, and dart forward suddenly. The brilliancy of the electric light, no doubt, dazzles their eyes greatly, for they do not appear to see objects near them, and, when alarmed by the splash of the scoop-net, dart right forward by use of the caudal fin. Mr. Nye, quickly perceiving this habit, takes advantage of it by plunging the net directly in front of the fish, which he almost invariably catches. On one occasion a fish turned in its flight, and projected itself several feet vertically into the air, very close to the side of the ship, working its wings vigorously, which was distinctly seen by several people on deck.

G. W. BAIRD.

Passed Assistant Engineer, U.S.N.

Washington, June 24.

An Indian snake-dance.

I have received a clipping from the New York *Commercial advertiser* containing a letter from a Mr. Trumble in reference to the article on the 'snake-dance' of the Moki Indians of Arizona (*Science*, vii. June 4). Mr. Trumble mentions the occurrence of similar performances among several Central and South American tribes, and discusses at some length the antidotes used. This feature was only touched upon in my paper for the reason that Dr. H. C. Yarrow of the army, who attended the dance at Wolpi for the special purpose of identifying the species of snakes used, and of determining whether they had been rendered innocuous, was present at the reading of the paper, and was kind enough to discuss it at some length. Perhaps the interest in the question would justify a few remarks on that phase of the subject. Dr. Yarrow identified four species of snakes, only one of which, however, was poisonous, — the spotted rattlesnake, or Crotalus confluentus. He descended into the snake *kiva* on the eve of the dance, and there examined the snakes which were to be used on the morrow. At his request a large rattlesnake, selected by himself, was held up for his examination by one of the Indians, and, upon prying its mouth open, he found the fangs intact and of large size. I may add, that, at the conclusion of the 1883 snake-dance, two rattlesnakes were captured, and sent to the national museum. They were examined soon after their arrival by Dr. S. Weir Mitchell of Philadelphia, who found them in perfect order: their fangs had not been disturbed, and the poison-sacks were intact and full of venom.

The snakes used in the dance undergo a very complicated course of treatment in the *kiva* where they are confined prior to their appearance in public. They are washed repeatedly in various kinds of 'medicine-water,' and are frequently handled or stroked with a downward, squeezing movement of the hand. Whether such treatment prolonged over a period of five or six days is sufficient to render innocuous a robust rattlesnake, is an open question. Both Captain Bourke in his book, and Dr. Yarrow in his remarks, mention seeing a large rattlesnake brought in from the fields on the day of the dance. These, at least, must have been capable of inflicting fatal wounds.

The Indians have the greatest confidence in the means they use to secure immunity. Dr. Yarrow, in an interview he had with the high priest soon after the dance, showed the old man a hypodermic syringe and a solution of permanganate of potassium, which he had brought along to use in case of necessity, and explained to him their use. The old man replied, "No doubt my brother's medicine is good, but we are quite satisfied with our own." The performers are very seldom bitten: I observed but one instance at Wolpi, none at Mashongnavi. Others, however, record two other instances at Wolpi, which escaped my attention: in both of these cases the bite was inflicted by non-venomous serpents. As the number of snakes used at that dance was about eighty, this is not a very high percentage. I am of the opinion that the Mokis rely on the previous treatment of the snakes, on their charms and incantations, rather than on any after-treatment of themselves. As Dr. Yarrow remarked, a snake which had been repeatedly handled, and had discovered that no injury was intended, would become comparatively tame, and this would account for the behavior of the snakes during the dance. In the hands of the dancers, they seem numbed and lifeless, and it was only when dropped rudely on the ground from the mouths of the dancers that they showed any disposition to fight.

The knowledge of the composition of the liquids used by the Mokis is confined to one man, a high priest; even the members of the order are ignorant of it: but, to provide against the loss of the secret, the knowledge is shared with an old woman of the tribe. The high priest keeps this knowledge to himself until he is, or thinks he is, on his death-bed;

he then communicates it to the successor whom he had previously selected, and to whom he had already taught all the other rights and ceremonies pertaining to the dance.

The various liquids or 'medicine-waters' are not procurable by those not in the order, as they are very jealously guarded. Wiki, the high snake-priest, in an interview held after the dances at a ranch in the neighborhood, was quite communicative for a while, but, when this subject was approached, became very much agitated. He said, that, were he to reveal the secret of the preparation of these liquids, his life would be the penalty. Dr. Yarrow succeeded, however, in obtaining a bottle of the liquid used after the dance, and it is now in the army medical museum.

It should be mentioned that these liquids are not looked upon by the Indians as antidotes. The liquid taken after the dance has no direct bearing on the question of poison. In reply to Dr. Yarrow's question as to the object of this ceremony (the vomiting after the dance), Wiki told him that "the presence of the snake between the lips of the dancer caused a profuse flow of saliva, which the dancer was necessarily obliged to swallow, and that if he did not get rid of this saliva, which was poisonous, his stomach would swell up and burst," — an operation, it is hardly necessary to say, which never occurred from this cause; and the account must have been derived, therefore, from some source outside the facts of the case.

Mr. Trumble speaks of gorging on the part of the participants in the dance; he also says the snakes are fed until they become inert, and finds in these practices a partial preventive of evil effects from snake-bite.

Neither of these apply to the Moki dances. The performers go into the dance after four days of what is practically fasting (they eat but one meal each day); and the snakes themselves, so far as I could learn, are given nothing whatever to eat. It is true that in Wiki's accounts the phrase, "and I bathed him, and gave him to drink of the liquid," occurs; but the giving of drink is metaphorical, and consists of sprinkling the snake with the liquid by means of a feather.

I think the study of the rites pertaining to serpent-worship, as they occur among the lower races of mankind, would throw much light on the serpent-symbolism which prevailed among quite highly civilized people; the Egyptians, for example: but our knowledge of the early phases of this form of worship is rather meager. Perhaps the tribes mentioned by Mr. Trumble may supply some of the needed information.

A writer in *Harper's weekly* (March 25, 1882), quoted by Captain Bourke, gives an account of a performance very similar to the Moki dance, but occurring among some Central American tribes. In this ceremony each performer has his own particular snake, which he has previously trained, and with which he performs various feats. This, however, is jugglery, an element which is entirely lacking in the Moki performances. On this point I cannot do better than to quote Dr. Yarrow's closing remarks: "I went to Wolpi expecting to find a good deal of humbug about the snake-dance; I came away convinced of the earnestness and fair dealing of the people, and without a doubt that they fully believed that their ceremonies would bring about the desired result."

I think Mr. Trumble is mistaken about the effects of curari; but the word has been applied to so many different varieties of poison, that it has come to have a rather vague meaning. Curarine, the active principle of curari, is said to cause paralysis of the motor nerves, and it has been used in medicine as an antidote for strychnine and as a remedy in hydrophobia and in tetanus. But this part of the subject I must leave for those better qualified for the discussion. The subject has excited much interest; and many eminent investigators, from the days of Sir Walter Raleigh (who published his account in 1595) down to the present time, have given it their attention. Probably the most complete account is that published by Dr. S. Weir Mitchell and Dr. W. A. Hammond in the latter's 'Physiological memoirs,' 1863.

There is a point in Mr. Trumble's letter which seems to deserve special attention: this is the use, by Indians, of antidotes against poisons. To the savage there is no unknown: every thing is explained; and this explanation is always the most simple, the most direct, and, as a rule, the most superficial, that could be applied. The savage can no more realize the physical causes of phenomena than he can the laws which govern the solar system. Instances of this are furnished in abundance by the Moki myths; but they need not be quoted here, as they occur in all tribes, and can be found in any work treating on mythologic philosophy. The inability to realize the facts of physical causation, the grandest which have yet been discovered by man, is not confined to savages, however, but is present, in a greater or less degree, in what we are accustomed to call the highest civilization. It follows, then, that poison as a physical cause of death is a conception which is beyond the ken of the savage mind, and such is actually the case. Poison, when it is conceived of at all by savages, — and this conception is rarer than is generally believed, — is not thought of as a substance containing in itself its fatal properties, but as being endowed with them by some outside power, — either human, as in witchcraft, or else supernatural. The antidote to poison as thus conceived consists of an appeal to the same powers which produced the poison, or, in other words, to charms, or prayers, or incantations.

COSMOS MINDELEFF.

Prehensile-tailed salamanders.

It is not well to be hasty in accepting the idea that the tail of the salamanders is of so little value to them that they might get along quite as well without it. Observation proves the organ to be of constant use in pushing, when the animal makes its way among weeds, grass, rocks, or other obstructions. It is the main dependence of such as swim; and of climbing species its importance as a support and a lever is very manifest. Those suggested are general uses, common to all tailed batrachians. Particular species have the tail still more specialized. It is to some extent an organ for grasping in the long-tailed terrestrial species. A frequent practice of the 'spotted salamander,' Amblystoma punctatum, when taken up, is to curl the tail around the fingers or hand to prevent falling. Suspended thus, hanging head downward, it will again and again try to regain footing rather than drop. Peculiar serpentine curves, and the motions of the very flexible tip, often give the tail of this species the appearance of feeling about for something, on its own account. The curves are so irregular at times, that the organ appears as if broken in several places. When at rest, some individuals have the habit of curling the tail closely against the body in a flat coil. Its capabilities are best seen in slender specimens, in which the tail is less thick and clumsy. Very likely Amblystoma jeffersonianum, and species of similar build, have the organ similar in sensitiveness and utility. Amblystoma mavortium, however, is lower in rank, and has the tail better adapted for swimming or pushing, as in other more aquatic forms. S. Garman.

Cambridge, Mass., June 27.

Association of official agricultural chemists.

The next meeting of this association will begin Thursday, Aug. 26, in the library of the Department of agriculture. All agricultural chemists holding official positions under the national or state governments, in agricultural colleges or experiment-stations, are entitled to membership. All other chemists interested in any way in the analysis of fertilizers or food-products are invited to attend the meeting, to present papers and take part in the discussion.

One of the chief objects of the association is to secure uniformity in methods of analysis employed. The attainment of such uniformity is of little less value than accuracy, in work of this kind.

I take this method of calling the attention of the chemists of the country, who are not members of the association, to the coming meeting.

H. W. Wiley,
Pres., and chairman of exec. com.

Washington, June 26.

Barometer exposure.

I have read with pleasure the paper referred to by Mr. Gilbert in his letter (*Science*, vol. vii. p. 571). His method seems to have shown, as clearly as could be without direct experiment, that the wind had the effect of lowering the barometer-readings in the building on Mount Washington. This direct evidence, if needed, has, I think, been supplied by the observations on Blue Hill, where it has been noticed, not only that the barometer in the building suddenly falls if the wind-velocity suddenly increases, but that during high winds the pressure in the building can be varied at will by merely opening and closing an aperture in the top of the building.

It does not seem unsafe, then, to draw one or two conclusions from these facts. In Loomis's tenth paper (*Amer. journ. sc.*, January, 1879), from an examination of a large number of storms, he arrives at the remarkable conclusion that "the low centre at the height of Mount Washington sometimes lags behind the low centre at the surface of the earth, apparently as much as two hundred miles." Mount Washington is only about one mile high; and if we draw two lines, — one to represent the earth's surface, and the other the storm-axis, — and make them diverge only one division in two hundred in length, the two lines will appear to the eye almost parallel. Such an inclination of the storm-axis seems incredible, and renders it probable that the apparent lagging was due to some other cause. Loomis shows, in this same paper, that the occurrence of high winds on Mount Washington from any easterly quarter is exceedingly rare; and in his eleventh paper he says, "In a majority of those cases in which an area of low barometer passes ever New England, attended by the usual system of circulating winds at the surface stations, this system of circulating winds does not extend to the height of six thousand feet." The effect of the indraught below only makes itself felt at the height of Mount Washington in front of storms by lessening the velocity of the prevailing westerly current, and in the rear of storms by increasing the velocity of this current.

This at once suggests that the apparent lagging of the storm-axis, or rather of the time of minimum pressure, on Mount Washington, is due to a mechanical effect of the wind on the observatory.

Mr. Gilbert has shown in his paper (pp. 531–533), from a series of observations, that wind-velocities of forty miles per hour from the north-west had the effect of lowering the pressure in the observatory on Mount Washington as much as eight-hundredths of an inch; wind-velocities of fifty miles, as much as thirteen-hundredths of an inch; and he estimated that wind-velocities of one hundred miles would lower it as much as half an inch. This equals any of the effects found by Loomis, and gives a plausible reason why the minimum pressure should occur later on Mount Washington than at sea-level. The same explanation applies to the lagging of the times of maximum pressure, since Loomis has shown in his second paper (*Amer. journ. sc.*, January, 1875) that the wind-velocities are larger in front than in the rear of maximum pressures.

Loomis also found that there was a lagging of the diurnal curves of pressure on Mount Washington and other mountains. He says in his tenth paper, "At the base of Mount Washington the principal maximum occurs at 8.30 A.M., but on the summit it does not occur until noon, being a retardation of three hours and a half."

Mr. Gilbert shows, on p. 526 of his paper, that from June 26 to June 28, 1873, some element on Mount Washington, which was undoubtedly the pressure, went through a diurnal variation coincident with the wind-velocity. During this time the wind each day reached a maximum near midnight, and a minimum near noon. This is a normal feature on high mountains; and if an increased wind-velocity tends, by a mechanical action on the building, to make the barometer read lower, it is readily seen that the pressure would tend to be lowest near midnight, and highest near mid-day. If, now, a double diurnal oscillation due to other causes be superposed on this, the chief maximum would occur much nearer noon than at lower stations, where the action of the wind is in the opposite direction.

The variations in the wind's velocity may not be the only cause of the phenomena considered in this letter. Loomis thinks that the wind-directions, and Ley that the upper cloud-motions, indicate a lagging of the storm-axis; and it seems probable that the expanding and contracting of the air from heat and cold have something to do with the occurrence of the chief maximum on mountains near noon, and in the lagging of the minimum pressure in storms; but the variations in the wind-velocity are undoubtedly an important factor, and it is very desirable that its influence might be eliminated.

H. Helm Clayton.

Blue Hill meteor. observ., June 28.

SCIENCE.—SUPPLEMENT.

FRIDAY, JULY 2, 1886.

ECONOMICS AND JURISPRUDENCE.

MR. INGRAM, in his excellent article upon political economy in the 'Encyclopaedia Britannica,' states as a characteristic feature of the historical school of economists, that they recognize a close relation to exist between economics and jurisprudence. "The point," he says (and this he takes from Dr. Adolph Wagner of the University of Berlin), "upon which all turns, is the old question of the relation of the individual to the community. Whoever, with the older juristic and political philosophy and national economy, places the individual in the centre, comes necessarily to the untenable results which, in the economic field, the physiocratic and Smithian school of free competition has set up. Wagner, on the contrary, investigates before every thing else the conditions of economic life of the community, and, in subordination to this, determines the sphere of the economic freedom of the individual." It is my purpose in what follows to expand somewhat the view thus expressed, and to show why it is impossible for the economist to arrive at just conclusions in economic matters unless he consciously allows his thought to be influenced by a keen appreciation of the science of jurisprudence, as also of the juridical structure of the society to which his attention is addressed.

It may avoid some misapprehension if we state clearly at the outset what is meant by the terms 'jurisprudence' and 'economics.' In the science of jurisprudence it is common to consider the legal structure of society, that phrase being used in its broadest sense. It might indeed be said that this science builds the framework of society, were there not danger of pressing the metaphor so far as to give rise to the conception of a purely mechanical arrangement in human relations. Questions of government, if they do not pertain to administration or to pure politics, find treatment under jurisprudence, as also do established customs which grant personal rights and liberties, and established laws which determine the nature of property. Or, to state the matter concisely, the material out of which a science of jurisprudence is formulated is, 1°, "the essential institutions of human society, by the use of which the objects of that society are carried out through the medium of government;" 2°, the established opinions of society, expressed in law, by which rights and duties, liberties and limitations, are determined for individual members of society.

Economics, on the other hand, deals with industrial activity. It has to do with men, with corporations, and with governments as industrial agents. It may, indeed, be properly defined as the science of industrial society; and one obtains for the first time a clear view of its general bearing when he discerns its subordinate relation to the science of society as a whole. The material out of which this science is built includes, 1°, the economic nature of man, to which all industrial activity may be traced; 2°, the material surroundings of men, to whose physical laws their industrial activity will in the long-run conform; 3°, the legal structure of society, which conditions the exercise of such industrial rights as are granted. None of these factors may be disregarded by the economist, if he would arrive at correct conclusions respecting the industrial actions of men; and the 'lego-historic' facts, although they may vary from time to time, are of as much importance while they last as the permanent facts of nature. Throughout the entire history of the world, until the dawn of what we technically term 'modern times,' the form of undertakership was dependent on the political structure of society. We observe property rights to have developed from communal to personal ownership; and with each step in this direction there has been a corresponding development of industrial methods. It has frequently been pointed out that personal liberty, and the freedom of action that it implies, were necessary to the realization of the industrial organization with which we are now familiar. And it is not too much to say that the economic character of man itself has been modified by means of the hereditary transmission of habits first contracted through the pressure of changes in the social structure; for, as the stroke of the shuttle is limited by the framework of the loom, so the industrial movements of men are bound by the liberties of law and of custom, and, to carry the metaphor a step further, the industrial weaving of society is largely determined by its legal structure.

If the analysis thus suggested be correct, one cannot disregard the close relation that exists between economics and jurisprudence. Both branches of thought are part of the larger study of society, and neither can be satisfactorily pursued to the exclusion of the other ; at least, the economist must hold ever in view the juridical system of the society with which he is concerned in order to fully explain the facts he may observe.

Such statements as the above, however, do not seem to adequately present the views entertained by historical economists. Not only does the jural system influence economic activity, but the theory of jurisprudence at any time accepted has much to do in giving shape and color to the accepted theory of economics. This is not a matter of speculation. It is declared by the history of both jurisprudence and economics during the last one hundred years. It will probably pass without question, that political writers of the last century, whose enthusiasm sprang from a desire for the free exercise of all manly powers, assumed some conception of inalienable rights as the basis of all their important arguments.

The rule of authority which they endeavored to shatter was the *jus dei;* and it was wholly logical, that, under the direction of such a rule, society should be regarded as a mechanical appliance permanently imposed upon men by some power outside society itself. This idea was shattered by the victory of French philosophy, but this did not go very far in realizing for the men that freedom which they sought. Its full effect, indeed, was to supplant the *jus dei* by the *jus naturae;* and though this change may have had decided results, extending political rights, the new principle adopted exercised as great a tyranny over men's minds as it was ever possible for any conception of a divine arrangement in the affairs of men to exercise. It was this new principle, first well formulated by political philosophers in their criticism upon the existing structure of government and jurisprudence, this desire to secure some natural law for the conduct of the affairs of men, that gave character to English political economy. English economy, indeed, is but the application of the *jus naturae* to industrial affairs. Or, to speak of modern economists, the historical school itself is an historical development. The views of this school, says Mr. Ingram, "do not appear to have arisen, like Comte's theory of sociology, out of general philosophical ideas: they seem rather to have been suggested by an extension to the economic field of the conception of the historical school of jurisprudence, of which Savigny was the most eminent representative. The juristic system is not a fixed social phenomenon, but is variable from one stage in the progress of society to another: it is in vital relation with the other co-existent social factors ; and what, in the jural sphere, is adapted to one period of development, is often unfit for another. These ideas were seen to be applicable to the economic system also. The relative point of view was thus reached, and the absolute attitude was found to be untenable. Cosmopolitanism in theory, or the assumption of a system equally true of every country, and what has been called perpetualism, or the assumption of a system applicable to every social stage, were alike discredited. And so the German historical school (of economists) appears to have taken its rise."

But we have not yet arrived at a full statement of the relation that exists between economics and jurisprudence. The modern school of political economy goes further than merely to recognize the existence of such a relation as has been suggested above. Having formulated a theory of society in harmony with the teachings of the science of history, the adherents of this school endeavor to bring their economic doctrines into accord with their social theory. It would be incorrect to claim uniformity of opinion respecting any theory of society. The Germans, in their general discussions, use the word 'state' as representing the final analysis of human relations; English and American writers, when they endeavor to present German ideas, employ the word 'nation;' and perhaps I show the leanings of my own mind in choosing the word 'society.' But whether 'state,' or 'nation,' or 'society,' the fundamental thought is the same. The thing itself brought to view is an organic growth, and not a mechanical arrangement. The springs of its action are not imposed from without, but lie wholly within itself. The law of its own development is the only permanent and universal fact which its analysis discloses : all other facts are relative truths ; and those systems of thought based upon them, temporary systems.

But there are two ways in which this organism — the state, the nation, society — may be regarded. It may be regarded as an organism moved by no conscious purpose, and consequently with no control over the course of its own growth ; or it may be conceived as a continuous conscious organism that is capable of placing before itself an ideal structure to be attained. The first conception reduces society to the grade of a physical organism. It places social relations under the same law of evolution that is disclosed by a study of the organic world. But, as Mr. Ward truly says, the philosophy of evolution applied in this manner to society becomes sterile, "because, while justly claiming a social science, it falls short of admitting its complete homology with other sciences, and, while demonstrating the uniformity of social as of physical phenomena, it denies to the former that susceptibility to artificial modification which, applied to the latter, constitutes the only practical value that science has for man." The second conception of the social organism endeavors to correct the error thus pointed out. It recognizes in society a power of self-control. It admits the truth of M. Thiers's sentence, that 'the nation is that being which reflects and determines its own action.' It holds it as useless to stop one's study with a reading of nature, and refuses to allow that the perfection of human conduct consists in following nature. The *jus naturae* finds first its true place when subordinated to the *jus hominum*.

I do not wish to be drawn from the question in hand to a discussion of the general theory of sociology, but the distinction that has been pointed out appears to me essential for a just appreciation of any study whatever that has to do with social relations. It lies back of the theory of both economics and jurisprudence, and points out the manner in which each may exercise an influence on the other. If we adopt the view that the social organism is subject to the same law of development as a physical organism, our study will be crowned only by negative results. *Laissez-faire* would then be logical, and the philosophy of anarchy inevitable. But if, on the other hand, we perceive that society may have a conscious purpose, we have discovered a scientific basis for positive and constructive study. We find that no incongruity exists in uniting the science and the art of society in the same discipline. The law of evolution, with its 'survival of the fittest' and its 'adaptation to environment,' comes to be the basis of a scientific theory of revolution or of reformation; for the fittest type to survive may first exist in the conscious purpose of society, and be realized by means of an environment arbitrarily determined.

This view of social relations leads to certain practical results in the study of economics that cannot be overlooked; and of these, none is perhaps more important than the new light thrown upon the nature and limitation of legal enactments in the process of social growth. The sphere in which law exerts a direct influence is quite restricted, but within that sphere it becomes a most efficient agency. Every change in law means a modification in rights; and when familiar rights are changed, or, what amounts to the same thing, when new duties are imposed, the plane of action for all members of society is adjusted to a new idea. In many instances legal enactments undertake to enforce certain lines of conduct on a stubborn minority; but this is not always the case, nor is it the most fruitful assistance rendered by law in the realization by society of its conscious purposes. As contrasted with this, it may occur that the entire community is in favor of some method of procedure, and yet the practice will be universally disregarded unless granted the sanction of law. This fact, which may at first seem strange, is easily understood when it is noticed that men are more powerfully moved by immediate than by ultimate interests, and that, in the absence of a law which restrains all alike, the fierceness of competition will lead individuals to disregard public opinion, even though they admit the rightness of its commands: for each man says to himself, "If I do not do this thing, which, I confess, is to the permanent injury of society, some one else will; the evil will be done, and I will lose the personal advantage of the doing of it. But pass a law which restrains alike my neighbor and myself, and I will gladly obey it." That is to say, public opinion considers the social interest; and with this the individual interest does not always harmonize. The one holds in mind the ultimate, the other the immediate, results; and the only way in which the social purpose can influence the practice of individuals is for law to establish uniformity of action. This is the most important use of law as an agency of reform. The thought has nothing to do with 'paternal government,' but is in perfect harmony with the idea of democracy. It is the means by which the social organism may realize its conscious purpose, and it needs no words of mine to show how important is this view of the efficiency of law in matters pertaining to industrial organization. The constructive economist is forced to admit its pertinency.

But there are other conclusions which spring from this idea of social relations, and which are of especial interest because they touch directly the great economic questions of the day. This is a time when much is heard of industrial re-organization as a means of solving the social problem; but the lesson taught by the foregoing analysis is, that, in all matters pertaining to re-organization, it should be held as a first principle to maintain harmony between the various parts of the social order. A study of history declares that no part of the social structure may be considered as good or bad in itself. What appears now to be wholly pernicious may once have been capable of complete defence. Most of the evils experienced, so far as they spring from established law or permanent custom, may be traced to the fact that some right or custom has outlived its time, or that some principle, in itself just, fails to be applied to all departments of social activity. We need not turn the pages of history in search of examples of uneven and disjoined development: the source of prevalent complaint is found in the fact that the conception of rights and duties, of liberties and constraints, of privileges and responsibilities, which lies at the basis of our juridical system, is not applied to the highly developed industrial system of the present. Difficulties have arisen because the industrial life and activity of the social organism have grown to a different plane from the one which underlies the juridical system. The piston of the social engine demands a longer stroke, the shuttle freer play, and the stationary settings of the machinery are rapped and battered in consequence. This thought may be amplified by the following suggestion, which, while being interesting in itself as bearing upon the great social question, will serve to further illustrate how closely are the sciences of jurisprudence and of economics related to each other.

The idea of liberty, which is an idea germane to every system of jurisprudence, finds its best practical presentation in English law. The peculiar feature of this English conception of liberty is, that every man is allowed full control over his own acts on condition of complete responsibility for all that may ensue from them. This is the basis of responsible government. It is well worked out in both criminal and civil law. It gives color to all thought on freedom of speech and freedom of the press. It rests, for its logical defence, upon the claim that the exercise of any power which touches the lives of others is of the nature of a grant to him who exercises it. But though this theory, that liberty is only possible under responsible exercise of power, is in good working-order so far as political and jural affairs are concerned, its controlling principle has never yet been adequately applied to the field of industrial activity. The most effective power of the present day is capital, for by means of capital the forces of nature are brought to serve the industrial purposes of men. But all men who work as business-agents must conform to the economic law of capital. In this day all must work with machinery, or not work at all; and yet the law of property, which grants ownership in capital, does not recognize its public character. The consequence is, that we find a power, which necessarily touches the life of every man, managed for purely private ends. This is contrary to the spirit of English liberty.

Could we carry the principle of responsible power over into the field of economics, and so adjust matters as to realize responsible control over all economic agencies, the industrial problem would, in my opinion, be as perfectly solved as its conditions will admit; and, what is of more importance, such a solution would be in full harmony with the form of Anglo-Saxon liberties. We have also every reason to believe that it would be satisfactory and final, for it consists in the extension of a principle well tried in our jural and political system to the industrial life of men.

The tendency of events has already set in this direction. Certain businesses are regarded as of a *quasi*-public character, and on that ground are adjudged to be under the control of the law. For example: the decisions in the so-called Granger cases established for law, and in public opinion, the right of the states to control railroad property; and the only question that now remains pertains to the best method of control. But there is no difference, except in degree, between the railroad business and many other lines of business. All businesses that escape in any marked degree the regulative influence of competitive action fall under the same rule. The community as consumers may set up a just claim for legal regulation, and defend the claim by the doctrine of English liberty. This, however, does not touch the labor problem, except as laborers are themselves consumers. Still the principle of responsibility is, in my opinion, adequate to the solution of this phase of the question also, though in this case it pertains to the relation existing between the employer and the employee. The fundamental point at issue is a question of industrial organization in the several industries. Private ownership in capital must be allowed, in order to secure its most economical administration; but there is no reason why its administration should be irresponsible. It is from its very nature a social force; and not only should the community as a whole have a word to say respecting its management, but the employees also, as members of the community. This can be done by increasing the duties of property, which would be equivalent to the creation of proprietary rights for the non-possessors. It is at this point, I trust, that American economics will part company with German socialism. It may be proper in Germany, where the principles underlying the juridical system are quite different from those that determine either English or American law, to advocate constructive socialism; but it is absurd for one who claims to be a disciple of the historical school of economy to adopt German conclusions in this respect. Our entire juridical structure is against it, and it is easier to bring our industries into harmony with the spirit of our law than to re-organize our society from top to bottom, industries included. At least, this line of reasoning is a fair illustration of the close relation that exists between jurisprudence and economics.

This subject is capable of indefinite expansion. Indeed, I have purposely omitted a consideration of the most apparent influence of the jural upon the industrial system, because, in the series to which this article belongs, it will find special treatment from another point of view. I refer to the effect of the law of property on general distribution, and the effect of distribution — through consumption — upon the entire economy of production. What has been said is suggestive rather than conclusive. It leads to the conception that political economy is a constructive as well as a formal study; that it is a subordinate and not an independent study; and that, so far as jurisprudence is concerned, not only does the jural system assist in explaining many facts of industrial life, but it may be advantageously used by society in the realization of industrial ends.

Henry Carter Adams.

ZOÖLOGY AT THE COLONIAL AND INDIAN EXHIBITION.[1]

Zoölogical knowledge is of such fundamental importance for the advancement of material prosperity, that the thoughtful visitor to a great exhibition may profitably inquire how high the various colonies now represented at the exhibition estimate a scientific acquaintance with natural objects. It is a matter for congratulation that some of the persons responsible are not of the school of Professor Huxley, so far as that distinguished naturalist believes that men of science are incompetent administrators: the Indian empire has as a commissioner Dr. Watt, a well-known botanist; the Canadian dominion is represented by the distinguished geologist, Dr. Selwyn; and the New Zealand court is directed by the eminent zoölogist, Dr. Julius von Haast.

On the whole, the zoölogist will, we fear, be disappointed with the show provided for him. In some of the courts the specimens might have been turned to better account; in others mere show-cases of brilliant birds, or, still worse, poor collections of common shells and corals, are the only objective signs of an interest in zoölogy. The idea of having a representation of the fauna of a particular district is excellent, and, had it been always well carried out, the present exhibition would, from the naturalist's point of view, have been really admirable. The best illustration of this kind is afforded by South Australia, the worst by the Indian empire. The latter exhibits so much technical skill in detail, that it is really irritating to find the general result so confused and ridiculous; a rock-snake on a tree, a crocodile on dry ground, are too trying to our patience. South Australia is very good as far as it goes, but it is not free from the objection to which West Australia and Queensland are still more obnoxious — the fauna of none of these places consists only of birds and mammals.

A most excellent and instructive show is made by New Zealand, the land of the recently extinct Dinornis, the wingless Apteryx, and the curious, low, lizard-like form Hatteria. The Otago university museum is an important contributor, and visitors and experts alike will admire the very beautiful specimens of cartilaginous skeletons which have been prepared under the direction of Prof. T. Jeffery Parker — worthy son of a worthy father. Among the shark-like forms here seen, should be noted especially Notidanus, which is remarkable for having its lower jaw, not merely connected with the skull by the upper half of its mandibular arch (as is the case in all pentadactyle vertebrates), but also by the hyoid (as is the case in the great majority of fishes), or for, in other words, exhibiting what Professor Huxley has called the 'amphistylic' mode; Callorhynchus, which is the southern representative of the northern 'holocephalous' Chimaera; and the bony Regalecus argenteus, one of the longest of the ribbon fishes, a memoir on which by Prof. T. J. Parker has been lately published by the Zoölogical society of London. Among the birds there stands in a prominent position an excellent skeleton of the gigantic moa (Dinornis maximus); there is an interesting group of Apteryx, as well as some well-stuffed specimens of the avifauna; the visitor may chance to hear a sheep-farmer dilating on the enormities of the kea parrot. There is a good collection of dried fish, and among the spirit specimens there are a number of species which, having been insufficiently described, will be gladly examined by stay-at-home naturalists. Of the teaching collections of the museum, it need only be said that they show quite as high a standard of preparation as the best to be found in our own country. This is quite the best zoölogical exhibit in the whole show, and the excellent preparation of the octopus is not the only one which may be profitably studied by curators of English museums.

Perhaps the exhibit which comes next in importance is that of Canada, where there is a really fine collection of fish and marine invertebrates, all well and carefully catalogued; the government of the dominion is to be congratulated on this proof of its interest in natural history. The authorities at home may, perhaps, be inclined to deduce the moral which presses itself on ourselves; the Canadian government has a department of fisheries, to which, in the year ending June, 1884, $116,531 were allotted. There are some very fine heads of mammals in other parts of the Canadian

[1] From *The Athenaeum*, June 12, 1886.

court; we have reason to know that a catalogue of the birds to be exhibited has been printed off, but the birds themselves do not seem to have yet arrived in England. We imagine that some such accident must have happened also to the exhibits of the Australian museum at Sydney, for this institution, which was well represented at the fisheries, has here a very poor show, which would, indeed, be improved were the specimens named. The finest set in the New South Wales court is the magnificent collection of shells lent by Dr. Cox, who is well known for his interest in zoölogy; the specimens are not named, but the catalogue gives their localities.

The Straits Settlements court is badly lighted, and appears to be cramped for space; this must explain why the really valuable collection of fish made by Dr. Rowell of Singapore has been placed on the wall with an eye rather to decorative effect than to scientific use. Dr. Rowell's collection contains also some good Crustacea, among which we notice a well-preserved example of the palm or robber crab (Birgus latro), the air-breathing apparatus of which has been described by Professor Semper.

In the neighboring court of British Guiana, we were most struck with the collection of nests of wasps, bees, and ants; but it is a pity that little information is given as to the species by which they were severally constructed.

In the court of the Bahamas there is a wonderful collection of more than sixty specimens of Oreaster reticulatus, which offers the zoölogist an opportunity for making a careful inquiry into the range of variation of this species. There are four, six, and seven rayed forms, as well as the more ordinary quinquiradiate specimens.

In the Barbadoes court there is an exceedingly interesting exhibit in the two specimens of Holopus rangi, which are lent by Sir Rawson Rawson. This very rare crinoid, described in 1837 by D'Orbigny, was incompletely known till Dr. Herbert Carpenter gave an account of the three specimens obtained by Sir Rawson when governor of the Windward Islands, and one in the possession of the Museum of comparative zoölogy at Cambridge, Mass., in his report on the stalked crinoids of the Challenger expedition. Holopus has been personally seen by so few naturalists, that they will be glad to have an opportunity of inspecting this enigmatic form for themselves; it is appropriately placed in a jar with a specimen of Pentacrinus muelleri, and, as that jar has flat sides instead of being round, the visitor will be able to see the specimens free from the distortion which is inseparable from a rounded jar.

In the Natal court there is a large collection of Lepidoptera and other insects in drawers, and a collection of birds which have, we believe, been examined by Captain Shelley, who is an authority on the avifauna of Africa. There is also a large case of insects in drawers in the Straits Settlements court, which have, no doubt, been examined by Mr. Distant.

The dugong in the Queensland court is, if our memory serves us rightly, a finer example than either shown by New South Wales in 1883; here, too, is a fine sawfish. The trophy of mother-of-pearl shells in the West Australian court is impressive. As to the spat of the pearl oyster shown in the Ceylon court, we will only say that the exhibiter is not at one with the authorities of the British museum, or with the specimens exhibited in the shell gallery of the Natural history department of that institution; the small Avicula vexillum is not the young of A. furcata.

A THEORY OF CRIMINALITY.

IN Italy, during the last few decades, a number of scientific men, mostly physicians, have devoted themselves to a careful study of criminal types. Their point of view is a strictly scientific one: they regard a crime as the expression of a dangerous trait of character. The character is more important than the act. Moreover, the criminal is not a spontaneous, capricious product: he does not stand alone, but belongs to a class. Thus the anthropology of the criminal classes becomes a distinct object of study. Again: criminality is essentially a morbid phenomenon, and is a defect analogous to insanity or idiocy. In this aspect the criminal is a psychological study. To characterize the spirit of this movement in a few words, one may say that it lays stress on the criminal rather than on the crime.

Foremost among the representatives of this view is Dr. Lombroso, the editor of a journal devoted to this movement, and author of a comprehensive work on the defective classes (*l'uomo delinquente*). Dr. Lombroso has recently stated his theory of criminality in a review article (*Nouvelle revue*, May, 1886), and it may be worth while to take advantage of this convenient statement by presenting it to English readers.

In general, one may recognize three types of causes of the outbreaks against the social order,— physical, social, and anthropological. Among the first may be mentioned climate. In the Argentine Republic the sharp changes of temperature favor a revolutionary character in the inhabitants. The season of year influences the amount of crime: crime predominates in the warm months. Of 192 revolutions in Europe, the months of June and July have the largest share; November and January, the smallest. So, too, heat is a factor. Southern countries (Italy, Spain, Greece) have the largest number of revolutions: northern countries (Russia, Sweden, Norway) have the least. Geographical position and other physical causes could be added. As social causes, Dr. Lombroso regards the struggle for supremacy among the various social castes or classes, a disharmony between the existing civilization and the prevalent economic conditions, an opposition between the political forms and the national feeling and needs. Such are the more constant occasions of revolutionary outbreaks, as shown in history. Mere accidental circumstances, such as the appearance of a great leader or writer, must also be considered.

Finally, the following are the prominent anthropological causes: the co-existence of races not readily assimilated, with, perphaps, a tendency to political changes; hereditary anomalies of character, such as criminality and moral insanity; or acquired anomalies, as alcoholism and insanity. All these go to form three classes of political defectives, — criminals by heredity, by habit, and by mental disease. These have furnished the subject-matter to the new science of criminal anthropology.

One must not suppose, that, because these criminals are classed under the insane, they will not be active in political crimes; for though they may be men of small intellect, yet the absence of the restraining power of a well-developed moral sense makes the bridge between thought and action shorter and smoother. A mere fanciful conception of possible crimes will take so strong a hold on their minds that the act itself will follow. More sensible and reflecting criminals would be repelled by the consequences and dangers of the act. In addition to this class of criminals, who become breakers of the peace simply because that happens to be the most accessible method of venting their perverse instincts, there is another class, who are led on by a wild passion for the destruction of the old, and the creation of something new. They need restless activity: their present condition seems the worst possible. As a rule, too, they are very fond of notoriety. They are in love with crime. The pain of others is a keen satisfaction to them: its horror attracts them. The French revolution shows such types. Lejeune made a little guillotine, and used it on the chickens destined for his table. Jean d'Heron wore a human ear as a cockade on his hat, and had others in his pockets. Carrier confessed that the writhings of the priests whom he condemned to torture gave him exquisite pleasure.

The modern socialists, anarchists, and dynamiters no doubt contain an element of these hereditary criminals, who use the political object as a mask for their instinctive tendencies to lawless outbreaks. The socialistic and the criminal types of face present strong resemblances. In some cases the introduction of such a criminal element transforms a purely political organization into a band of outlaws: the Molly-Maguires are an example of this.

All these facts urge the study of these defective classes. Society has a right to defend itself against these enemies of all peace and progress. But the punishment must be directed to the removal of the evil. The born criminal can readily be detected: his craniological peculiarities, the absence of a moral sense, the reckless cruelty of his deeds, point him out. The treatment for these must aim at removing all opportunities of indulging their passions, for meeting others of their kind (for the epidemic contagion of this disease is one of its worst characteristics), for bringing into the world others fated to follow in their footsteps. For their children, houses of correction and careful discipline should be at hand.

The relation between insanity and crime is one both of cause and of effect. Esquirol has shown an increase of insanity and suicides at each outbreak of the French revolution. Lumier declares that the excitements of 1870 and 1871 were the more or less indirect causes of seventeen hundred cases of insanity. This simply means that the same morbid element, tending to pronounced insanity in one direction and to pronounced criminality in another, is brought to the front by a common cause. Very frequently, too, both tendencies can be seen in the same individuals. Marat, for example, had attacks of maniacal exaltation, and a passion for continually scribbling. He had a sloping forehead, was prognathous, had a prominent jaw and high cheek bones, and a haggard eye, all of which correspond closely with the insane type of face. Later his delusion of ambition changed into one of persecution and homicidal monomania. Dr. Lombroso cites case after case, all telling the same story. He includes Guiteau in this list, and agrees with the opinion of an Italian alienist, that his trial was simply 'scandalous.' The real place for such beings is in a much needed institution, — an asylum for insane criminals.

A few words as to criminals who have acquired their sinful traits. Alcohol is the most common cause. This always plays a prominent *rôle* in political outbreaks: the French revolution is no exception. Here is another great practical problem needing solution.

So very hasty a sketch of an important theory is necessarily unsatisfactory. It may serve, however, to call attention to the fact that a change in our view of crime and criminals seems about to take place.

The several interests involved in this change of view are many and important. When a chemist is called to court to give expert testimony, the law accepts the results of science as final; but when the doctor testifies, it is at once evident that the medical and legal points of view are essentially different, and in conflict with one another. The law is interested only in the question of responsibility, and demands a 'yes' or 'no' when a truly scientific answer cannot be given in that form. A medico-legal case almost always presents strange inconsistencies. The law should certainly be as ready to accept the testimony of science from the doctor as from the chemist, and should remember that they may both be equally valuable though not equally definite. If such views as these urged by Dr. Lombroso ever become the guiding principles of the law courts, a great and beneficial change in the treatment of alleged insane criminals is sure to follow. Our knowledge of these marked classes is becoming sufficiently accurate and scientific to warrant a practical application of these views in the legal trials, and a theoretical appreciation of them in our theories of ethics. J. JASTROW.

ANNALS OF THE CAKCHIQUELS.

THE above forms the sixth volume of the editor's 'Library of aboriginal literature,' and contains a portion of a manuscript termed by Brasseur de Bourbourg, its former proprietor, 'Mêmorial de Tecpan Atitlan.' Its language is the Cakchiquel dialect of the wide-spread Maya family: it was composed by various members of the Xahila (a clan or family once ruling among that tribe) during the sixteenth century, and brought into its present form, as Dr. Brinton assumes, between 1620 and 1650. Only that half of the manuscript was published by him, with translation, which refers directly to the legendary and documentary history of the tribe.

There are three ways open for the publication of linguistic manuscripts of this sort. The first is to print the text, *tel quel*, with all its faults and inconsistencies; the second, to emend the faulty text according to the grammatic laws observable in the language, and to place the readings of the original, where they differ from the corrected forms, on the lower margin. A third mode of proceeding, and the most scientific of all, would be to embark for Guatemala, and there to compare the old text with the pronunciation and wording which the actual Cakchiquels would give to it. This would enable the editor not only to present the text in a scientific alphabet, but also to add a correct translation to it.

The annals of the Cakchiquels. By DANIEL G. BRINTON. Philadelphia, *Brinton*, 1885. 8°.

But none of these three courses was followed by our editor. The inconsistent orthography of the original prompted him to adopt the first two courses simultaneously and eclectically, and thus he succeeded in producing confusion in the text. His excuse (p. 63) is, "I have felt myself free to exercise in the printed page nearly the same freedom which I find in the manuscript. At first, this will prove somewhat *puzzling* to the student of the original. . . . In the punctuation I have also been lax in reducing the text to the requirements of modern standards."

Not less unfortunate than this method is the incorrectness of his proof-reading; for on p. 107 we find the proper name *Vookaok* correctly written, but on p. 110 he prints it *ahauh voo kaok;* the adverb *mahaniok* (p. 66) appears in the vocabulary as *mahanick;* the Greco-English term *allophylic* (p. 196) as *allophyllic;* and in two French quotations from Brasseur's translation he finds himself prodigiously at variance with French accentuation (pp. 197, 206). The appended 'Notes' convey very little information on grammatic or other subjects which we have to know before we can understand the text, and the condition of the vocabulary is very unsatisfactory. We look in vain for the terms *petebal, navipe, onohel, g'anel* (the name of a month); and even some of the frequently occurring numerals, as *vuo–o, voo* ('five'), are not entered. The translation is a mere paraphrase full of gaps, and the text as printed does not by any means render justice to its highly interesting contents, which, in their historic importance, are second only to those of the Popol Vuh.

PROFESSORS AYRTON AND PERRY, the English electricians, have accidentally observed that on amalgamation, or coating with quicksilver, brass expands; so that, if one side only is amalgamated, a plate of brass becomes curved. They imagine that this may be the primary cause of the phenomena of the Japanese 'magic mirror,' which has cast on its back a pattern that is quite invisible on the polished face, yet is mysteriously distinct in the patch of light reflected by the mirror upon a screen. Amalgamation would affect the thinner parts made by the pattern more than the rest of the plate, giving the mirror the imperceptible unevenness that becomes plainly apparent in the reflected image.

SCIENCE.

FRIDAY, JULY 9, 1886.

COMMENT AND CRITICISM.

NOT INFREQUENTLY STATEMENTS APPEAR of the death of some individual who has passed his hundredth year. The evidence in these instances of great longevity is, as a rule, exceedingly unreliable, and oftentimes there is not so much as an entry in a family Bible upon which to rest the claim. Professor Humphrey of England has determined to investigate, so far as he can, these reported cases, and is now collecting the information from every available source. While there can be no doubt that there have been many true claimants to the title of centenarians, yet it will probably be found, as a result of Professor Humphrey's labors, that a not inconsiderable number have falsely or ignorantly laid claim to an honor which they did not deserve.

THE EXAMINATION OF THE BRAIN of the late King of Bavaria by six of the medical profession of Germany has resulted in confirming the opinion of his physicians given during his lifetime, that he was insane. Marked changes of the brain substance and its membranes, and also of the bones of the skull, were found; some of them showing evidences of having existed for a considerable time, and others of more recent formation. These signs of degeneration, coupled with the idiosyncrasies which marked the later years of his reign, leave but little room for doubt as to the insanity of King Louis.

FROM TIME TO TIME epidemics of scarlet-fever more or less extensive have been traced to the dairy. The usual history has been that of some attendant, while convalescing from the disease, and before the skin had thoroughly desquamated, being found in the act of milking. Portions of skin containing the infectious material have thus found their way into the milk, and the disease has appeared among the consumers. Another method by which this disease may be propagated has just been brought to light by Professor Cameron of London. He finds that the cows themselves may have scarlet-fever; and in an epidemic recently investigated by him, this was, in his opinion, the source of infection in a family attacked with the disease. Dr. Cameron regards it as occurring usually in the first instance in newly-calved cows, and communicated to healthy cows by the hands of those who do the milking. The symptoms in the cow are very similar to those observed in the human species, including fever, sore throat, discharges from the nostrils, and an eruption upon the skin.

THE SEARCH FOR THE GERM of hydrophobia, or rabies as it should more properly be termed, has up to very recent date been unsuccessful. The London *Lancet* announces that Dr. Dowdeswell claims to have found it in the central canal of the spinal cord and in the medulla oblongata. He has also found it in other parts of the brain and cord, but not in such abundance. He describes it as a micrococcus, and accounts for the failure of others to find it, by the fact that the hitherto known methods of staining will not affect it. He will shortly describe his own method, and an opportunity will then be given to experts to examine the evidence on which he bases his claim: until then the matter remains *sub judice.*

THE FIELD-WORK of the coast and geodetic survey is almost at a standstill. owing to the lack of money to conduct it. Only those parties are at work which had been sent out prior to the close of the fiscal year. The parties on the transcontinental arc will be put in the field as soon as the appropriation passes. All the parties from the south are now in, except those of Assistant Hodgkins, who has been detained at Cape Lookout by bad weather, which has prevented his making a survey to show the changes in that locality, which, from casual observations and a partial report by Mr. Fairman Rodgers, are very great. This form of delay in work is common to all the government departments, first to one and then the other, when the proper committees fail to do their work promptly. Some delay may be justifiable under the conditions; but it is none the less injurious.

THE PLANTING AND EXHUMING OF A PRAYER.

It may not be known to all the readers of *Science* that Mrs. Colonel Stevenson brought with her from New Mexico last autumn, Wa-Wah, a Zuñi woman, the most expert weaver and potter in her pueblo, and one of the five priestesses of the order of Ko-Ko.

For six months this woman has taught her patroness the language, myths, and arts of the Zuñis, — now explaining some intricate ceremony, at another time weaving belt or blanket under the eye of the camera, or with wonderful dignity and self-possession moving among the most enlightened society of the metropolis.

As the season of the summer solstice, or, more correctly, the summer moon, approached, Wa-Wah expressed the greatest anxiety to join with her distant people in the semi-annual plume-planting, the other festival occurring at the time of the winter moon. Letters were written to New Mexico, and the very day ascertained upon which the ceremony would take place in Zuñi (see accompanying plate, fig. 1).

Wa-Wah was all excitement to make her preparation of meal, sticks, paint, and feathers. All of these were abundant enough in the stores, but nothing of that kind would suffice. Various diplomatic schemes were tried, but her heart was fixed. The prayer must be right to infinitesimal particulars, or she would have nought to do with it.

Meal must be mixed with powdered shells and turquoise ; the treasures of the national museum had to be opened ; and the very pieces of yellow, blue, and black pigment collected in former years by the Bureau of ethnology must be laid under contribution for the stems of the sacred prayer-sticks. Mr. Ridgway's department of ornithology was invoked to supply feathers of the golden eagle (Aquila chrysaetos), the wild turkey (Meleagris mexicana), the mallard (Anas boschas), and the bluebird (Scialia arctica).

Fresh twigs from the cottonwood-trees were gathered for stems to the plumes. In the national museum are many boxes, said by the collectors to have been Zuñi plume-boxes (fig. 2), in which such treasures are kept. The plumes, which form the material instrument or accompaniment of the prayer we are describing, are made as follows : Take a straight piece of wood about the size of a lead-pencil and as long as the distance from the crease in the palm of the hand to the end of the middle finger. Make a slight incision around the stick near one end. Take a short stiff feather of the eagle, the turkey, the duck, and the bluebird, and one or two downy feathers of the eagle. Lay them together so that all the under sides will be toward the stick, and wrap their quill ends and the stick securely together with a cord made of native cotton, sufficiently long to leave free ends five or six inches in length after the tying. To these free ends tie another bunch of smaller feathers from the four kinds of birds (fig. 3). The upright feathers indicate the prayer as addressed to the sun, moon, and Ko-Ko ; the trailing feathers, that the suppliant asks for help to walk in the straight path of Zuñi morality.

Ten plumes were thus finished on Friday, June 18, and dedicated to the several spiritual powers by painting the stems as follows : —

1. *Sun-plume.* — Blue stem ; feathers of eagle, duck, and bluebird on stem and streamer ; 2. *Moon-plume.* — Yellow stem ; feathers of eagle, duck, and bluebird on stem and streamer ; 3 – 6. *Ko-Ko plumes.* — Black stems ; feathers of eagle, turkey, duck, and bluebird on stem or streamer ; 7 – 10. *Ancestral plumes.* — Black stems ; feathers of eagle, turkey, duck, and bluebird on stem or streamer.

On Saturday, June 19, at two o'clock in the afternoon, in a retired garden in Washington, Wa-Wah performed the ceremony of planting the plumes. Her time was arranged so as to act simultaneously with her people at Zuñi.

A hole was dug six inches square and fourteen inches deep, three inches of loose earth being left in the bottom. Around the top for a foot or more the surface dirt was smoothed like a garden-bed. Meal mixed with powdered shells and turquoise was sprinkled freely about and in the hole. Wa-Wah, arranged in her best attire, holding all of her plumes in her left hand, kneeled by the excavation (fig. 4). Taking the sun-plume in her right hand, she prayed for the good influences of the sun upon herself, her people, the crops, and her friends, and then forced the blue stem into the loose dirt of the cavity on the extreme west side, the inner sides of the feathers toward the east. The prayer continuing, the moon-plume, then the four Ko-Ko plumes, and lastly the four ancestral plumes, were planted in order, all with feathers inclining eastward.

Wa-Wah then arose, drew forth her little bag of sacred meal, poured a small quantity into her own hand and that of each of her two friends, who were watching with the deepest interest. Each, in turn, sprinkled the meal over the shrine, blowing gently with the breath (fig 5).

The utmost sincerity manifested itself in every portion of this ceremony. It seemed to those who gazed in rapt silence at this simple devotion, that they were witnesses to the surviving worship of the primeval world.

SCIENCE, July 9, 1886.

BURYING A PRAYER IN WASHINGTON: A REMNANT OF AN EXPIRING WORSHIP.

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BURYING A PRAYER IN WASHINGTON: A REMNANT OF AN EXPIRING WORSHIP.

It was necessary that the sunlight should look upon this prayer during the rest of the day: therefore every precaution was taken to protect the place from intrusion.

On Monday morning, with the consent of Wa-Wah, the prayer-plumes, and the earth containing them, were carefully dug up, without disturbing a feather (fig. 6), and deposited in the national museum, perhaps the most unique object ever placed among its precious collections.

This ceremony has been carefully studied among the Zuñis by Mr. Frank Cushing and Mrs. Stevenson, and among the Navajos by Dr. Washington Matthews, all of whom will give more detailed descriptions, with translations of the prayers, in the future reports of the Bureau of ethnology.

O. T. MASON.

U. S. national museum.

CAN ECONOMISTS AGREE UPON THE BASIS OF THEIR TEACHINGS?

ONE of the first and most obvious tests by which to determine whether men possess exact and reliable knowledge of a subject should be afforded by the agreement or disagreement of its recognized cultivators. I propose to show in the present paper that there is no sound reason why political economy should not favorably pass such a test. It is true that its cultivators differ both in the methods and objects of their studies. But such differences do not imply difference of views respecting either fundamental principles or conclusions.

Let us illustrate this by the case of physics. We have some writers and teachers of physics who prefer the experimental method. They teach principles by experiments, and lay little stress on mathematical deduction. Others teach the leading branches of the subject by mathematical reasoning, clothing their results in formulae and theorems.

But these two classes of teachers do not stand in any antagonism to each other, nor accuse each other of ignorance. Each class recognizes the fact that there can be no diversity between correct theory and experimental results, and gives the other credit for aiming at truth in his own way. It is very clear to them that they are viewing and approaching the same subject from different points.

So, also, there are some economists who lay most stress upon the general principles of the science and the conclusions to be deductively obtained from them. Others prefer to lay stress upon the observed facts of society and business, showing the student how to work out such theories as may be founded on the facts he observes.

But it is an unpleasant fact that these two classes of teachers do not, like their brethren the physicists, mutually recognize each other as seeking and reaching valuable truths by different ways. Their attitude toward each other resembles that of the mediaeval philosophers more than that of the modern scientists. They divide themselves into 'schools,' each of which seems very unwilling to admit any truth in the system of the other. I hold that this state of things is a great drawback to the character and usefulness of economic science, and propose to inquire whether there is any necessity for its existence.

Since we must agree upon a common end, I shall assume such end to be the improvement of society, either by promoting such public measures and social movements as tend in that direction, or by discouraging and repressing those which tend to injure society. It is true that this is viewing the subject as an art and a policy rather than a science, and, in fact, taking a stand-point which detracts from its scientific dignity. But I am careful to say that this practical end is not the immediate subject which concerns us, but only the ultimate object which we may have in view.

Admitting, then, that a student desires to know what measures will benefit society, and what measures will injure it, how shall he proceed in acquiring that knowledge? I reply, he must be able to trace beneficial and injurious causes to their effects upon the social organism. If the knights of labor tell him that they want him to favor an eight-hour law, he wants to foresee what effect such a law will have on the interest of all concerned, — wage-workers, mechanics, men out of employment, and capitalists. So, also, when two opposing parties want him to vote for or against the coinage of silver, he cannot reach any intelligent conclusion unless he can foresee what effect free coinage or a cessation of coinage will have upon industry, commerce, and wealth. In a word, society being an extremely complicated and delicate organism, he must know what effects different causes may have upon it.

How shall he prepare himself for this great problem? I answer, that he must prepare himself as he would in the case of any other organism or machine: he must begin by understanding the anatomy and physiology of the social organism in its minutest details. Especially must he understand to what forces it is subjected, and what influence these forces have upon its workings.

Possibly we may here be met with the assertion that this is not a subject on which any exact knowledge can be acquired. There are respectable people, even teachers of economics, who seem to deny that they are dealing with a science. All we can say in reply is, that this arises either from misapprehending what a science is, or from contemning the subject as unworthy of study. Science consists very largely in the establishment of exact relations between cause and effect, and a subject in which such a relation cannot be traced is unworthy of serious study as a science. In a word, if we admit that we can trace the relation of cause and effect, then we admit ourselves to be dealing with a science. If we do not admit this, then it is of no use to talk about questions of economic policy, and the safest course is to frown upon all social movements as productive of results which no man can foresee, and which are as likely to do harm as good.

The next question which arises is, how shall we proceed to acquire the necessary knowledge of society, — by purely deductive processes from general principles, or by the study of the facts as developed by history and statistics? I reply, we can attain no result except by a judicious combination of both processes. Some questions can be settled conclusively by common-sense deduction, while others are about matters of fact, and can be settled only by a study of facts. If a proposition were before the people of New York to withdraw water from the Croton Lake for industrial uses, and if the promoters of the scheme should publish an historical investigation of the phenomena of all aqueducts from the time of Caesar until now, to show that the withdrawal of the water would increase the available supply in New York, everybody would laugh at them. So in economics. No study of facts will tell us whether the number of houses available for a community will be increased or diminished by restricting the number of men who shall be allowed to learn the arts of carpentry and brick-laying, and by diminishing their hours of labor. But common sense settles the question at once.

If asked whether the most urgent want of the student is a knowledge of facts, or the practice of deduction and the study of deductive methods, I should reply that neither was urgent. What is really urgent is, that he shall know how to study facts effectively, and be able to understand principles rationally. The prevailing defect of the times is too much reliance on deduction, and too little understanding how to study the facts of the social organism, and how to apply principles to the study. What all economists should agree upon in their teaching, is to emphasize both the understanding of principles and the investigation of facts.

I have in my mind's eye two ideal men. The one has at his fingers' ends the state of commerce and trade the world over, knows the amount of imports and exports of all nations, and has their laws of banking and currency learned off by heart, but, with all this knowledge, does not understand the laws of supply and demand, nor see any reason why there should be a relation between the imports and exports of a country. The other ideal man has a clear understanding of the laws of supply and demand, and all other abstract principles of economics, but is absolutely ignorant of the actual condition of trade and commerce in any part of the world. Which man is better equipped to answer an economic question? I reply, that, taking them as they stand, neither is well equipped. But the second man has this advantage over the first, — that, when the question is presented to him, he will know how to investigate it, and, with the aid of better informed men, will be able to find out the essential facts for himself; while the other man will never be able to make any really valuable use of his knowledge. Hence I prefer a system of instruction which is more concerned in teaching the student how to think and investigate, than in storing his mind with facts.

SIMON NEWCOMB.

GEOGRAPHICAL NOTES.

The Kongo. — The steam-launch Peace, belonging to the English missionaries on the Kongo, has been busily engaged, since her arrival on the river, in geographical work. Among the voyages made and reported by the Rev. G. Grenfell are a reconnaissance of the Kassai or Quango to longitude 17° 30′ East Greenwich. Another journey included a visit to the Lomami and Ikelemba, affluents of the left bank, and several others of the right bank, among them the Nkemfe, which proved narrow and tortuous. The Mobangi was navigable as far as explored; the Itimbiri also as far as the Lobi Falls, in 23° 28′ east longitude and 1° 50′ north latitude. At three or four miles from the junction of the Mbura with the Kongo, the former was found to divide into two branches, both barred by rapids or falls, the south branch having a cataract forty feet high. The Lomami is a fine river; but the current is very swift and the channel tortuous, so that the launch could make good but some six miles a day during the latter part of their stay upon it. In August of last year the Lulongo was ascended to a distance of nearly seven hundred miles. Its principal affluent is the Lopori, in 1° 12′ north latitude. Stanley's Black River, which enters the Kongo near the equator, is formed by the junction of the Juapa and Bosira. Hostile tribes forced the explorers to retreat after exploring the former some three hundred miles, when it was still navigable. The Bosira was only navigable for about two-thirds that distance. Careful astronomical observations were made, and the final reduction of the many results obtained will greatly ameliorate the charts of the Kongo basin. The Rev. Mr. Grenfell insists upon the richness of the upper Kongo basin, and especially of the Kassai valley, and reiterates the opinion expressed by others, that a railway across the arid region of the lower Kongo is the only means by which commerce can be assured an entrance into this vast and fertile region.

Trade-route to Bolivia. — Information from Buenos Ayres indicates that Thouar departed thence for the upper river last February, and expected to reach Tarija early in April. He was to ascend the Pilcomayo with a Bolivian escort on a steamer of two hundred tons detailed for the purpose. It is hoped that the explorations now in progress will result in a permanent route for the commerce of eastern Bolivia toward the Atlantic. M. Thouar's health continued good, though fever was very prevalent: he attributes his exemption, at least in part, to the use of fumigations of sulphur.

Lake Moeris. — Mr. Cope Whitehouse, who has been investigating the supposed site of Lake Moeris in the Raian basin, writes, that, assisted by Herr Stadler, a government engineer, and his party, a line of levels has been run between the canal of Gharak, connecting with the Nile, and the margin of the depression. At a point twelve metres from the level of the Mediterranean a bench-mark was established, and a sketch of the whole basin made. The ruins of the Wadi Moelleh are supposed by Mr. Whitehouse to be those of Dionisian placed by Ptolemy on a long and narrow arm of Lake Moeris. Col. Scott Moncrieff, director of public works, will have made a general plan and estimates for a canal, to fill the basin from the Nile, as soon as the hot season is over. The Mussulmans regard the project favorably, as they have a tradition that Lake Moeris was established by the patriarch Joseph, the Bahr Jussuf still retaining his name. It would result from these works that at high Nile an area of six hundred square kilometres could be covered to a depth of eighty or ninety metres, capable of doubling the volume of the low Nile, and of rendering an immense extent of now desert ground susceptible of cultivation.

The spring in Alaska. — The spring in Alaska has been unusually late and cold, with exceptional precipitation. A large number of prospectors have crossed over the divide to the British head waters of the Yukon, in search of the rich diggings found by a lucky few last year. Many of them are doubtless doomed to severe disappointment. The fishing-fleet has already sailed from San Francisco, consisting of eleven vessels, of 2,331 tons, manned by 273 men. Four of the vessels fish in the Okhotsk Sea; the remainder, in Alaskan waters.

PARIS LETTER.

Professor de Lacaze-Duthiers, whose name is familiar to all zoölogists, owing to many very good contributions to the biological sciences, has, after a rather severe illness which kept him confined to his room for more than three months, resumed his yearly task, and begun his lectures. As usual, his opening address was devoted to a general summing-up of what work has been done in his laboratory during the past year; but this time, instead of a short summary, he delivered a lengthy address concerning his seventeen-years' task as a professor of zoölogy in the Sorbonne.

M. de Lacaze-Duthiers was appointed in 1869. Professor Milne-Edwards being then professor of comparative anatomy, M. de Lacaze-Duthiers had to undertake the teaching of zoölogy proper; which he did, it must be said, with a great deal of talent and energy. He understood very well that zoölogy can be taught only in part, and that the greater part of that science the student must learn by himself alone, without tuition, by practice and experience under the direction of his teacher. In order to give students all possible aid, he undertook to found a marine biological station on the Brittany coast. With the aid of government, he began the laboratory of Roscoff in 1872, and thus accomplished a very useful work. I visited this laboratory some two or three years ago, and spent there a month or so in scientific pursuits. It is very well organized and directed.

Roscoff is a little town, or rather a big village, near Morlaix, where a few people come to spend the summer season, for sea-bathing, and where there is nothing to prevent a good time of hard work, since the only diversion to be had is work itself. The inmates of the laboratory, who are allowed to spend their time as they please, with Professor de Lacaze-Duthiers's consent, live in the laboratory itself. Each has his sleeping-room. Some work in their sleeping-rooms; others, in two or three big rooms fixed up for working purposes, and representing real zoölogical laboratories. A library and a parlor are for general use; an aquarium, with a number of tanks, contains the rare or curious species of the coast; there is also a collection of preserved specimens, which will be used some day to build up a fauna of the Roscoff coast.

Roscoff receives a good number of students who are preparing their *licence-ès-sciences:* the other visitors are either licentiates who are preparing their doctorate theses, or doctors who are pursuing new researches. The fauna is very rich, and the species are numerous. The tides being very high, there is a good deal to be found at low water, under the rocks, or in the pools. The laboratory is open from May to October.

In 1881, Professor de Lacaze-Duthiers began forming another laboratory, a winter one, on the Mediterranean coast. This is the laboratory Arago of Banyuls, close to the Spanish frontier. The state had little to do with the establishment of this laboratory: Professor de Lacaze-Duthiers preferred asking money right and left, of the municipal boards, of the towns of Perpignan, Banyuls, etc., and succeeded in getting money enough to build a very commodious laboratory in a very short time. Having been an inmate of this laboratory during a whole winter season, — the Banyuls laboratory is open from November to June, — I am qualified to speak of it; and it must be said that the organization is a very good one.

As there is no tide in the Mediterranean, the animals are fetched by two or three boats belonging to the laboratory: they are furnished with all the necessary implements, and have a crew of four men. Those of Roscoff need only two or three sailors.

At Banyuls the persons who work in the laboratory do not live in it: each has his working-room, but one must lodge and board in the village, where good enough accommodations can be found. I had there a whole house, with accommodations for five persons, at the rate of twelve dollars a month. Living is cheap; and I can say from personal experience, that, for a biological student, nothing can be pleasanter than a season at Banyuls, where the climate is generally fine, and the scenery very pretty, looking out on the blue Mediterranean.

The laboratory comprises an aquarium, with tanks full of pretty and curious specimens of marine life, a library, a collection of preserved specimens, and accommodations for twenty-five persons. There are three boats and one life-preserver. Although the fauna is not as rich as it is in Roscoff, the animals are numerous. The Medusae, Siphonophora, and many other Coelenterata are especially pretty, and on some days are to be found in enormous numbers. The laboratory of Banyuls is especially reserved for students who have already taken their degree of licentiate, and are preparing a thesis, or for scientists who wish to study some zoölogical questions; but it is not open to beginners, to persons who have not yet had practical experience in zoölogy.

After having founded his first laboratory, that of Roscoff, Professor de Lacaze-Duthiers founded, in 1872, his *Archives de zoologie expérimentale et générale*, so as to be able to publish the works of his pupils and of the persons who come to his laboratories. This paper has succeeded so well, that it is at present overcrowded, and cannot accept all that is proposed for publication.

These results show that Professor de Lacaze-Duthiers's first seventeen years in the Sorbonne have been very useful to zoölogy, especially if one considers the number of papers he has published, and the number of pupils he has had, and has yet.

In consequence of Milne-Edwards's death, Professor de Lacaze-Duthiers has taken the professorship of comparative anatomy: that of zoölogy has been given to one of his best pupils, M. Delage. It is to be hoped that M. de Lacaze-Duthiers will be able to continue a long time making himself useful to science. The students, on hearing his address some days ago concerning his past work, all concurred in this feeling, and made it known by very liberal and hearty cheers.

In one of my last letters I spoke about the great services rendered by photography in the recent caving-in of a quarry near Périgueux. MM. Langlois and Siemens have continued taking photographs of the yet buried victims, and have disclosed new facts. The photographs, taken in the way I have already explained, show three corpses, of which one was immediately and easily recognized; another is supposed to be a man who was in the quarry at the time of the accident; the third is unknown. These photographs not only show all the tools and implements the victims had with them, such as saws, planks of wood, a cart, etc., but they also show that the unfortunate men must have lived some time, since one of them, who always wore short-cut hair, is seen on the photograph to have very long locks. It is certain that these men lived some time, and that the smoke perceived some days after the accident was due to their having built a fire to warm themselves or to do some cooking. The public feeling is very much excited against the directors of the quarry for not having earnestly tried to get at the victim when it might still have been useful.

At the last meeting of the Société de psychologie physiologique a good many strange facts were made known by different persons, concerning instances of somnambulic sleep induced at a distance. It would seem that certain persons are able to induce sleep in a subject, Madame B., by pure mental operation, by willing it, at a distance of some hundred yards. The fact is a very interesting one; but it seems that it would be better, before trying to explain it, as some would like to, to see if the fact is real and positive. The persons who have witnessed it are certainly very trustworthy, but this is no guaranty that they had all the requisites for experimenting in a satisfactory manner. Deceitfulness is so frequent in persons of hysterical nature, and experimenting is so difficult, as the Hippocratic aphorism says, that such questions ought to be studied only by professional experimenters. One may be a sound philosopher or a good physician, and yet understand nothing about experimenting. As for medical students, their authority in such matters is of little worth. The society ought to appoint a committee to investigate the matters brought forward, and select some professional experimenters of a sceptical turn of mind, and somewhat more incredulous than are most of the persons who study, or pretend to study, somnambulic phenomena.

At the meeting of May 17 of the Academy of sciences, the academy presented M. Chevreul, the veteran of French science, with a very fine gift, in commemoration of his hundredth year. As he came into the room, the whole assembly rose, and the president, Admiral Jurien de la Gravière, made a little speech, in which he very appropriately remarked "that what we honor and celebrate in your green and majestic old age is not, to be sure, the length of your life: it is, above all, the good use you have made of this exceptional favor of Providence." The gift made to M. Chevreul consists of a bronze by Dubois, representing 'Study and meditation.' It is allegorical, and does not at all represent M. Chevreul's features, which, it must be said, are not particularly handsome. M. Chevreul answered briefly and in very feeling terms. It is in August that M. Chevreul's hundredth year will close. It had been decided that it was better to anticipate the anniversary some weeks, because in August many members of the academy are out of Paris, taking some rest, or travelling, and because postponing is rather dangerous with a centenarian.

Dr. Worms has recently made known to the Academy of medicine the results of his investigations concerning Daltonism and other sorts of color-blindness among the *personnel* of the Northern railway. The number of persons examined is 11,173, and the proportion of defective color-vision is a very small one. Two persons only were utterly incapable of distinguishing one color from another; three were color-blind for red; six for green; eighteen mistook green for red; fifteen could not distinguish green from blue or gray; fifty-two had a certain weakness in color-vision. Upon the whole, the defects of color-vision are very scarce among the persons examined by M. Worms; and there is not much danger to be feared for railroad travellers from these defects.

M. Balbiani, professor in the Collége de France, published some days ago, in the *Revue scientifique*, an interesting paper on viviparous fishes, in answer to a letter written by a person of New Orleans concerning a viviparous ray. It seems, from the letter, that this fish is very much disliked by fishermen, not only because it is viviparous, and so differs from other fishes, but because it seems also to have menses, like mammalia. Professor Balbiani contributes an interesting note on the subject, and explains in a very acceptable manner the appearance which so much troubles the New Orleans fishermen.

Among the recent publications of scientific interest, we may notice Professor Cornil's second edition of 'Les bacteries.' This book is a very good one, and the first edition was sold in a few months, so that a second has become necessary. Professor Cornil has added many new facts concerning bacteriology, and his book is more valuable than ever.

Professor Herzen of Lausanne has published a little work on digestion. He entirely confirms Schiff's theory of peptogenes, and shows how well conducted have been this physiologist's experiments. Professor Herzen was able to examine a man with a gastric fistula for some time, and has made very useful experiments concerning the therapeutics of dyspepsia. He shows how this disease ought to be treated, rationally, and his book is of practical as well as of scientific interest.

We may also notice the second edition of Professor Bouchard's 'Maladies dues au ralentissement de la nutrition' ('Diseases due to retardation of nutrition'). This book is always full of suggestive facts, and deserves the fame it has enjoyed since the day it came out.

M. Miquel, the well-known micrographer, recently read at the meeting of the Société de médecine publique, a paper on horal variations of aerial bacteria. There is a sort of tide with high and low water marks in the distribution of these micro-organisms. There is a first high-water between six and nine A.M., and a second from six to eight P.M. The minima are at two P.M. and two A.M. These differences are also perceived in open rooms, but not in closed apartments. The inference is, that it is better to ventilate rooms from eleven in the evening to five in the morning; but this is not always very easy and practical.

Some days ago M. Denika, a pupil of Professor de Lacaze-Duthiers, published a very interesting thesis on the structure of a gorilla embryo, studying all the particulars of the different systems of the body, and establishing an interesting comparison with the organization of other monkeys. This gorilla embryo is the first that has been dissected yet, and studied with real care.

A new publication was started some time ago in Paris. It is the 'Grande encyclopédie,'—a cyclopaedia in which all facts at present known concerning science, literature, arts, legislation, etc., are condensed; it is a summary of present knowledge. The first volume is now ready. The whole publication will comprise some twenty or twenty-five quarto volumes. It is written by a number of contributors, and only by specialists, under the direction of a committee comprising MM. Berthelot, Hahn, Levasseur, Laisant, Marion, etc. It seems to be a very good idea; and, although the 'Grande encyclopédie' does not pretend to create the furor that Diderot and d'Alembert's did, from a philosophical point of view, it certainly will be of great use, if it continues as it has begun, being very complete and well prepared. There are no such cyclopaedias in France yet, written by competent persons; and there is no doubt that this publication really meets a general demand. It is printed with great care, and most of the articles are made up from the latest and best documents. It is to be expected that the public will look on it favorably, if it continues as it has begun, and if the contributors are always well chosen by the directing committee. It is time that France should have a cyclopaedia able to stand a comparison with those of England and of America.

At a recent meeting of the Academy of sciences, M. d'Arsonval presented a very well combined instrument devised for the investigation of the duration of different psychical or physiological phenomena. It is very useful, for instance, for the study of reaction-time, of perception-periods, and for the study of the dilemma-time in distinguishing two or more perceptions. The great advantage of this instrument is, that it disposes of the estimation of the experimenter himself, and gives much more exact results in the very delicate and difficult estimation of the duration of mental phenomena. M. d'Arsonval is a very able man in all that concerns mechanical contrivances; and his instrument, which I saw at the works of Ch. Verdin (the constructor) some days ago, is a very well contrived one. V.

Paris, June 15.

NOTES AND NEWS.

CONGRESSMAN VIELE of New York made a strong effort in the house last week to secure an appropriation of ten thousand dollars to continue the National board of health. Representative Randall declared that there was no need for a national board of health, and the house seemed to coincide with him, for the item proposed by General Viele was not adopted.

— Dr. C. H. F. Peters, of the Litchfield observatory of Hamilton college, discovered on the night of the 28th of June a new asteroid of the eleventh magnitude: its number will be 259. Number 258 has been named Tyche.

— The organizing committee of Section A of the British association has arranged that a special discussion shall be held, jointly with Section D, on the physical and physiological theories of color-vision. The discussion will be opened by Lord Rayleigh, and Dr. Michael Foster will also take part in it. Persons who wish to contribute papers bearing on the subject of discussion are requested to send their names to the recorders of Sections A or D, at 22 Albemarle Street, W., not later than Aug. 1.

— 'Consanguinity in marriage' was the subject of an address by Dr. McKee at a recent meeting of the Ohio state medical society. The belief that consanguineous marriages are followed by evil effects upon the offspring is not accepted by the author, and the object of his address was to show its falsity. A very interesting and concise account is given of the Mosaic law, and also of that of the Greeks and Romans, in reference to the marriages between relations; and full quotations are made from the statistics of modern writers and observers. Among the eighteen conclusions drawn as the result of the author's studies are the following: 1. Like breeds like, good or bad, entirely independent of consanguinity. 2. Intemperance, luxury, dissipation, sloth, and shiftlessness, as well as hygienic surroundings and innumerable other causes, should bear much of the responsibility laid at the door of consanguinity. 3. Data are of doubtful reliability, full of flaws and false reasoning. The noted cases are the unfortunate ones. The favorable are unknown or forgotten. It is the ill news which travels fast and far. 4. Statistics show about the same proportion of deaf-mutes, idiots, and insane persons, descendant from consanguineous marriages, to the whole number of those unfortunates, as the number of consanguineous marriages is to the whole number of marriages. 5. Consanguineous marriages which bring together persons having a disease or morbid tendency in common are dangerous to the offspring; not, however, one whit more so than the marriage of any other two persons not related, yet having an equal amount of tendency to disease in common. 6. The half a hundred abnormalities ascribed to consanguinity, including almost all the ills that flesh is heir to, — among others, whooping-cough, — approaches the ludicrous. 7. Consanguineous marriages, no other objection being present, should not be opposed on physiological grounds. The address closes with an exhaustive bibliography of the subject, including some thirty writers, and extending, in point of time, from Moses to the present year.

— A French journal cites the fact that a number of persons have recently been poisoned in France by eating asparagus grown in localities where small amounts of sulphide of carbon existed in the soil. The symptoms were those of cramps and diarrhoea.

— Rumination is commonly supposed to be a digestive process peculiar to certain of the lower animals. There are, however, some forty cases on record where this power has been possessed by members of the human species. It usually commences so soon after birth that the affected individual cannot state its commencement, and appears to be present in males almost exclusively. It is in all its steps essentially the same as in the ruminating animals, and, as it mostly occurs in those who are large eaters, it is evidently one of nature's methods to provide for more thorough mastication in those who eat to excess, or do not take the necessary time to masticate their food properly in the first instance.

— The Boat-sailer's manual, by E. F. Qualtrough, U. S. N. (New York, *Scribner*, 1886, 24°), deserves and should command a ready sale among the many whose interest in the subject is awakened or revived by the triumphs of the Puritan or Priscilla. There is a great deal of information in it, most germane to the subject and very well arranged. The language is, however, unintelligible to the general reader; and the glossaries, of which there are two, are quite defective. They should be consolidated, to save the trouble of two searches, and even then there are forty-two words unknown ashore, used by the author and not defined.

— The annual report of the astronomer royal, Mr. Christie, was submitted to the Board of visitors of the Greenwich observatory on June 5, and gives an account of the progress and activity of the observatory for the year ending May 20, 1886. Copies of the original report have not yet reached this country, but the following particulars of its contents have been obtained from abstracts which have been published in *The Athenaeum* and *Nature*. The regular work of the transit circle and the altazimuth has been continued, and very satisfactory results have been obtained with the apparatus for determining absolute personal equations brought into use with the former instrument some months ago. Spectroscopic observations include a considerable number made of the new star which burst out last August in the great nebula of Andromeda. The spectroscopic observations of Sirius indicate, as in the last three years, a displacement of the F line towards the blue: this displacement would correspond to a motion of the earth towards Sirius at a rate of something more than twenty miles per second, though, from the nature of the observations, the amount of such a motion cannot be considered as very accurately determined. For the year 1885, a photographic record of the sun's surface can be made out for 360 days by filling up the gaps in the series of Greenwich photographs from photographs obtained in India and the Mauritius. Observations of comets and of casual phenomena have been made with the equatorials; and the magnetic and meteorological observations, the time-service, etc., have been kept up as in previous years. The full import of the statement that the reductions of the observations are keeping pace with their registration, will be appreciated by all who are engaged in routine astronomical work. In regard to the new equatorial, Mr. Christie says, "The construction of an object-glass of 28 inches aperture and of 28 inches focal length, with suitable tube, to be mounted on the south-east equatorial, has been authorized by the government, and the necessary funds have been provided in the estimates. The work has been intrusted to Mr. Grubb, with whom I have arranged the details of the tube, which is to be of special construction, adapted to the conditions of the mountings, and available for spectroscopy and photography as well as for eye observations. Mr. Grubb proposes to provide means for readily separating the lenses of the object-glass to such a distance as will give the proper correction for photographic rays."

— In connection with the recent notice of Professor Hull's 'Report on the geology of Palestine,' it has recently been stated (*Geol. mag. Lond.*, September, 1884) that Dr. Schweinfurth, the well-known African explorer, has recently announced the discovery of paleozoic fossils in the Wady Arabah, west of the Gulf of Suez, in sandstone hitherto regarded as Nubian sandstone. The fossils have been submitted to Professor Beyrich, who identifies a species of Spirigera or Athyris, allied to A. concentrica, and stems of crinoids. The exposure seems to be not dissimilar from that of the Wady Narb on the other side of the Red Sea. Dr. Schweinfurth's paper is in the Bulletin of the Egyptian institute for 1885 (Cairo, 1886). This discovery confirms the suggestion of Sir William Dawson as to the carboniferous age of the lower part of the Nubian sandstone of Egypt, based on a fossil plant and on its geological relations.

— The human spleen has been removed seven times in Italy, and in but two instances has the patient recovered. Prof. Antonio Ceci of Genoa has recently performed the operation, and his is one of the two successful cases. The patient was a poor girl, seventeen years of age, and the enlarged spleen weighed one-fifteenth of her entire bodily weight.

— Malignant pustule is fortunately of very rare occurrence. A patient suffering from this disease has recently died in Guy's Hospital, London. He was employed on a wharf, in the handling of foreign hides, and undoubtedly contracted the disease from the hide of an animal which had been affected with the disease known by the French as charbon, by the Germans as milzbrand, but by English-speaking people as anthrax. The patient noticed a pimple on the back of his neck, which in twenty-four hours became greatly enlarged, and the glands of the neck were swollen. The surgeons removed the enlarged pimple at once, but without avail, the man dying in about four days from the time he first noticed the pimple. This disease may also be contracted by the bite of an insect, a fly for instance, which has been feeding upon the carcass of an infected animal. The microbe of the disease is a bacillus (Bacillus anthracis), and was observed in the blood of cattle as long ago as 1849 by Pollender, although its importance was first recognized by Davaine in 1850.

— The evidence of the greater safety of ether than chloroform as an anaesthetic is accumulating very rapidly. In England during 1885 there were twelve deaths attributable to chloroform, and but three to ether.

— Physicians are now using aniline-oil as a local anaesthetic when simple operations, such as the opening of a felon, are to be performed. The finger, in such a case, is dipped for a short time in the oil, and, although the flesh may subsequently be cut to the bone, it is said there is absolutely no pain.

— We learn from the *Sidereal messenger* for July that the contract for mounting the 36-inch objective has been awarded by the Lick trustees to Warner and Swasey of Cleveland, O., for $42,000. The telescope is to be fifty-seven feet long; the diameter of the tube, forty-two inches. Provisions are made by which it will be possible for the observer at the eye-end of the telescope to command all the possible motions, and these same motions can also be controlled by an observer stationed on a small balcony twenty feet above the floor. It is expected that the mounting will be completed in April, 1887, and that the glass will be brought to Mount Hamilton and put in place some time during the summer following. The total cost of the equatorial and dome will be about $164,850; the cost of the dome being $56,850; the mounting, $42,000; the visual objective, $53,000; the additional photographic lens, $13,000.

— Mr. H. C. Wilson, assistant astronomer at the Cincinnati observatory, has accepted a position as computer under the Transit of Venus commission in Washington.

— The 'Atlantic pilot chart' for July calls attention to the necessity for the establishment of a simple international code, by means of which passing ships can indicate readily and exactly the points where they have encountered ice. Many systems have been proposed, but that copyrighted by Mr. F. Wyneken of New York seems to be the best yet offered, and has been adopted by many transatlantic steamer companies according to the chart.

— MM. Regnard and Loye recently made some investigations of interest on the body of a criminal who died under the guillotine. For physiological research the authorities arranged that possession should be given instantly after the execution. Immediately after the decapitation a temporary rigor of the whole muscular system took place. In lifting the body by the heels the whole frame was moved, and remained absolutely rigid and inflexible. Even the eyelids could hardly be forced open. Not a tremor of any sort was discernible. This state lasted between two and three minutes. At three minutes from decapitation voluntary reflex action had completely disappeared. Irritation of the soles of the feet, of the conjunctiva, of the spinal marrow, produced no effect. Only the pupils contracted slightly before a bright light. The first experiment was to determine the action of the pneumogastric nerve on pulmonary contractility. The investigations of Williams and Paul Bert have shown that in the dog the circular muscular fibres surrounding the bronchia are innervated from the vagus. But in the dog the pneumogastric is so intimately connected with the sympathetic, that it is difficult to determine to which of these nerves the action of the muscles of the lung should be ascribed. In man they are separated. In the present case the result of the experiment showed clearly that the action of the pneumogastric determined the contraction of the lung by the contraction of the circular fibres.

Forty-five minutes after decapitation the intestines were perfectly free from motion, and the access of air to the abdominal cavity did not excite it. On excitation of the two vagus nerves, movement of the stomach and intestines was very evident, extending as far as the transverse colon. Longet had supposed that this action of the stomach took place only when it was filled, but in the present case it was entirely empty. On re-excitation, the walls of the stomach folded in plications, and drops of gastric fluid were visible over almost the whole of its surface. The heart beat at the rate of fifty-one pulsations per minute twelve minutes after execution: it ceased entirely at the end of the twentieth minute. These experiments bring nothing unexpected, but they give final confirmation to theories hitherto based only on vivisection of animals, and extended to man by hypothesis. They may also re-assure those physiologists who have feared that conscious life might exist after decapitation by the guillotine.

— The utilization of scrap tin has exercised the minds of many inventors who have seen a fortune in it, if they could only separate the covering metal from the sheet of iron beneath it. It is estimated, says *Engineering*, that the supply of old and scrap tin at London, Birmingham, Swansea, Wolverhampton, Truro, Liverpool, and Glasgow, amounts to 30,000 tons per year, and that this can be obtained at 5s. per ton, or less. Of this weight, five per cent is pure tin, which, in ingot form, is worth £95 to £100 per ton; while the iron, separated from the tin, is worth about 40s. per ton. Hence 20 tons of scrap, which can be bought for £5, would realize, when the two metals are separated, at least £130, a sum which allows a very good margin to cover the cost of the manufacturing operations. A company, called the Electro metal extracting, refining, and plating company, of 76 Finsbury Pavement, E.C., has been formed to carry out a new process by which the tin is stripped from the iron in a perfectly pure form, while the foundation plate is unattacked. The scrap is placed in a series of baths, through which a current from a dynamo is sent; and while there the white metal is dissolved, and is afterwards recovered in metallic state. It is said that the operations are so inexpensive that a profit of £79 is realized from the treatment of every 20 tons of scrap. The process is also set forth as being applicable to mining refuse, tailings, and slags containing gold, silver, copper, tin, etc., as well as to plating metals with zinc.

— All of the original coast survey plain table sheets of the water-front of New York, Brooklyn, and Jersey City, have been published by photo-lithography on the full scale of the surveys, and are now ready for use. A chart has been prepared, and is now ready for publication, which will fill a long-felt want by supplying in one sheet all of the waters of Washington Territory north of Gray's Harbor. This chart covers the coast from Tacoma to Nanimo.

— Professor Baird and the usual complement of officials composing the summer force of the fish commission left Washington on Tuesday last, July 6, for Wood's Holl, Mass., to be absent till October.

— The second number of the *Political science quarterly*, edited by the faculty of political science of Columbia college, contains the following articles: Andrew Jackson, by Anson D. Morse; The Constitution in civil war, by William A. Dunning, Ph.D.; Ambiguous citizenship, by Hon. William L. Scruggs; The Christian socialist, by Edwin R. A. Seligman, Ph.D.; The legal tender question, by Harry Harmon Neill; Constitutional crisis in Norway, by Prof. John W. Burgess; The conflict in Egypt, I., by John Eliot Bowen, Ph.D.

— The passage of the Suez Canal, which until recently occupied from thirty-six to forty-eight hours, can be made, now that navigation during the night is possible, in sixteen hours for vessels fitted with the electric light apparatus. This important advance is the result of a very interesting report by Commander Hector, of the steamer Carthage, belonging to the Peninsular and oriental company, and addressed to the directors. This report was written after the Carthage made the first continuous passage, under the authorization of the Canal company, given the 1st of December, 1885. The Carthage arrived at Suez after a run from Port Said of eighteen hours. The actual running time was sixteen hours. there having been two delays caused by impediments in the channel: the mean speed made was 5.43 miles per hour. The passage as far as Ismailia was the most interesting, because it was the first attempt to take a large vessel through at night, with the aid of the electric light.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The new school of economists and the history of economics.

Permit me to make a correction of a misstatement, no doubt inadvertent, in Professor Ely's article in the last issue of *Science*, on the economic discussion. He says that the 'new school' of economists "were the first in America to give a proper position to Adam Smith, Ricardo, and Malthus, by the introduction of courses in the history of political economy into our colleges." And yet, at least as early as 1878, and I believe for several years before that date, Professor Dunbar gave at Harvard university an advanced course in political economy, in which a large part of the time was occupied with a careful examination of the history and development of economic doctrines. The writings of Adam Smith, Ricardo, and Malthus were naturally given especial attention. The course of which this historical study was a part has continued to be given from year to year since it was first instituted. Other institutions may also have offered courses of the same kind; but certainly in this instance the history and literature of political economy were studied before the new school had entered the field.

There is a tendency in the new school to claim for itself perhaps an undue share of credit for the advances in economic thought and economic teaching which have taken place in the last ten or fifteen years, — a tendency which seems to me to be illustrated by Professor Ely's somewhat hasty remark.

F. W. TAUSSIG.

Newport, July 4.

Sea-level and ocean-currents.

In the number of *Science* of Jan. 1, I published some notes on the great equatorial westward flow of the earth's atmosphere and its influence upon oceanic circulation. I credited to this great atmospheric current the westward movement of the surface water of the ocean beneath it, and considered the friction of the winds as the most important factor in the whole system of oceanic circulation. In an interesting letter published in *Science* of Jan. 22, on sea-level and ocean-currents, Mr. William Ferrel states that the theory which attributes the movement of ocean-currents to the friction of the winds is untenable, saying, among other things, "that it is well known that ordinary winds have very little effect in changing sea-level except in very shallow water." He fortifies this assertion by quoting, from the report of the chief of engineers, observations which seem to show that the mean level of the water at either end of Lake Ontario varies but one-third of an inch with changes of wind; that the sea level is precisely the same on both sides of the Isthmus of Darien; and that the sea-level on the coast of Ireland is the same in summer and winter, though the more violent westerly winds of winter should raise that level if winds were capable of moving and heaping up water on a coast.

Though fully appreciating the accuracy and value of Mr. Ferrel's work, and differing from so high authority with extreme reluctance, I deem it but justice to myself to say that the question is by no means so simple as he represents it, and that there are many facts which prove, beyond all argument, the power of wind to move great masses of water, and to produce all the phenomena of oceanic circulation. For example: for ten years I occupied in summer a country house on an island in Lake Erie, and I have more than once known a strong westerly wind to depress the level of the water in the west end of the lake, and raise it at Buffalo by two feet or more. This means the actual transfer, within a few hours, of a sheet of water of half the area of Lake Erie, and one foot in thickness, from the western to the eastern portion of the lake.

I was once detained at Indianola, Tex., three days by a norther, which blew the water off the coast till the harbor was almost dry land.

Again: since this discussion began, violent southeasterly gales have forced the ocean water into New York harbor, and raised the water-level six feet or more, inundating much of the lower portion of the city, and causing great destruction of property. As this rise was general along the coast, and was felt as sensibly at Sandy Hook as at the Battery, it is evident that we here have proof that wind is capable of moving vast bodies of water before it, even where the depth is considerable.

All the facts cited by Mr. Ferrel in support of his statement are of equivocal bearing on this question. The sea-level on the isthmus is still under discussion, and, if it shall be proved to be the same on both sides, that fact would be as difficult of explanation on the gravitation as the wind theory.

Capt. John Brown of Put-in-Bay Island reports to me that "a strong westerly wind sometimes depresses the water-level at Put-in-Bay four feet below the normal." And Mr. Julius Pohlman of Buffalo writes me as follows: "I learn from the records of the signal office here that the heaviest south-west storms on record raised the waters at this end of the lake between eight and nine feet above the ordinary level.

It is true that more violent winds are encountered on the Atlantic in winter than in summer, but almost none of these are continuous across the ocean. All the cyclones are rotary, and the storms not such are local and temporary. A change or reversal of direction of the wind would soon neutralize its effect, and in winter the antagonistic easterly winds are correspondingly violent on the European coast. On the whole, it is doubtful whether the sum of the impulses of the westerly wind is much greater in winter than in summer.

Since the atmosphere presses on the ocean with a weight of nearly fifteen pounds to the square inch, it is evident that when the air is moved the friction must be great. This is demonstrated by the rapid raising of ridges of water before a strong wind; and these ridges are all waves of translation. Waves of oscillation occur, but they are rare; and the apparatus so frequently employed for illustrating wave-motion by vertical rods successively lifted is misleading.

Mr. Ferrel says, in conclusion, "A continuous wind for some time in any direction causes merely surface currents of considerable velocity;" but it requires no argument to show that such surface currents, if continuous, would infallibly produce a movement of the deeper strata of water in the same direction.

The time estimated by Zöppritz for the transmission of surface motion to the depth of a hundred metres seems to me grossly exaggerated: but even if ten times longer than his estimates, the great equatorial wind, which has doubtless been blowing from east to west since the ocean has had an existence, would be amply sufficient to establish a movement that would form a *primum mobile* for the whole system of oceanic circulation.

That gravitation is a factor in oceanic circulation is proven by the presence of ice-cold water in the abysses of the ocean under the equator, — water that must have flowed in from the polar regions, — but it has seemed to me, and to many others whose opinions are worth more than mine, that it is a much less important factor than wind-friction. Those interested in the subject will do well to read the chapters on ocean-currents in Croll's 'Climate and time,' and the papers by Croll and Carpenter in the London and Edinburgh *Philosophical journal*, and the Proceedings of the Royal society.

J. S. NEWBERRY.

Columbia college, July 1.

Private research and government science.

Since the promulgation and discussion of the bill to curtail the work of the scientific bureaus at Washington, and Mr. Herbert's appeal "to the best literary and scientific thought of the country to come to our aid and join us in the effort to effect a reform and arrest this pernicious tendency," much has been written and said upon this subject.

One of the chief arguments brought to bear by those opposed to the extraordinary scientific progress being made, and the vast amount of scientific work being done by this country at the seat of its government, is, that this work is proving detrimental to private research in similar channels.

Further, it has been said by the opposition that these scientific publications of the U. S. geological survey are valueless in the book-markets of the world; and Mr. Herbert points to that law in the organization of the survey which specifies that it shall sell all its publications not exchanged at cost, and that during the past six years this sale has realized an amount but slightly exceeding fifteen hundred dollars.

Now, one of the best proofs that this scientific activity on the part of the government is in no way checking private research, has been recently brought forward by Professor Agassiz, who laid before this commission of investigation the titles of forty-eight publications of the Museum of comparative zoölogy at Cambridge, alone.

But perhaps a still better light is thrown upon these two latter questions by an unprejudiced examination of such a catalogue as is published by Dulau & Co. of 37 Soho Square, London. Here we find five of Mr. O. G. Elliot's zoölogical monographs on sale for five hundred and forty-five dollars, and other evidences of the very highest activity in private research in America on every page. Moreover, to prove that the government publications of this country are not held as being valueless in the book markets of the world, we see any number of the publications of the geological survey, and other scientific bureaus of Washington, on sale in the above catalogue, and being sold at prices fully equalling those of private pulications. That more money has not been realized at the survey for the sale of its works, simply speaks in favor of how eagerly they are sought in exchange, leaving but a few copies each year on hand for sale.

The excellent handbooks of geology of this country by Dana and LeConte do not seem to have been suppressed by government interest in this highly important work; and if we run our eyes over the bibliography and illustrations of this science, as set forth in these two volumes, I defy any one to say that the government work is not appreciated, or that private researches in this field are checked. The same holds good for all the other sciences.

I think when the sense of the vote of the "best literary and scientific thought of this country" is taken upon Mr. Herbert's appeal to suppress such works as the paleontological monographs of Marsh, Ward, White, and others, and the magnificent publications in the bibliography of science undertaken and accurately carried through by our government, there will be an enormous zero on his side of the ticket. Government moneys can be squandered on far worse things in the times of peace, than such schemes as powerfully aid the progress of knowledge, culture, science, and learning. Be it said to the credit of this country that she sees fit to invest her surplus means to the advancement of such ends.

R. W. SHUFELDT.

Fort Wingate, N. Mex., June 29.

Expulsion theory of comets.

Mr. Proctor's article in a recent number of the *Nineteenth century*, on the expulsion theory of comets, leads one to believe that the solution of this problem is not only as far off as ever, but that little headway is being made for a general clearing-up of the 'mystery.' There are many serious objections to this particular theory of the origin of comets. We admit, of course, that the earth and Mars, for instance, or even the moon, may have been at one time scenes of vast fiery eruptions, etc. But that this cast-off matter should go out into space in a burning state, and continue to go out, probably, for a great number of years, then return, still in a burning state (the alleged comet),—while the body from which it was expelled, and a much greater size as a matter of course, always remaining in close proximity to the sun, and drawing closer all the time, should cool down and become solid and non-luminous, such as the earth, Mars, or the moon is at the present time,—is certainly something on which Mr. Proctor's theory throws little light. The expelled matter must naturally cool down the same as the body from which it was expelled, and except by accident, considering the distance it would have to travel to meet another source of heat (a sun), we can only come to one conclusion in regard to the expulsion theory, it won't do.

G.

Brooklyn, June 29.

Flooding the Sahara.

Mr. G. W. Plympton's very interesting and suggestive article on the flooding of the Sahara (*Science*, vol. vii. pp. 542–544) induced me to make some numerical estimates, based upon the data furnished by him, which may be of some interest to readers of *Science*. He shows that "the area, which, lying below the Mediterranean, can possibly be flooded by it" (the united areas of the depressed portions), is, by M. Roudaire's measurements, about 3,100 square miles; and the average depth, if flooded, would be 78 feet. Now, assuming the area of the cross-section of the water of the Inlet Canal to be 2,000 square feet, and the average velocity of the inflowing water during the whole time of flooding to be 2 feet per second (not a low estimate), it follows that the average inflow would be 4,000 cubic feet per second $= 3,456 \times 10^5$ cubic feet per day $= 1,262,277 \times 10^5$ cubic feet per year.

Again: 3,100 square miles $= 864,230 \times 10^5$ square feet; and, the average depth being 78 feet, the amount of water required to flood it to this depth $= 67,409,971 \times 10^5$ cubic feet. Consequently such a canal would require 53.4 years to flood the comparatively small and shallow Saharian lake, under the assumption that during the inflow no water was lost by evaporation or by absorption into the porous bed.

In such an arid and hot climate, evaporation alone would probably prolong the time of flooding for hundreds of years: indeed, the time might be prolonged indefinitely, for the loss by evaporation might ultimately be equal to the supply by inflow. We have a case in point in Pyramid Lake, in Nevada, into which the bold and rapid outlet of Lake Tahoe (Truckee River) perpetually flows without flooding it. Of course, by increasing the dimensions of the Inlet Canal, or augmenting the velocity of the inflowing water, the computed time of flooding might be proportionately shortened; but, after all, the feeble efforts of man are insignificant in relation to the great hydraulic systems of nature.

John LeConte.

Berkeley, Cal., June 29.

A dissolving smoke-ring.

The remarkable breaking-up of a smoke-ring from a locomotive in Chicago was observed by me, a few days since, in company with a mechanical engineer of New York, whose estimate of size and height I adopt. The ring rose to an elevation of about one hundred and fifty feet, and attained a diameter of twenty or twenty-five feet, as nearly as could be estimated. It broke up suddenly with a rush of the smoke *along the line of the ring* toward two centres; namely, the smoke of the south half coming together in the centre of that half of the line, and the smoke of the north half correspondingly to a centre in the north. After these momentary and confused aggregations, all semblance of form disappeared. A vortex ring is different from the theoretic planetary ring breaking up into satellites, but aggregation of the dissolving smoke-ring is suggestive.

H. W. Parker.

Grinnell, Io.

Surface tension and muscular contraction.

I would offer as an attempt to explain the nature of muscular contraction the hypothesis that the contraction is due to the phenomena of surface tension.

By surface tension of a liquid is meant a peculiarity presented by its surface, due to a difference in state between the molecules in the surface and those in the interior of the liquid. That there must be an essential difference between the surface of a mass and its interior follows from the fact that the molecular forces acting on any particle within the mass are equal in every direction, and so must balance one another; while the particles in the surface film, having no particles above them, are acted on only from below and at the sides, and so are constantly drawn down against the mass: so that the liquid must be under a definite surface tension.

This surface film behaves as a perfectly elastic membrane stretched in every direction by equal tensions, and takes the form of smallest area consistent with the conditions. This tendency of the film to become as small as possible is well illustrated by the soap-bubble, which may be considered as a layer of water with two surface films. So, when left to its own molecular forces, a drop of liquid assumes that form having the smallest superficies, with a given content, which is the sphere.

When a drop of liquid rests upon a surface which it does not wet, it assumes the form of a sphere more or less flattened out; and the greater the surface tension of the liquid forming the drop is, the more nearly does it approach the spherical form, and whatever alters its surface tension causes a corresponding alteration in the form of the drop.

Many substances, even in small quantity, exert a considerable influence on the surface tension of liquids.

If a drop of water resting upon a greasy surface, which it does not wet, be touched with a little alcohol, its surface tension is diminished, and it immediately spreads out over a larger area; but, when the alcohol evaporates, the surface tension of the water is increased, and it again contracts into a more globular form.

Remarkable changes in form are caused when a globule of mercury is electrically polarized. In organic substances the surface tension increases with the increase of certain elements entering into their composition, and diminishes with the increase or diminution of others; e.g., in butyric acid and acetic anhydride the increase of oxygen and diminution of hydrogen increase the surface tension.

Now, to see the bearing of this upon the contraction of a muscular fibre, it is necessary to remember that the surface tension of a liquid may be changed by a change in its composition, that the contracting elements of a muscular fibre are the cells, and that the composition of the cells is changed at the time of a contraction.

The cells are of an oblong shape extended in the axis of contraction; and when contraction occurs the cells grow shorter and thicker, just as an oblong drop of water grows shorter and thicker when its surface tension is increased.

Now, a tendency to contraction must follow an increase in the surface tension of the cell; and that there probably are changes in the surface tension of the cell during contraction, follows from the fact that there are chemical changes in the cell, more rapid during contraction than rest. The changes occurring in acting muscle may be identical with those in resting muscle; but in resting muscle, restoration keeps pace with destruction, while in contraction, destruction largely exceeds restoration: so any thing hastening the decompositions within the cell may cause contraction.

Exhaustion is explained by the accumulation of products of decomposition, since fatigue in muscles in which circulation has ceased may be readily removed by renewing the current of blood.

This hypothesis may be thus summed up: the active shortening of the fibre is due to an increase in the surface tension of the substance of the cell, caused by an increase in the proportional amount of the products of decomposition. Equilibrium is restored — after the stimulus which hastened the chemical changes has ceased — by a part of the products of decomposition finding their way into the blood-current, and possibly by the remaining products helping to build up the original compound.

Elmer Starr, M.D.

Buffalo, N.Y., June 25.

Trenton natural history society.

So far as my own communications to the Trenton natural history society are concerned, the report thereof in *Science* (viii. No. 178) is a wilful misstatement. As what I did state will soon be published, it is unnecessary to enter into explanations.

Chas. C. Abbott, M.D.

Trenton, N.J., July 2.

SCIENCE.—SUPPLEMENT.

FRIDAY, JULY 9, 1886.

THOUGHTS ON UNIVERSITIES.[1]

No one can visit Cambridge this summer withıt remembering that two hundred and fifty years ;o an acorn was here planted from which an oak ıs grown. No scholar can come from a distant ıte without wishing to offer his tribute, however adequate it may be, to the wisdom which has ›verned the counsels of Harvard through eight ›nerations. A graduate of Yale will, I trust, be ›rdoned for associating the name of his own *alma ıter* with that of her elder sister. Their united fluence has not only been strong in New Engıd, but strong in other portions of the land. It difficult to surmise what would have been the ndition of American society if these foundations ıd never existed. Their graduates have proɔted the literature, the science, the statesmanip, and the religion of the land; but more than is is true. Their methods of instruction, their ıwritten laws, their high endeavors, and their ademic spirit have re-appeared in each new state the west, as each new state has initiated its cial order. To be governed by the experience Harvard and Yale is in many an educaɔnal court an appeal to common law. To tablish another Harvard or another Yale, to ırture the germ from which a great university ight grow, has been the aspiration of many a triot, of many a Christian. It was a laureate both Harvard and Yale, the sagacious Manash Cutler, who initiated the policy of securing the states beyond the Alleghanies a certain ›rtion of the public lands for the foundation of ıiversities. Among the pioneers of California ıs one who went from New England 'with colge on the brain;' and now every ship which ters the Golden Gate faces the buildings of a ıiversity which Henry Durant did much to tablish.

The history of higher education as guided by the ›o oldest foundations in this country may be conlered in four periods: in the first, extending ɔm the earliest settlement until the revolution, e English college idea was dominant in its simest form; the second, following the severance of legiance to the crown, was the time when professional schools in medicine, law, and theology were begun; the third, beginning about the middle of this century, was marked by the formation of scientific schools; and in the present period we are looking for the fulfilment of the university ideal, brought hither by the earliest immigrants from England.

The colonial vocabulary was modest. Whatever else it might be, 'university' seemed a very great noun, to be used as guardedly as 'episcopacy' or 'sovereignty.' In the earliest mention I remember of the cradle of Harvard, the alternative is found, 'a school or colledge;' and in Connecticut, 'collegiate school' was in vogue for seventeen years. "We on purpose gave your academy as low a name as we could that it might the better stand in wind and weather," said the well-known civilians who were consulted in 1701 by Pierpont and his colleagues at the mouth of the Quinnipiac. Elsewhere, under other influences, there was not the same caution, nor the same success. Several years before the settlement of Massachusetts Bay, the Virginia company determined to set apart, at Henrico, ten thousand acres of land for 'a university,' including one thousand for a college 'for the children of the infidels.' There was another project for a university as early as 1624, which has lately been brought to light. Dr. E. D. Neill, in 'Virginia Vetusta,' calls attention to the fact that an island in the Susquehanna, which the traveller may see to the north as he crosses the railroad-bridge at Havre de Grace, was conditionally given for "the foundinge and maintenance of a universitie and such schools in Virginia as shall there be erected and shall be called *Academia Virginiensis et Oxoniensis.*" The death of the projector, Edward Palmer, interrupted his plans.

Mr. Dexter has established the fact, that, before 1647, nearly a hundred graduates of English universities had migrated to New England, three-fourths of whom were from Cambridge; and the elaborate volumes of Mullinger exhibit in great fulness the conditions of collegiate and university life as they were known to these Cambridge wanderers in the earliest half of the seventeenth century. It is evident that the university idea was then subordinate to the collegiate; logic was riding a high horse; science and literature, as then represented by mathematics and Greek, were alike undervalued. An anecdote recorded by Mullinger reveals at a glance the situation. "Seth Ward,

[1] An address before the Phi Beta Kappa society of ırvard college, July 1, 1886, by Daniel C. Gilman, president of the Johns Hopkins university.

having lighted on some mathematical works in the library of Sidney, could find no one to interpret them. The books, says his biographer, were Greek, — I mean unintelligible to all the fellows." The spirit of observation, experiment, and research, was rarely apparent; discipline by masters and tutors took precedence of the inspiration of professors. When we consider this origin, still more when we recall the poverty of the colonists, and still more when we think of the comprehensiveness of the university ideal, even in the seventeenth century, it is not strange, that, before the revolution, American colleges were colleges, and nothing more. Even degrees were only conferred in the faculty of arts. In 1774, when Governor Hutchison was discussing colonial affairs in Lord Dartmouth's office, Mr. Pownall asked if Harvard was a university, and, if not, on what pretence it conferred degrees. Hutchison replied "that they had given Masters' and Bachelors' degrees from the beginning; and that two or three years ago, out of respect to a venerable old gentleman they gave him a doctor's degree, and that the next year, or next but one, two or three more were made Doctors. . . . After so long usage he thought it would be hard to disturb the college."

It is a significant fact that at the beginning of the revolution, in 1776, George Washington was made a doctor of laws at Harvard, and, at its close in 1783, John Warren, a doctor of medicine. From that time on, there was no hesitation in the bestowal of degrees in other faculties than that of arts.

I need not rehearse the steps by which the schools of medicine, law, and theology were added to the college; cautiously, indeed (as outside departments, which must not be allowed to draw their support from the parent trunk), and yet permanently. It is a noteworthy fact that the example of Harvard and Yale in establishing theological schools has rarely been followed in other places, even where schools of law, medicine, and science have been established. It is enough to add that professional education was organized during the first thirty or forty years of this century, in a much less orderly way than that in which the colleges were instituted.

The third period in the development of higher education was the recognition of the fact, that, besides the three traditional professions, a multitude of modern vocations required a liberal training. In consequence of this, came scientific schools, often, at first, adjacent to the classical colleges, and sometimes on independent foundations, many of these schools being aided by the national provision for technical instruction and by other noteworthy gifts.

We are now fairly entered upon the fourth period, when more attention than ever before will certainly be given to the idea of the university, — an idea long dormant but never dead. The second decennium of this century was but just begun, when a university was chartered in Maryland; and before it closed, the first of the western universities, endowed by a gift of the public lands, was organized in the county and town of Athens, O., precursor of the prosperous foundation in Michigan, and of like institutions in other parts of the old north-western territory. Early in this century, Americans had frequently gone abroad for medical and scientific training, but between 1820 and 1830 many turned their eyes to Germany for historical and philological study; and the line which began with Everett, Ticknor, Bancroft, and Woolsey, has been unbroken to this day. Through these returning wanderers, and through the importation from Germany, England, and Switzerland, of foreigners distinguished as professors, — Lieber and Beck, Sylvester and Long, Agassiz and Guyot, and their compeers, — the notion of a philosophical department of a university, superior to a college, independent of and to some extent introductory to professional schools, has become familiar. But the boldest innovation, and the most influential, was the work of one whose name is perpetually associated with the Declaration of Independence and the University of Virginia. It was in 1826 that his plans assumed form, and introduced to the people of this country — not without some opposition — the free methods of continental universities, and especially of the University of France.

Thus, as years have rolled on, the word 'university,' at first employed with caution, has been reiterated in so many connections, that it has lost its distinctive significance, and a special plea must be made for the restoration to its true sovereignty, of the noblest term in the vocabulary of education. Notions injurious and erroneous are already abroad. Poor and feeble schools, sometimes intended for the destitute, beg support on the ground that they are universities. The name has been given to a school of arts and trades, to a school of modern languages, and to a school in which only primary studies are taught. Not only so, but many graduates of old and conservative institutions, if we may judge from recent writings, are at sea. There are those who think that a university can be made by so christening it; others who suppose that the gift of a million is the only requisite; it is often said that the establishment of four faculties constitutes a university; there is a current notion that a college without a religion is a university, and another that a college without a curriculum is a university. I have even read in the newspapers the description of a building which "will be, when finished, the finest university in the country;" and I know of a school for girls, the trustees of which not only have the power to confer all degrees, but may designate a board of lady managers possessing the same powers.

Surely it is time for the scholars of the country to take their bearings. In Cambridge the anniversary so soon to be celebrated will not be allowed to pass without munificent contributions for most noble ends; the president of Yale college, who this day assumes his high office with the unanimous plaudits of Yalensians, is the representative of the university idea based upon academic traditions; the voice of Princeton, like a herald, has proclaimed its purposes; Cornell has succeeded in a litigation which establishes its right to a large endowment; the secretary of the interior has commended to congress the importance of a national university, and a bill has been introduced looking towards such an establishment; the Roman Catholic Church, at its recent council in Baltimore, initiated measures for a university in the capital of the nation; while on the remotest borders of the land the gift of many millions is assured for promoting a new foundation. Already, in the Mississippi valley, men are laboriously unfolding their lofty ideals. It is therefore a critical time. Wise plans will be like good seed: they will spring up, and bear fruit a hundred-fold. Bad plans will be like tares growing up with the wheat, impossible to eradicate.

It is obvious that the modes of organization will vary, so that we shall have many different types of universities. Four types have already appeared, — those which proceed from the original historic colleges, those established in the name of the state, those avowedly ecclesiastical, and those which are founded by private benefactions. Each mode of organization has advantages which may be defended, each its limitations. If the older colleges suffer from traditions, the younger lack experience and historic growth. The state universities are liable to political mismanagement: ecclesiastical foundations are in danger of being narrow.

Under these circumstances, I ask you to consider the characteristics of a university, the marks by which it should be distinguished.

It is needless before this audience to repeat the numerous definitions which have been framed, or to rehearse the brilliant projects which have been formed by learned, gifted men; but I hope it will not be amiss to recall some of the noble aims which have always inspired endeavors to establish the highest institutions of learning.

Among the brightest signs of a vigorous university, is zeal for the advancement of learning. Another phrase has been lately used, the 'endowment of research.' I prefer the other term; for it takes us back to the dawn of modern science, and connects our efforts with those of three hundred years ago, when Francis Bacon gave an impulse to all subsequent thought, and published what his recent biographer has called the first great book in English prose of secular interest, — "the first of a long line of books which have attempted to teach English readers how to think of knowledge, to make it really and intelligently the interest, not of the school or the study or the laboratory only, but of society at large. It was a book with a purpose, new then, but of which we have seen the fulfilment."

The processes by which we gain acquaintance with the world are very slow. The detection of another asteroid, the calculation of a new orbit, the measurement of a lofty peak, the discovery of a bird, a fish, an insect, a flower, hitherto 'unknown to science,' would be but trifles if each new fact remained apart from other facts; but, when among learned men discoveries are brought into relations with familiar truths, the group suggests a law, the law an inference, the inference an experiment, the experiment a conclusion; and so from fact to law, and from law to fact, with rhythmic movement, knowledge marches on, while eager hosts of practical men stand ready to apply to human life each fresh discovery. Investigation, co-ordination, and promulgation are not performed exclusively by universities; but these processes, so fruitful in good, are most efficient where large numbers of the erudite and the acute, of strong reasoners and faithful critics, are associated for mutual assistance, correction, and encouragement. It is an impressive passage with which the lamented Jevons closed his 'Principles of science.' After reminding the reader of the infinite domain of mathematical inquiry, compared with which the whole accomplishments of a Laplace or a Lagrange are as the little corner of the multiplication table, which has really an indefinite extent, he goes on to say that inconceivable advances will be made by the human intellect unless there is an unforeseen catastrophe to the species or the globe. "Since the time of Newton and Leibnitz, whole worlds of problems have been solved, which before were hardly conceived as matters of inquiry. In our own day, extended methods of mathematical reasoning, such as the system of quaternions, have been brought into existence. What intelligent man will doubt that the recondite speculations of a Cayley or a Sylvester may possibly lead to some new methods, at the simplicity and power of which a future age will wonder, and yet wonder more that to us they were so dark and difficult?"

Let me draw an illustration from another science which will be acknowledged as of transcendent importance even by those, if such sceptics there be, who have no confidence in transcendental mathematics. Cohnheim, the great pathologist of Germany, whose death occurred in 1884, declares, in the introduction to his 'General pathology,' that the study of the causes of disease is absolutely without limits, for it touches upon the most heterogeneous branches of science. Cosmical physics, meteorology and geology, not less than the social sciences, chemistry, as well as botany and zoölogy, all bring their contributions to that branch of pathology. So, with all his knowledge and ability, this leader in pathology restricted his own work to the study of disordered physiological functions. But what prevention of suffering, what sanitary alleviations, what prolongation of life, may we not anticipate in future generations, when man thoroughly understands his complex environment, and adapts himself to it?

In the accumulation of knowledge, as of other forms of wealth, saving must follow earning. So among the offices of a university we find the conservation of experience. Ignorant as the nineteenth century appears when we survey the long category of inquiries now held in abeyance by mathematicians, astronomers, physicists, chemists, and biologists, by ethnologists, philologers, historians, and publicists, let us ask how much man has advanced since the ages of stone, of iron, and of brass. Such books as Tylor's and Morgan's, such observations as those of Livingstone and Stanley, show us what man is without a history; what society is where no storage is provided for the lessons learned by successive generations, and where the wisest and best are content to pass away, leaving no sign. It is the business of universities, not only to perpetuate the records of culture, but to bring them out in modern, timely, and intelligible interpretations, so that all may know the laws of human progress, the dangers which imperil society, the conditions of advancing civilization. Experiments upon fundamental laws — such as the establishment of home rule, and the adjustment of the discord between industry and capital — may destroy or may promote the happiness of many generations. That mistakes may not be made, historical politics must be studied, and what is this but the study of the experience of mankind in endeavors to promote the social welfare? As there have been great lawgivers in the past, whose codes have been put to secular tests, so momentous experiments have run through centuries, and involved the welfare of nations, — experiments which have been recorded and interpreted, but which call for still closer study, by the wisest intellects, before their lessons are exhausted. Can such researches be made in a moment? Can they be undertaken by a knight of labor? Are the facts to be gathered in a circulating library? Or must we depend upon scholars trained to handle the apparatus of learning? Gladstone and Bryce and Morley may or may not be right in all the subordinate features of the measures which they are advocating; but their influence at this very moment is resting on the fulcrum of historic knowledge, the value of local self-government. Hamilton, Jefferson, Madison, and Marshall were far from being 'inspired' when they initiated the constitutional measures by which the United States are governed; and there is abundant evidence to show that they were students of the past experience of mankind in confederated politics. The compact of the Mayflower was reduced to writing within the sheltering arm of Cape Cod; but its ideas are those of men who knew the laws of Moses and Solomon, and who had seen in Holland, as well as in England, what favors and what hinders the development of civil and religious liberty. Within the shadow of the University of Leyden, a stone marks the spot where John Robinson lived, taught, and died; and the name of Elder Brewster of the Mayflower has been recently discovered among the matriculates of Peterhouse, Cambridge. In our day the pioneers of 1849 carried with them to the remotest shores of the continent ideas which soon took the form of laws, customs, colleges, schools, churches, hospitals, unknown under the Mexican sway; but they had learned these ideas in the historic schools of the Atlantic seaboard.

The universities are the natural conservators of educational experience, and should be recognized as the guides of public education. In a better state of society, means will be found to make the men of learning in a given generation responsible for the systems of primary teaching; giving potency to their counsel not only at the end but in every stage of scholastic life. Upon text-books, courses of study, methods of discipline, the qualifications of teachers, the value of rewards, honors, and examinations, the voice of the universities should be heard. The confusion and uncertainty which now prevail are indications that in schools of the lowest as of the highest grades, re-adjustments are needed which can only be wisely directed by those whose learning embraces the experience of many generations. The wisest are none too wise in pedagogics, but they are better counsellors than the ignorant.

Dr. Lieber, in a letter to Secretary Seward, at the close of the civil war, presented a strong plea for the reference of international disputes to universities. Reminding the secretary that their authority had been invoked upon internal controversies in France and Germany, he asked, Why not refer to them in international affairs? The law faculty of a renowned university in a minor state would seem, he says, "almost made for this high function, and its selection as a court of international arbitration would be a measure worthy of England and the United States;" and he risks the prophecy that "the cis-Caucasian race will rise at no very distant day to the selection of such umpires, far more dignified than a crowned arbitrator can be."

Among the offices of a university, there is one too often undervalued, or perhaps forgotten, — the discovery and development of unusual talent. I do not speak of genius, which takes care of itself. Nobody can tell how it comes to pass that men of extraordinary minds are born of commonplace parentage, and bred in schools of adversity, away from books and masters. Institutions are not essential to their education. But every one who observes in a series of years the advancement of men of talents, as distinguished from men of genius, must believe that the fostering diet of a university — 'its plain living and high thinking' — favors the growth of scholars, investigators, reasoners, orators, statesmen of enduring reputation, poets, and discoverers. Such men are rarely produced in the freedom of the wilderness, in the publicity of travel and of trade, or in the seclusion of private life; they are not the natural product of libraries and museums, when these stand apart from universities; they are rarely produced by schools of a lower grade. Exceptions are familiar; but the history of civilization declares that promising youth should have the most favorable opportunities for intercourse with other minds, living as well as dead, comrades as well as teachers, governors as well as friends. It declares that in most cases talents will seize opportunity, and opportunity will help talents. Just now, in our own country, there is special reason for affirming that talents should be encouraged without respect to property. Indeed, it is quite probable that the rich need the stimulus of academic honors more than the poor: certainly the good of society requires that intellectual power, wherever detected, should be encouraged to exercise its highest functions.

Cardinal Newman (in a page which refers to Sir Isaac Newton's perception of truths, mathematical and physical, though proof was absent; and to Professor Sylvester's discovery, a century and a half later, of the proof of Newton's rule for ascertaining the imaginary roots of equations) says that a parallel gift is the intuitive perception of character possessed by certain men; as there are physicians who excel in diagnosis, and lawyers in the detection of crime.

Maurice, the greatest theologian of our day, was so strong an advocate of university education, that he suggests a sort of *quo warranto* forcing "those who are destined by their birth or property to any thing above the middle station in society, and intended to live in England, . . . to show cause why they do not put themselves in the best position for becoming what Coleridge calls the 'clerisy' of the land."

Devotion to literature will always distinguish a complete university. Within the academic walls you may always find the lover of humanities; here in perpetual residence, those who know the Athenian dramatists, the Augustan poets, the mediaeval epic writers, Chaucer and Shakspeare, and the leaders in literature of every name and tongue. In the class-rooms of the university, successive generations of youth should be presented to these illustrious men. The secrets of their excellence should be pointed out; the delights of literary enjoyment should be set forth; the possibilities of production in our day should be indicated; and, withal, the principles of criticism should be inculcated, as remote from sarcasm and fault-finding on the one hand, as from prostrate adoration and overwrought sympathy on the other.

It is common in these days to lament that the taste of the public, as indicated by the remorseless self-recording apparatus of the public libraries and the glaring indications of the book-stalls, is depraved; but it is well to remember that many counteracting influences are vigorous. Never was Shakspeare read and studied as he is to-day; never was Chaucer so familiar to the youth at school; never was the Bible so widely read; never were such translations accessible as are now within reach of all. In all this, the power of the universities is felt: give them the credit. But let us hope that in the future more attention than ever before will be given to the study of literature and art. Fortunate would it be if in every seat of learning such a living teacher could be found as a Wordsworth, a Tennyson, a Browning, or a Lowell.

Among the characteristics of a university, I name the defence of ideality, the maintenance of spiritualism. There are those in every generation who fear that inquiry is hostile to religion. Although universities are the children of the Christian church, although for a long period the papal sanction was desirable if not essential to their establishment, although the earliest colleges in this country were strictly religious, and although almost every denomination in the land desires its own university, there is an undercurrent of talk which shows that the influence of the higher education is often regarded in certain circles as adverse to spiritual and religious life. If this were so, many would prefer to see the academic walls fall down in a night, and the treasures of the ages reduced to smoke and ashes. But fortunately, indeed, there is no such danger. Alarmists are cowards. That piety is infantile which apprehends that knowledge is fatal to reverence, devotion, righteousness, and faith. As the most recent utterances of science point more and more steadily to the plan of a great designer, as the studies of psychology and of history confirm the doctrine, at least as old as Solomon, that righteousness exalteth a nation, so we may affirm that the two essentials of Christianity, on which hang all the law and the prophets, — the love of God and the love of our neighbor,— are enforced and not weakened by the influence of universities. We may also rest assured that institutions devoted to the ascertainment of truth as the ultimate object of intellectual exertion, and to the promulgation of truth as an imperative moral obligation, are not the harbingers of harm. Individuals will err; generations will labor under false ideas; domineering intellects will dazzle for a time the ordinary mind; error, like disease, must be clearly understood before the mode of correction can be formulated; but there is no better way known to man for securing intellectual and moral integrity than to encourage those habits, those methods, and those pursuits which tend to establish truth.

Near the close of his address before the University of Munich, at the celebration of its jubilee in 1872, a great theologian, Dr. Döllinger, referred to the perils of the times in words which were received with prolonged applause. "Who knows," said he, "but that for a time Germany may remain confined in that strait prison, without air and light, which we call materialism? This would be a forerunner of approaching national ruin. But this can only happen in case the universities of Germany, forgetting their traditions and yielding to a shameful lethargy, should waste their best treasures. But no, our universities will form the impregnable wall ready to stop the devastating flood."

The maintenance of a high standard of professional learning may also be named among the requisites of a university. So it is on the continent of Europe, so partially in Great Britain, so it should be everywhere. The slender means of our fathers compelled them to restrict their outlays to that which was regarded as fundamental or general education; and so it came to pass (as we have already been reminded) that professional schools were established in this country as independent foundations. Even where they are placed under the university *aegis*, they have been regarded as only children by adoption, ready enough for the funds which have been provided for academic training, but without any claims to inherit the birthright. The injury to the country from this state of things is obvious. The professional schools are everywhere in danger of being, nay, in many places they actually are, places of technical instead of liberal education. Their scholars are not encouraged to show a proficiency in those fundamental studies which the experience of the world has demanded for the first degree in arts. It is well known that many a medical school graduates young men who could not get admission to a college of repute. Ought we, then, to wonder that quackery is popular, and that it is better to own a patent medicine than a gold-mine? It was a wise and good man who said that there is no greater curse to a country than an uneducated ministry, and yet how common it is for the schools of theology in this country to be isolated from the best affiliations! Lawyers are too often trained with reference to getting on at the bar, and find themselves unprepared for the higher walks of jurisprudence and statesmanship. The members of congress and of the state legislatures annually exhibit to the world poverty of preparation for the critical duties which devolve upon them. I am far from believing that university schools of law, medicine, and theology, will settle the perplexing questions of the day, either in science, religion, or politics; but, if the experience of the world is worth any thing, it can nowhere be so effectively and easily acquired as in the faculties of a well-organized university, where each particular study is defined and illuminated by the steady light which comes from collateral pursuits, from the brilliant suggestions of learned and gifted teachers. Moreover, science has developed in modern society scores of professions, each of which requires preparation as liberal as law, medicine, or theology. The schools in which modern sciences are studied may indeed grow up far apart from the fostering care of universities; and there is some advantage doubtless, while they are in their early years, in being free from academic traditions: but schools of science are legitimate branches of a modern university, and are gradually assuming their proper relations. In a significant paragraph which has lately appeared in the newspapers, it is said, that, with the new arrangements for instruction in the University of Cambridge, Eng., its degree of engineer will be one of the most valuable which can anywhere be attained.

Finally, among the merits of a university, is the cultivation of a spirit of repose. As the distractions of modern civilization multiply, as newspaper enterprise brings to our daily vision the conflicts and transactions of mankind, as books become superabundant, and periodicals more and more indispensable, — and more and more technical, — some corrective must exist, or there will be no more enjoyment in an intellectual life than there is in making money in the turmoil of the bourse. The whirl of the nineteenth century has already affected the colleges, with detriment to that seclusion which best promotes the acquisition of knowledge. A man of great experience in public affairs has said that a great university should be at once "the best place of education, the greatest machine for research, and the most delicious retreat for learned leisure." This is doubtless the truth, but it is only a half-truth. Universities with ample resources for the support of investigators, scholars, thinkers, and philosophers, numerous enough, learned enough, and wise enough to be felt among the powers of the age, will prove the safeguards of repose, not only for those who live within their learned cloisters, but for all who come under their influence. A society of the choicest minds produced in any country, engaged in receiving and imparting knowledge, devoted to the study of nature, the noblest monuments of literature, the marvellous abstractions of mathematical reasoning, the results of historical evidence, the progress of human civilization, and the foundations of religious faith, will be at once an example of productive quietude, and an incitement to the philosophic view of life, so important to our countrymen in this day, when the miserable cry of pessimism on the one hand, and the delightful but deceitful illusions of optimism on the other hand, are in danger of leading them from the middle path, and from that reasonableness of mind which first recognizes that which is, and then has the hope and courage to strive for the better.

In what has now been said, it has been made apparent that our fathers brought with them to the western world the idea of a university as an institution superior to, though not exclusive of, a college, and that this idea, sometimes obscured by mist, has never lost its radiance. I have also called your attention to some of the functions which are embodied in the conception of a university, — the advancement of learning, the conservation of knowledge, the development of talent, the promotion of spirituality, the cultivation of literature, the elevation of professional standards, and the maintenance of repose.

I add a few suggestions of a practical character, which I hope will be approved in this seat of learning.

We should look for the liberal endowment of universities to the generosity of wealthy individuals. It is doubtful whether the national government, or the government of any state, will ever provide funds which will be adequate for the highest education. There is a growing disposition in the eastern states to restrict all provision for public instruction to schools of primary and secondary rank. Were any legislative body to appropriate a sufficient financial support, there is nothing in the tendencies of modern politics to show that the representatives of the people, as they are in these days elected, would have the wisdom to mark out the pathway of a great university. Ecclesiastical zeal is more likely to be successfully invoked. The conception of a university pervaded by a spirit of enlightened Christianity is inspiring to the mind of every believer. It seems to associate religion and science as co-workers for the good of man. It is more than probable, under this consideration, that a Catholic university will ere long be initiated; and, if it succeeds, the example may lead to a union of Protestants for a kindred object. But it would be a misfortune and an injury, as I believe, to the religious progress of the country, if each of the denominations into which the evangelical world is divided were to aim at the maintenance of a university under its own sectarian name. The endowments which are called for are too large to be made up by petty contributions. Great gifts are essential, and consequently those who in the favorable conditions of this fruitful and prosperous land have acquired large fortunes should be urged by all the considerations of far-sighted philanthropy to make generous contributions for the development of the highest institutions of learning. There is now in the golden book of our republic a noble list of such benefactors. Experience has shown no safer investments than those which have been given to learning, — none which are more permanent, none which yield a better return.

It is a common error in this country to suppose that we need many universities. Just the reverse is true: we need but few, but we need them strong. There is great danger that funds will be scattered, teachers isolated, and scholars kept away from their proper fields, by attempts, of which we have seen too many, to establish post-graduate courses with very inadequate means.

Even professional schools have been initiated where the fees of the pupils have been the only criteria of success. We should lend our influence as scholars to enlarging the resources of the universities which are strong, and to discouraging new foundations unless there is a positive guaranty that they are also to be strong. There are half a dozen or more places which could be named where a million of dollars would be more fruitful than thrice that sum in any new establishment. No greater service could be rendered at this time than a rigid enforcement of the scriptural rule, "For whosoever hath, to him shall be given, and he shall have more abundance: but whosoever hath not, from him shall be taken away even that he hath."

There is another danger to which I must call attention, — the danger of an incorrect conception of the purposes which should influence young men in pursuing university courses beyond a college curriculum. Those who have watched the tendencies of graduated students must have observed with a good deal of alarm the disposition which they sometimes show to concentrate attention upon very special subjects. Unfortunately many of these same persons are entirely dependent for their support on the salaries which they may earn. Now, instead of bringing to the educational exchange qualities which are always in demand, and which always receive remuneration, they come forward as doctors of philosophy with special attainments in some limited field, and are saddened to find that there is no demand for the acquisitions which they offer. I do not hesitate to say that if the drift of university work in this country is toward premature and excessive specialization, many a mariner is doomed to shipwreck on that rock. Even in Germany, where specialization has been favored, the cry is heard, too many specialists, too many university candidates. It would be a misfortune to this country, if we should find in the course of a few years a superabundance of men with rare acquisitions of a kind for which there is no demand. It would then be rightly said that our universities did not produce the fruit which had been expected. On the other hand, if residence in a university, beyond the college course, is found to widen the student's capacities as it increases his knowledge; if he learns the art of imparting what he knows; if he acquires the sense of proportion, and sees the subjects which he studies with the right perspective; if he strengthens the foundations as he carries upward the obelisk,—then he will gain, and not lose, by prolonged preparation for the duties of life. For every individual who may with wisdom be encouraged to devote himself to a very limited domain, there are scores who may be bidden to widen their culture. I do not now refer to those upon whom fortune has smiled, and who have the means to do as they please in preparing for life; but I have in mind many a struggling aspirant for the scholar's fame, who would be a happier and a more useful man if he had not set his face so resolutely against those studies which adorn the intellectual character, and give grace, dignity, and acceptability to their possessor. The first business of every man is to win his bread; if he is sure of that, he may wander at his own sweet will through meadows and woods.

In all the difficulties which are encountered by those who are endeavoring to advance the institutions of this country to their highest usefulness, great encouragement may be derived from a study of the results secured in other countries and in other ages. It is only by the review of long periods of time that the most instructive lessons can be learned. The history of European universities is yet to be written by one who has the requisite vision, and who can estimate with an accurate judgment the various forces by which they have been moulded, and the various services they have rendered to humanity. But there are many histories of famous foundations, many biographies of illustrious teachers, many surveys of literature, science, and education, many elaborate schemes of organization, and many proposals of reform. The mind of a master is indeed needed to co-ordinate what is thus recorded, — to be the interpreter of the house called beautiful. But the American scholar need not wait for such a comprehensive work; the American philanthropist need not delay his benefactions until more experience is secured. The centuries speak with many voices, but they are all harmonious. From the revival of letters until now, from the days of Gerson, the great chancellor of the University of Paris, five hundred years ago, every advance in civilization has been dependent upon the influences which have proceeded from the seats of learning. Their light has illuminated the foremost nations of Christendom. In days to come, more than in days that are past, their power for good will be felt upon the interests of mankind. Let us hope and believe, let us labor and pray, that the American universities when they are fully organized may be worth allies of the strongest and best foundations, — steady promoters of knowledge, virtue, and faith.

THE sixty-ninth annual meeting of the Swiss society of natural science will be held at Geneva, Aug. 9–12.

SCIENCE.

FRIDAY, JULY 16, 1886.

COMMENT AND CRITICISM.

THE U. S. FISH COMMISSION is now well started in its summer work. Professor Baird and a party of a dozen scientific men and investigators are at Wood's Holl; the Albatross is in northern waters, engaged in dredging for marine life; the Fish Hawk has gone to St. Jeromes, on the Chesapeake; and the Lookout has been engaged for some time in the lower Chesapeake, conducting experiments in hatching crabs and Spanish mackerel. At St. Jeromes the principal work is in oyster-culture. At this season the spawning oysters are secured, and the spawn taken from them artificially by methods devised by Professors Ryder and Brooks. Perhaps the most significant features of the work of the commission this season, however, are the experiments in the propagation of crabs and Spanish mackerel, which bid fair to be as successful as those recently inaugurated at Wood's Holl in the artificial propagation of the lobster. One of the results of these experiments will be the transportation of millions of young crab to the Pacific coast, where, when once firmly established, they will add materially to the food-products of the waters of that section. Scientific experts on the commission state that no crab of the Pacific waters can ever take the place of the blue or edible crab of the Atlantic coast.

THE PASTEUR INSTITUTE in France is more successful in its appeals for financial aid than a similar institute organized for the same purpose in the city of New York. The French people have already contributed more than one million francs towards the perpetuation of the Paris institute, at which more than a thousand persons have been inoculated for the prevention of rabies, while we are informed that the support given to Dr. Mott for a similar purpose is so meagre that his work will probably be discontinued after a few weeks. The American people were willing to subscribe an unlimited amount to send a few children to Paris; but, now that an opportunity is given them to provide protection to the whole population of the United States, they fail to respond.

No. 180.—1886.

THE CONTROVERSY over the glacial origin of lake-basins has had a satisfactory termination in at least one case. Heim of Zurich has maintained the inefficiency of glacial erosion, and refused to admit that the Swiss or any other large lakes could have such an origin. Penck, lately of Munich, now in Vienna, has insisted that the Bavarian lakes were cut out by ice, and implied that Lake Zurich and many others were also. Last fall these two professors undertook a joint excursion, going together to the ground formerly examined by each one alone, and they found that their problems are really distinct. Heim now admits that the Bavarian lakes are, after all, most probably glacial excavations in gravel deposits; and Penck sees that dislocation has had an essential share in the formation of Lake Zurich, although ice may have given it the finishing touches. The concluding paragraph of their joint report, as translated in the *Geological magazine* for June, teaches a larger lesson than many controversialists have learned: "There is, therefore, no real difference of opinion between us, touching the Lake of Zurich and the lakes of the Bavarian highlands, either as regards the facts or the conclusions from them; and as in the present case, so also does it often happen, that, by a more exact conjoint examination, differences become of much less importance than they appear to be from a distance."

LADY FLORA WILMOT died at Swansea, Eng., after taking chloroform in a dentist's chair, for the extraction of a tooth. The anaesthetic was administered by a physician. The patient had taken chloroform twice before without any bad effects. In all, but two drams were used. All attempts to restore the patient by the use of nitrite of amyl and artificial respiration were of no avail. The physician remarked immediately after the extraction of the tooth, "I hate giving chloroform for you dentists, because you will have your patients sitting up." Both the dentist and the physician were exonerated by the jury which was called to hold an inquest. The evidences of the danger in the administration of chloroform are so overwhelming, except in a very few cases, that no one is justified at the present day in using it in so simple an operation as the extraction of a tooth; and a jury would be doing its full duty in holding responsible for the death of the patient any physician or dentist who administered it in such a case, with a fatal result.

ONE OF THE DIFFICULT problems which presents itself for solution in the south is how to reduce the mortality among the blacks. That it has not yet been solved is made evident by a study of the vital statistics of southern cities. These records show that the death-rate of the negroes is double that of the whites. Savannah, Ga., however, seems to be exceptionally unhealthy in this regard. It is stated that in that city, while the rate for the white population is but 12.19 per thousand, a remarkably low rate and probably not correct, that for the blacks is 122. If these figures are correct, there is opportunity for much missionary work of a sanitary nature in the city of Savannah.

ECONOMIC LAWS AND METHODS.

IF it should be said that the material out of which the science of mechanics was built was wood and stone, iron and steel, every one would see the mistake. But when Mr. H. C. Adams, in his interesting paper on economics and jurisprudence, speaks of the material surroundings of men and the legal structure of society as material out of which the science of economics is built, he falls into precisely the same error (*Science*, July 2).

It would be unfair to Mr. Adams personally to lay too much stress on a random expression torn from its context; but it is not unfair to the school of thought to which he belongs. We have singled this expression out for criticism because it is characteristic of the school. It represents a view of the whole subject which is likely to lead to grave mistakes in thinking and in action. That Mr. Adams himself will make those mistakes, we do not believe. We should be sorry to say a word which should even seem to detract from the value of his work. He is one of the few men who combine originality with critical judgment. But the high character of the writer makes it all the more necessary to protest against his mistakes, even though they be but incidental. What he does inadvertently, others will be led to do deliberately.

The error lies in confounding the material to which a science is applied, with the material out of which it is built; or — to put the same thing in another form — in identifying the material of a science with the materials of an art. In itself this may seem a trivial matter; in its consequences it is extremely serious.

The material out of which the science of mechanics is built is not wood or iron, in any sense whatever. The science is built out of a few simple laws of motion, nowhere *exactly* realized in nature, and yet now admitted by every sensible man to be true. And in like manner the material out of which the science of economics is built consists of a few simple laws of human nature, the chief of which is that men strive to obtain the maximum of satisfaction with the minimum of sacrifice. It does not insist that the sacrifice shall be solely physical, or the satisfaction purely material. It makes no more unwarranted assumptions than does pure mechanics. The 'economic man' has as much and as little real existence as the 'material point.' As the fundamental assumptions of mechanics are involved in the definition of motion and the fact of its measurement, so the fundamental assumptions of political economy are involved in the definition of motives, and the fact of their measurement. This measurement is far less accurate in moral science than in physical science: the danger of dogmatism is therefore greater, and the need for verification more constant. But to say that the verification *is* the science, is as much a mistake in the one case as in the other.

It is a mistake which is often made, and which does great harm, both in science and in practice. It defeats the usefulness of verification as a means of discovery. An illustration will help to make this clear. The discovery of Neptune was due to a study of the motions of Uranus. It was found that these motions were not exactly such as the laws of mechanics, applied to the position of the known planets, would explain. It was therefore assumed that there must be certain unknown conditions which entered into the case; and careful reasoning led to the discovery of a new planet, whose position and size fulfilled those conditions.

Now, let it be observed, that, by the method which the historical school so highly commends, the inference from the motions of Uranus would simply have been that the law of gravitation *was not as rigid as is commonly supposed.* Such an inference would not merely have been wrong in itself, but it would have prevented the discovery of Neptune.

It is only when you assume a rigid law that your verification leads to new discoveries; and it leads to the most fruitful discoveries where the law at first seems to fail. That these new discoveries may sometimes take such a form that the old statement of the law will need to be partly or wholly rejected, does not alter the case. The man who tries to reason without rigid hypotheses cripples his power of investigation. Any one who understands the real power and importance of verification is justly indignant at any such conception of science as will prevent the use of verification as a means of discovery. The failures of the attempt to work without rigid hypotheses, from Lord Bacon down, have been so conspicuous that they hardly need repetition. Where the German school of economists has made any advance in the field of political economy itself, it has been done by an abandonment of the so-called historical method, and by a rigid application of deductive reasoning combined with careful verification. It is Cohn, and not Roscher, who represents the really fruitful line of German thought; and, whatever Cohn may at times have professed, he relies strongly both on abstract reasoning and on the rigidity of law.

There is one class of cases where these distinctions fall away, and where the Baconian method is a good one. When a science is so crude as to be mainly occupied with description and classification, there is little chance for the use of rigid hypotheses. Here the distinction between the material and the science falls away. Physics remained in this condition till the seventeenth century; chemistry, till the eighteenth; it was not till the nineteenth that 'natural history' began to give place to biology.

Sociology as a whole can hardly be said to have advanced beyond this stage; but certain departments of sociology are distinctly beyond it, notably law and political economy. They have reached the point where it is possible to frame hypotheses and to carry out deductions and verifications. The field of each science is limited; but, within its proper sphere, each is a true science. It is right enough to say that each is a part of something greater. In the future we may hope that a scientific sociology will be developed which shall include many other sciences. But we have a science of political economy, and we have not as yet a science of sociology in any thing like the same sense. To reject the part which we have for the sake of the whole, which we have not, would be the extreme of folly. It would be the same thing as to have rejected the undulatory theory of light fifty years ago because the correlation of forces was not yet discovered. The theory of light was but a part of the truth; but it was only on the basis of such parts that the whole could be built up. A scientific part is a better starting-point than an unscientific whole.

There is another class of dangers to which we are exposed when we deny all independence to economic reasoning. The man or state that refuses to recognize the rigidity of economic laws is likely to suffer for it, sooner or later, in his practical experience.

It is impossible for a man not to let his habits of thought affect his habits of action. If he is accustomed to make rigid assumptions, he tries to make things conform to these assumptions, and to insist that something is wrong where they do not. If, on the other hand, he reasons loosely, he comes to act recklessly, and to believe that his own luck or skill will save him from the necessity of careful calculation. The error of reckless overconfidence is at once more destructive and more common than the error of fatalism; and any thing which encourages the former is usually more dangerous than that which encourages the latter.

If a nearly spent cannon-ball is slowly rolling toward you, the natural and sensible thing to do is to get out of the way. The fatalist may refuse to do so because of his blind belief in fate. The fool may refuse to do so because he thinks it is not coming fast enough to hurt him. Now, either extreme is bad; but the practical danger is from the latter. The experience of army surgeons will show that in the instance given there are probably ten fools to one fatalist.

And in like manner the danger of believing that economic laws can be interfered with by human effort is ten times greater than the danger of an extreme belief in *laissez-faire*. Human nature is far more inclined to the former error. Where the economists make a mistake in opposing state interference (as when they tried to stop English factory legislation), people will generally take their own course in spite of them. Where they make the mistake of not opposing it, people will be only too ready to seize upon their arguments. And the same thing holds true of individual action as well as of state action. The danger of believing that the results of past experience are uncertain is far greater than the danger of believing that we are helpless to improve upon them.

As a matter of fact, there are limits within which the results of past experience are surprisingly rigid. That the worse currency drives out the better; that food prices depend upon the margin of cultivation rather than upon rent; that reckless marriage means starvation wages, — are laws which nations have been for centuries attempting to disregard, and of which they are hardly yet learning the full force. They mark limits, and effective limits, upon legislative activity. As long as political economy is occupied with defining those limits, it can maintain its claim to the position of an authoritative science. It says to the legislator, 'Thus far shalt thou go, and no farther.' It does not say, 'Such and such legislation will produce the best results;' but it says, 'Beyond certain limits, all legislation fails.' This is the natural relation of a science to an art. Mechanics does not tell the bridge-builder exactly how he must build his bridge; considerations of beauty and convenience must be taken into account: but mechanics warns the builder, that, if he disregards certain conditions of stability, his bridge will fall. Nobody insists that the axioms of mechanics should be modified because a bridge with the maximum of stability would be inconvenient or unsafe. Nor do we insist that mechanics should solve all the problems of bridge-building. We let mechanical considerations limit the practical application of aesthetics, and we let aesthetic considerations limit the practical application of mechanical principles. We do not attempt to fuse the two things together, and then distrust both of them.

This may fairly illustrate the relation of economics and jurisprudence. Whether we shall ever be able to combine them into one science may be uncertain; but we have not been able to do so as yet. Each limits the practical application of the other. Industrial activity is limited by legal conditions; legislative activity, by economic conditions. The attempt to confuse the two, and to merge them in a crude science of sociology, seems for the present likely to check scientific progress, and to involve us in serious practical dangers. Each, as a science, is independent, authoritative, and rigid; each forms the basis of an art which is subject to a thousand limitations.

ARTHUR T. HADLEY.

CONVOCATION OF THE UNIVERSITY OF THE STATE OF NEW YORK.

THE twenty-fourth convocation of the University of the state of New York began its sessions in the senate chamber of the capitol at Albany on Tuesday morning, July 6. There was assembled a large number of college professors, normal and high school teachers, and friends of education, from New York and other states.

The address of Hon. Henry R. Pierson, chancellor of the university, was a very able and eloquent defence of the work of the university and its board of regents, having special reference to the proposal recently made to abolish them both. The chancellor examined in some detail the history and organization of Oxford, Cambridge, and London universities. He showed that these universities stand in precisely the same relation to the federated colleges under their control that the University of the state of New York bears to the high schools, academies, and colleges of the state. The history of the university amply justifies its existence. Starting in 1784 with only one weak college — King's college, now Columbia — under its control, it embraced, in 1885, 45 colleges having 784 instructors and 11,702 students, and 1,571 graduates during the year. The total value of this college property is $23,164,612.82, and their yearly expenditure amounts to $1,787,391.51. Besides this, there were, in 1885, 283 academies under the control of the regents of the university, and 72,426 answer-papers were examined and passed upon under the supervision of the regents during the year. The chancellor stated that post-graduate courses, with corresponding examinations and degrees, were now under consideration. He concluded, "Read the record of these convocations, and I venture to say that no similar records of educational value can be found. Shall we consider these convocations a failure and nothing worth? It is true, the university does not confer many degrees, because that is a power concurrent with the colleges, and it has been thought best to leave that duty mainly with them. I think I have proved that in its past and present the duties of the university have been defined by law, and that it has performed all the duties devolving upon it; that the corporate name is not a misnomer, and should not mislead; and that the regents are doing too noble a work to be abolished or merged with any other body of educational workers."

The main interest of the first morning session centred in the discussion of the subject of manual training, which was introduced in a paper by Principal Love of Jamestown. Mr. Love claimed that the test of the practicability of manual training must be its usefulness. Any system of training that does not start out with the idea that the scholar must become a producer is defective. Principal Love detailed the workings of a system of manual training introduced by him in Jamestown, asserting that it did not detract from, but rather added to, the quantity and quality of intellectual work performed by the pupils. His account showed a gratifying success with an experiment which must sooner or later become general.

The afternoon session was given up to a discussion of the question, 'Has the college a logical place in the American system of education?' The subject was introduced by papers by Prof. Oren Root of Hamilton college and Prof. S. G. Williams of Cornell. Both essayists, as well as Vice-Chancellor MacCracken of the University of the city of New York, who opened the discussion of the papers, combated the view expressed in some quarters, — notably by Professor West of Princeton, in a paper read before the National teachers' association at Saratoga in 1885, — that the work of the college would ultimately fall to the academies and universities, and the college itself fall away as unnecessary. In opposing this view, all the speakers were agreed that the college continues and completes the boy's education, begun in the school and academy, while the university trains educated men in special branches. Professor Williams attributed much of the misunderstanding on this subject to the fact that many colleges were forgetting their true position and function in their endeavor to become universities. Professor Williams said that the ideal college course would, in his opinion, call for sixteen hours of recitation per week, devoted as follows: language, one-half; mathematics (meaning algebra, geometry, and trigonometry, and these only), one-eighth; history, a little more than one-eighth; and elementary science, including civics and psychology, a little more than one-quarter. To such a curriculum elocution and gymnastics could easily be added, and it would serve to train the pupil as the college ought to train him, and did train before it was carried away by a wrong ambition.

For Wednesday morning's session, Dr. L. Sauveur was announced to explain and defend the 'natural method' of teaching languages. He was not able to be present, and Mr. C. W. Bardeen briefly presented the chief points of excellence in connection with the natural method. Principal George C. Sawyer of Utica followed with a scholarly and exhaustive attack on the 'natural method' as a fraud and a sham. Dr. Sawyer claimed, that, under this method, all the work devolves upon the teacher, and the pupil picks up, with no disciplinary training, a parrot-like acquaintance with a limited vocabulary. Moreover, the main value from studying a language lies in learning to read it, to imbibe the thought and spirit and culture of another people, and not merely to hold a conversation in it.

The discussion was continued by Professor Wells of Union college, Principal Farr of Glens Falls, and Principal Cheney of Kingston, all of whom opposed the so-called 'natural method,' and defended the old or rational method both because of its practical results and its disciplinary training.

Dr. James Hall, director of the New York state museum of natural history, followed with a brief account of that museum and its educational work. Dr. Hall said that it represented every department of natural history. The mineral wealth of the state should also be represented. Nearly ten years ago there were distributed to schools and colleges about twenty thousand specimens in geology and mineralogy, and the museum is now prepared to distribute about five thousand more authentic specimens, which is a valuable adjunct to the teachers' work in these schools. In this way the educational use of the museum is manifested by its publications and its distributions of specimens. The museum will continue to aid the cause of education and be a part of the educational system of the state. Teachers and investigators are invited to seek assistance and information of the museum; and, if institutions want collections augmented from its duplicates, the museum of Albany will be glad to respond as readily and as heartily as it can.

Principal C. T. R. Smith of Lansingburgh presented a paper, which was an able exposition of the desirability of allowing plane geometry to precede algebra in the regents' course of study. Professor Root of Hamilton agreed with Principal Smith, and showed clearly by concrete examples how the logical and natural order would be restored by the proposed change. Considerable discussion followed, the general sentiment being that the change should at least be permitted as an alternative even if not sanctioned entirely.

An unusually large and brilliant audience assembled in the evening, when President McCosh of Princeton was announced to deliver an address on elective studies in college. Dr. McCosh opened with the proposition that a college or university should, so far as its funds would permit, offer instruction in every branch of literature and science, carefully excluding all that is merely showy. Modern education, he continued, began in the seventh century with the foundation of the Cathedral schools with their Trivium and Quadrivium. At this time there was no possibility of electives, because during its course the university of that day could teach all that was known. A new era began with the Renaissance, and again in the seventeenth century the subjects of study were greatly increased by the new mathematics of Descartes, Newton, and Leibnitz. In the eighteenth century were founded the Royal society in England, the French academy, and the Berlin academy of sciences. Chemistry, biology, and botany became sciences, and were placed in the curriculum. This great increase in subjects of study has gone on, until, in our day, it is absolutely impossible to master them all. The age of universal scholars, of Erasmus, of Scaliger, of Leibnitz, has gone never to return.

Having established the fact that an elective system is now necessary in our colleges, the further question arises, how is it to be regulated? Having reference only to candidates for the B.A. degree, which implies a general culture and scholarship, the standard of which we must not allow to be lowered, we may say, first, that there should be prescribed studies in every year of the college course. These must embrace what experience has proven the fundamental and disciplinary studies, both for the purpose of training an accurate and scholarly mind and for bearing practical fruit. The principal of these is language. Our own language should have the first and the last place in every scheme of instruction, but every educated man should know at least two languages in addition to his own. The Greek language should by all means be maintained as a requisite for the degree of B.A., as being the most perfect and subtle of languages, and as being the medium of the grandest literature of the ancient world. In the second place, no man is a scholar who has not studied mathematics: therefore they should be prescribed in a certain degree. And, thirdly, no man is educated who has not some knowledge of philosophy, including under this head the social and political sciences. With a well-arranged plan of obligatory studies, embracing language, science, and philosophy, should be combined an indefinite number of elective studies. No electives should be permitted in the freshman year. This year should be spent in the thorough mastery of the elementary branches and in becoming acquainted with the general system of the college, so that the pupil may be prepared to make his choice of studies later an intelligent one. Only a few electives may safely be allowed in the sophomore year, but in the last two years of the college course they may be freely introduced. In this elective system, however, the student should not be allowed to dissipate his energies in too many directions. Four electives at most should be allowed him.

While this should be firmly adhered to in the course leading to the B.A. degree, other courses should be encouraged, and corresponding degrees awarded on their successful completion. Each of these degrees should be plainly designated by its title, so as not to be mistaken for the B.A. degree.

Our students in colleges are not increasing in proportion to the population. One reason is that they enter college too late, and it is only at the age of twenty-six or twenty-eight that they are able to support themselves by their profession. This is longer than most boys can wait, and longer than most parents can afford to have them wait: so they are dispensing with the college course. The remedy for this is to improve the work of the schools so that a boy can enter college at sixteen, and enter on his profession at twenty-two or twenty-three years of age. A healthy boy of fair ability ought to be able to accomplish this without difficulty.

Dr. McCosh's argument and practical suggestions were most favorably received by the members of the convocation.

On Thursday morning, July 8, the convocation held its closing session. Professor Hewett of Cornell read a paper on the relations of the colleges and academies, in which he pointed out the fact that the systems of Germany, Massachusetts, and Michigan, were superior to those of New York as far as the relations between preparatory schools and colleges are concerned. He urged that the colleges should unite in setting a standard which the high schools and academies would have to observe or else give way to private schools. Inspection of preparatory schools by competent officers was also recommended.

On the conclusion of the discussion of Professor Hewett's paper, Chancellor Sims of Syracuse university took the chair, and opened the conference of college presidents in the state of New York on the question of classical requirements for the degree of B.A. He was followed by President Dodge of Madison university, Warden Fairbairn of St. Stephen's college, and Brother Conway of Canisius college. Every speaker took the ground that the reputation of the B.A. degree must be preserved, and that Greek and Latin must be rigidly insisted on as requisite for its attainment.

The last business of the convocation was to discuss briefly medical education, the sentiment being that a physician should be examined for his license to practise by a board not composed of his instructors. At one P.M. Chancellor Pierson declared the convocation adjourned *sine die.*

Among the other papers of interest were the following: Rev. Brother Noah, Tact in teaching; J. A. Lintner, The present state of entomological science in the United States; President Hyde of Bowdoin, The relation of higher education to religion; Professor Wilson of Cornell, The elements of knowledge; Principal E. H. Cook of Potsdam, Systematic habit in education.

THE INDIAN SURVEY REPORT.

THE general report on the operations of the survey of India for the year 1884–85, which has been received from India a month earlier than usual, contains the record of work done by one of the busiest departments of the government of that country, the following abstract of which we find in *The Athenaeum.* The officers of the department are constantly engaged in surveys in all parts of the peninsula, and every year a greater area is added to the map as either triangulated or topographically surveyed. Our attention may be most profitably directed to the geographical discoveries chronicled in the present report, although they do not include any thing so remarkable as the journey of A. K. in the report of two years ago.

Prominent among the additions to our geographical knowledge is the survey made by the officers of the Afghan commission of the country between Quetta and Kuhsan on the Perso-Afghan frontier. This independent traverse was for a distance of 767 linear miles without a break. The Helmund valley was mapped up to the Hamun; and Major Holdich, with his assistants Captains Gore and Talbot, has plane-tabled an extent of 15,000 square miles in this part of Afghanistan. But the most distinct achievements of the year were attained on the northern and eastern frontiers of India. Colonel Woodthorpe's trip across the Patkai range to the villages of the friendly Bor Kamptis, in the valley of the western branch of the Irrawaddy, was a perilous but successful attempt to carry one stage further the examination of the country beyond the north-east frontier. The history of this tour is given by Major C. R. Macgregor in the appendix, which consists of the narratives on which Colonel De Prée has based his general report. The country through which the expedition had to pass *en route* to the Kampti villages was the scene of many Singpho depredations; and more than one place was indicated by the guide as having witnessed the massacre of helpless Kampti traders, and fear of the Singphos was generally assigned as the cause of the absence of trade between the Brahmaputra and Irrawaddy. At Langnu, the first Kampti village, the party, after some not unnatural hesitation considering it was a surprise visit, was favorably received, and made the acquaintance of representatives of several new tribes, such as the Marus, who are extremely poor and live on roots in some hills south of the Namkiu valley, and the Kunnungs, described as a gentle and pleasant-looking people with melodious voices. In the country of the latter, silver-mines exist, which supply the whole of this region with coin and ornaments. Just as the Singphos raid on the Kamptis, a people called the Singlengs plunder the Kunnungs, and sell those they capture as slaves to the Tibetans. At Langdao the party was obstructed; but the people were pacified by fair words and the present of some rupees to propitiate their 'Nats.' Near this village Colonel Woodthorpe crossed the Irrawaddy or Namkiu, which at this point is only eighty-five yards broad and not deep. China is known as Khé Moung, and the tribes only resort there — a journey of a month and eight days — for the purpose of buying opium; and that not so often as formerly, because Assam opium is found to be better and more easily procurable. The explorers received a polite message from Lukun, the head chief of the Kamptis, to visit him in his capital of Padao. The chief is described as 'a fine-looking shrewd old fellow,' who originally came from Bhamo, and whose assistance will prove of great utility in exploring the country beyond his territory in the direction of the silver-mines. The return journey across the Patkai range was attended with great difficulty and peril, as the rivers were flooded, and supplies were almost exhausted. In fact, when the expedition joined a party sent out to relieve them, they were on the verge of starvation. Major Macgregor expresses the opinion that the idea of a trade-route to China from Assam is any thing but a visionary one; and the more knowledge we acquire about the tribes of this region, the more reasonable does it appear that there may, after all, be a short route between Assam and the province of Szchuen.

Captain Wahab's narrative of the Baluchistan operations is chiefly interesting for its reference to the passes in that country between the fertile planes of Kachhi and Khelat proper. The Gazak pass, which leads direct to the Khan's capital, will be surveyed later on; but farther north the Vehova pass has been examined, with the result that it has been found a good road, passable for laden camels, and with good water, grass, and fuel. The writer calls attention to the great change that has taken place in the security of the district through which the Pishin railway is now being constructed. A few years ago this was one of the most lawless tracts on the frontier: now camps of coolies are scattered along the whole line quite unguarded, and apparently as secure as if they were in India.

Colonel Tanner's account of the Himalayan survey is very interesting reading; and his forced march across the Lipu Lek pass brought him into direct contact with a Tibetan Jongpen or governor, who used plain language regarding the attempts of the English to enter his country. He said, "We are not angry at your coming this once, but we never wish to see you again. Our government don't allow the English in Tibet, but you one and all try to push your way past our frontier posts." If this expresses the Tibetan view of the subject, it is to be feared that Mr. Colman Macaulay has not much chance of succeeding in his mission. Colonel Tanner gives a graphic description of the village of Budi — the most delightful place he had seen in the Himalayas — and of the terrors of the Nirpania-kidanda, or waterless spur, which occurs between the Lipu Lek pass and Kumaon. The most important piece of work in this direction was accomplished by a surveyor named R. N., under Colonel Tanner's direction. This explorer made a circuit of the great mountain Kinchinjinga, delineated the boundary between north-east Nepaul and Tibet, fixed the peak of Nuijin Sangra, and completed the sketch of the Zemu River. Colonel Tanner's surveys are particularly interesting as establishing the accuracy of those made by A. K. Our brief account will serve to indicate how much interesting matter is contained in this report.

A SALT-MINE IN WESTERN NEW YORK.

MR. WILLIAM FOSTER, jun., of New York has at last succeeded in sinking a shaft to the salt deposits of central New York. As I was permitted a few weeks ago to descend to the mine, I will, by the owner's permission, give the facts to the public so far as they are of scientific and general interest.

This is, I believe, the first successful attempt to mine the salt deposits of this region. In the neighborhood of Syracuse no salt deposits have been found; but the dependence is wholly upon salt springs which derive their salt from unknown sources. In the valley of the Genesee, in Livingston county, about thirty miles south of Rochester, deposits of salt were penetrated some years ago, in boring for oil, at a depth of about a thousand feet; and numerous wells have been bored from which brine is pumped, both there and in Wyoming county to the west. Previous attempts to sink shafts to these deposits in Canada have encountered so much water, that the projects have proved impracticable; but the present attempt seems to be entirely successful. The shaft was sunk 1,013 feet; and the mine is perfectly dry, with the exception of a little water which drips down the shaft. An inch-and-a-half pipe removes all the water. When I visited the mine in April last, they had drifted about 300 feet in each direction. The stratum of salt in which they are working is twenty-two feet thick, and fourteen feet of it is pure salt. The miners remove it by blasting (boring holes with augers specially adapted to the purpose, and inserting small charges of dynamite). I collected some of the dust which was coming from one of these holes, which had penetrated about four feet horizontally and about midway between the top and the bottom. This has been analyzed for me by Professor Jewett of Oberlin, with the following result: —

	PER CENT.
Sodium chloride	97.84
Calcium sulphate	1.04
Moisture	.08
Residue insoluble in water	.43
Magnesic sulphate	trace
Total	99.39

This is remarkably free from impurities, even for refined salt. Doubtless, by selecting specimens, a still greater purity might have been obtained. The above specimen fairly represents the purity of a stratum fourteen feet thick, which is now being mined without hinderance from any causes.

Other strata of salt were found both above and below this one. The upper stratum was reached at a depth of 991 feet, and was so mixed with shale as to be unprofitable. The lower stratum was reached at 1,047 feet, and is fifty feet in thickness, being practically clear salt. Between these two there was also a four-foot stratum of clear salt. Thus, in all, there is, within a distance of two hundred feet, not far from eighty feet of solid salt at a depth of a little over a thousand feet below the surface. The shaft begins in Hamilton shale. The following is the record: —

	Thickness in feet.	Depth in feet.
Shale	407	407
Corniferous lime rock	148	555
Shale	223	778
Limestone and shale	70	848
Shale	102	950
Lime-rock	11	961
Shale and salt	30	991
First bed clear salt	22	1,013
Lime-rock and shale	28	1,041
Second bed clear salt	4	1,045
Rock	2	1,047
Third bed clear salt	58	1,105

This mine is at Piffard Station, Livingston county, on the Buffalo, New York, and Philadelphia railroad.

G. F. WRIGHT.

LONDON LETTER.

THE movement previously referred to in this correspondence, for promoting such changes in the University of London as will bring the teachers of the various colleges into closer relations than at present with the examiners, has just made a great step in advance. At a meeting of convocation (i.e., of the general body of graduates) on June 29, a scheme was adopted, and sent on to the senate (the executive body) for consideration. It proposes, 1°, that the constitution of the senate be enlarged by the direct representation thereon of certain educational bodies in and near London, such as University college and Kings college, London, the Royal college of physicians and of surgeons, the Royal society, the council of legal education, etc; 2°, that certain colleges shall, under the title 'constituent colleges,' form a part of the university; 3°, that a council of education shall be established, consisting of representative graduates, representatives of these constituent colleges, the examiners, which shall advise the senate on all matters relating to the subjects of examination, and shall appoint boards of studies; 4°, that the university (now entirely dependent on fees and a treasury grant) shall have power to hold real property, in order that it may assist by any suitable means in promoting higher education. Except on the question of the admission of women to degrees, there have never been debates in convocation at which more interest has been shown. At the present moment, a keenly contested parliamentary election is being carried on in the university. The poll is open for five days; the voting is open, and may be done in person, or by voting-papers sworn before a justice of the peace and then sent in by mail. Sir John Lubbock, F.R.S., formerly vice-chancellor, represented the university for many years as a liberal, but not a 'home-ruler;' and he is now opposed by Mr. Frederick Harrison, the Gladstonian candidate.

In connection with the Colonial and Indian exhibition, a very useful series of conferences are being held in the Conference hall of the exhibition. Many of these are devoted to an exposition of the resources of some particular colony — to various industrial products and questions — and to such subjects as the federation of the colonies, etc. One day was devoted to the subject of the position of science in colonial education, which was introduced in a very exhaustive paper by Mr. William Lant Carpenter.

The colonies to which Mr. Carpenter had directed his attention were, Canada generally; in South Africa, the Cape of Good Hope and Natal; western and South Australia, Victoria, New South Wales, Queensland, New Zealand, and Tasmania; the last of which, unfortunately, was not represented at the present exhibition. An account of the present condition of scientific education in each of these colonies was given, in primary, secondary, and grammar or high schools, in colleges and universities, and in museums, etc., for adults. The most perfect scheme of education was probably that of the little colony of New Brunswick, which was admirably arranged. This colony spent one-third of its entire revenue on education, and one-eighth of its entire population in 1885 received instruction in hygiene. There was a universal desire in the colonies to realize as far as possible Professor Huxley's idea that a system of public instruction should be an educational ladder reaching from the gutter to the university.

As a general conclusion, Mr. Carpenter thought that the claims of science to a place in state-aided primary education were more fully recognized than in the old country; and this, not merely because it was the only foundation upon which a system of technological education could be securely built, but for its value in drawing out the minds of the pupils. As regards the branches by which the time-honored routine of subjects may be most beneficially varied, precedence was almost universally accorded to drawing, and to the objective presentation of the elements of science. In secondary grammar and high schools, science scarcely occupied a position equal to that in corresponding English schools; but there were many signs of improvement in this respect. In the colleges and universities of the older colonies, the classical and academic influence was still very strong, while in the newer ones the claims of scientific education to be put on an equal footing with literary were recognized. Great as had been the progress of public opinion in England during the last few years on the importance of science as an element in education, the author was disposed to consider it greater in the colonies in the same period. Certainly the development of that opinion to its present point had been much more rapid in the colonies than at home. There were many voluntary colonial associations for the promotion of science; and the author concluded his paper by throwing out the suggestion, that, if there were grave and practical difficulties in the way of an imperial federation of the Australian colonies, the establishment of an Australian association for the advancement of science, somewhat on the lines of the British and American associations for similar purposes, might not be beyond the reach of practical scientists; and he was strongly of opinion that such a federation would tend to strengthen 'the position of science in colonial education.'

The annual meeting of the Society of chemical industry is about to be held at Liverpool. The success of this society, which was only founded five years ago, has been remarkable, chiefly because it met a great want. It numbers over two thousand members, some resident in remote parts of the world. It has sections in the chief manufacturing districts of England and Scotland, such as Newcastle, Manchester, Birmingham, Bristol, etc. Its journal, issued monthly, is a very valuable record of industrial chemistry; the abstracts of patents, and of papers in foreign journals, being a special feature in it.

The experimental farm of the Royal agricultural society has recently been visited by distinguished colonists, as well as officially by the members of the society. It was started in 1877 to put to a practical test the relative manurial values attributable to the consumption of certain feeding-stuffs, which, on chemical considerations, should differ widely in their fertilizing effects on the farm. Among the manurially rich food, decorticated cotton cake has been employed. One important economical fact has been clearly brought out: viz., that even heavy dressings of concentrated soluble nitrogenous manures, whether ammonium sulphate or sodium nitrate, leave in the soil, when applied to cereal crops, no appreciable residue for the use of a succeeding crop. W.

London, July 3.

NOTES AND NEWS.

THE thirty-fifth meeting of the American association for the advancement of science will be held at Buffalo, from Wednesday morning, Aug. 18, until Tuesday evening, Aug. 24, 1886. For the third time, at intervals of ten years each, the association has accepted an invitation to hold a meeting in Buffalo. The local committee intend to make the meeting a great success; and members who were at the meeting of 1876 need only to recall it, in order to form an idea of what the coming meeting promises to be. To those who were not present, it is only necessary to state that the facilities which the city offers are all that can be desired, both in regard to rooms for the several sections and in hotel accommodations, while the health and comfort of the city in the month of August are well known. The headquarters of the association will be at the high school, and all the offices and meeting rooms will be in that building or in one of the schoolhouses near by. The hotel headquarters will be at the Genesee house. Board and lodging for members and their families may be had at the rate of $1 to $3 a day, and reduced rates have been obtained from many railroads. A special circular in relation to railroads, hotels, and other matters, has been issued by the local committee. In order to take advantage of these arrangements, members who have not received the local committee's circular should send for a copy at once. Arrangements for excursions and receptions will be announced by the local committee. The officers of Sections D and H have issued special circulars relating to the meeting, which can be had by addressing the respective secretaries. Special information relating to any of the sections will be furnished by their officers. In Section E special attention will be given to the problems connected with the Niagara Falls and its gorge.

— Two Italian physiologists have recently been experimenting upon the effect of various drugs on the sense of taste. They find that the prolonged application of ice removes the sensibility for all tastes, — sweet, sour, salt, and bitter. The effect of cocoaine is to destroy the sensibility for bitter only. All other substances can still be tasted, but the application of a bitter substance yields only a sensation of contact. The removal of the sensibility remains the longer, the longer and more intense the application of the cocoaine. Of course, the effect is only transient. They find other substances that reduce the sensibility for bitter taste; but cocoaine seems to be the only one which selects all the fibres that conduct the sensation of bitter, and paralyzes them. Other substances, such as caffeine and morphia, diminish the discriminative sensibility between different intensities of bitter. The application of a two-per-cent solution of sulphuric acid has a peculiar effect. It makes distilled water taste sweet, and even makes a quinine solution have a sweet taste, but this only at the tip of the tongue; elsewhere it tastes bitter, as usual. These experiments are particularly important because they are the first that promise a rational application of the law of specific nerve-energy to the sense of taste. They seem to suggest the supposition of separate fibres for the conduction of separate tastes, and thus make close connection with the recently discovered hot and cold points in the skin, which are the terminal portions of nerve-fibres for the separate conduction of sensations of heat and cold.

— Protap Chandra Roy of Calcutta, secretary of the Dātavya Bhārata Kāryālaya, has issued an appeal for aid in rescuing the ancient Indian literature. The Dātavya Bhārata Kāryālaya has, within the course of the last eight years, printed and gratuitously distributed two editions of the Mahābhārata in Bengalee translation, each edition comprising nearly three thousand copies. The fourth edition of the Mahābhārata (the third of the series for gratuitous distribution) has been commenced, and it will take some time before it is completed. One edition of the Harivānça, comprising three thousand copies, has been exhausted. The Rāmāyana also, that was taken in hand, has been completed, the text of Valmiki being published with a translation. Roughly estimated, the Bhārata Kāryālaya has distributed up to date nearly twelve thousand copies of the Rāmāyana, Mahābhārata, and the Harivānça taken together, and that number will swell to eighteen thousand, when the fourth edition of the Mahābhārata shall be complete. Leaving aside the arithmetical results of the Kāryālaya's operations, it might fairly be presumed that the genuine demand for eighteen thousand copies of the sacred books of India represents a degree of interest taken by the people in the history of their past that is certainly not discouraging. An English translation of the Mahābhārata in monthly parts has been begun; and twenty-two parts have already been issued. To insure permanency to the Bhārata Kāryālaya, it is necessary to collect funds. Contributions may be sent to W. E. Coleman, San Francisco; to Prof. H. Jacobi of the University of Kiel; to M. A. Barth of 6 Rue du Vieux Columbier, Paris; to Prof. Max Müller, 7, Norham Gardens, Oxford, England.

— Captain Grimes, British steamship Humboldt, Rio de Janeiro, to New Orleans, reports, under date June 10, witnessing a battle between a large sperm-whale, thrasher, and sword-fish. The vessel was in latitude 13° 25′ south, longitude 36° 16′ west, off San Salvador, Brazil. The fish were far off, and would not have been sighted were it not for the great commotion occasioned by the fight. The steamer ran down to the combatants, and lay to till the end of the battle, resulting in the death of the whale and sword-fish.

— Mr. Douglas Home, the well-known medium, died June 21, at Auteuil, at the age of 52.

— Letters from Colonel Lockhart's party give a complete contradiction to the story of his arrest. The mission was well received by the Afghans, who proved very friendly.

— It is proposed to hold in the autumn of 1887 an international congress of shorthand writers of all existing systems, and of persons interested in shorthand generally, to celebrate conjointly two events of importance: 1. The jubilee of the introduction of Mr. Isaac Pitman's system of phonography, marking as it does an era in the development of shorthand on scientific principles; 2. The tercentenary of modern shorthand originated by Dr. Timothy Bright about 1587, continued by Peter Bales (1590), John Willis (1602), Edmond Willis (1618), Shelton (1620), Cartwright (1642), Rich (1646), Mason (1672), Gurney (1740), Byrom (1767), Mavor (1780), Taylor (1786), Lewis (1812), and many others in past generations, and finally by Mr. Pitman and other English and continental authors of the present day.

— The rapid development of the technical sciences and the specialization of the various departments of civil engineering of late years have so enlarged its field as to make it desirable that the student should be allowed some freedom of choice as to the particular line of work to be specially pursued in the application of these general principles. To meet this requirement, the Massachusetts institute of technology has arranged a general course of study, covering the whole field of civil engineering, adapted for those students who have not decided what special branch they will afterward pursue, while it affords at the same time an opportunity for those students who desire it to devote themselves more extensively to certain special branches.

— Applicants for admission to the dental schools of Great Britain must pass a satisfactory examination in English grammar and history, in Latin, in algebra, geometry, and physics; and, before they can receive their degree of L.D.S., they must study for four years anatomy, chemistry, surgery, and such other branches as are taught in the medical schools, besides those which specially pertain to dentistry, as operative dentistry, the administration of anaesthetics. In London there are two dental hospitals in which all the operations known to that branch are practised, and to which students have admission and opportunity to operate. In the National dental hospital, during the year 1885, 9,001 fillings were inserted, of which 1,014 were of gold, the others being of gutta-percha or other plastic material.

— Consul-General Gibbs of Bolivia has given a very interesting account of the coca-plant, which is now so much employed in medical practice, and which, together with opium, chloral, and other drugs, is beginning to gain its victims from the ranks of those who, having commenced its use for medicinal purposes, have become so enslaved by it that they cannot give it up. This plant is grown in the province of Yungas, and brought some sixty miles to Lapaz, Bolivia, which is the great market for it. The bushes, which are grown on the sides of the mountains, furnish three crops a year of the leaves, from which the drug is obtained. The leaves are dried in the sun, and, after being pressed, are packed in bales. The annual production is 7,500,000 pounds, of which Bolivia consumes fifty-five per cent; the United States and Europe, five per cent; and the rest is consumed in other parts of South America.

— The Entomological club of the American association for the advancement of science will hold its meetings during the week of the association in the library of the Buffalo society of natural science. The first meeting will be held on Tuesday, Aug. 17, at 2 P.M.; and Prof. J. A. Lintner, president of the club, will deliver his address at that time. During the week there will be an excursion to some point of interest; and a reception has been tendered the club by the entomologists of Buffalo. It is very desirable that those entomologists expecting to attend should signify their intention to the secretary of the club, John B. Smith, national museum, Washington, D.C.

— The Botanical club of the American association for the advancement of science will hold its meetings, as usual, during the week of the association. The first meeting will take place on Wednesday at 9 A.M. in the room assigned to the biological section. Any botanist or person specially interested in botany, who is a member of the association, and has registered for the Buffalo meeting, may become a member of the club by filling out a blank to be obtained at the desk of the local committee. The plans for excursions are not yet matured. For further information address Dr. J. C. Arthur, secretary of the club, Geneva, N.Y.

— The Society for the promotion of agricultural science will hold its seventh annual meeting in Buffalo, beginning on Tuesday, Aug. 17. For further information address Dr. Byron D. Halsted, secretary, Ames, Io.

— The present custodian of the Cincinnati society of natural history, Prof. Joseph F. James, has resigned his position to accept the professorship of botany and geology in the Miami university, Oxford, O. The executive board of the society have appointed a committee to receive applications for the position, and to examine the credentials of applicants.

The *Athenaeum* announces that Prof. Karl Pearson will contribute a volume to the 'International series' which will be to physics what Professor Clifford's 'Common sense of the exact sciences' (which Professor Pearson edited) is to mathematics, and will, in fact, form a companion work.

— At the meeting of the Académie des sciences, May 31, MM. Cailletet and Mathias read a paper entitled 'Researches on the densities of liquefied gases and of their saturated vapors.' They have followed the researches of Faraday, Thilorier, Bussy, and D'Andreif upon the density of the liquid gases. The apparatus they have employed was of great simplicity, all of glass, capable of resisting the pressure of many atmospheres. The gases on which they operated were protoxide of azote, ethylene, and carbonic acid. Their results confirm those of M. Sarrau. The authors' experiments demonstrate that at the critical point the density of the liquid gas is equal to that of its vapor. M. Fizeau also stated that his observations taught him that the luminiferous ether is entirely unaffected by the motion of the matter which it permeates, and said that he hoped soon to announce the existence of a peculiar variation in the magnetic force of magnets, apparently in relation with the direction of the earth's motion through space, calculated to throw light on the immobility of the ether and its relations to ponderable matter.

— There are in the United States about one hundred medical colleges of good repute, at which more than ten thousand students attend annually. From these institutions go out each year from five to one hundred and fifty or more graduates, to swell the ranks of a profession which now numbers in the United States more than seventy-seven thousand members. For the additional instruction of these doctors there are published more than one hundred and fifty medical journals.

— From the *Medical news* we learn that a German physician was recently much puzzled by a case which he was called to attend. The patient, a child five weeks old, was incessantly crying, and was undoubtedly suffering from colic, and its skin was of a bluish color. Further examination revealed the fact that the nurse was in the habit of using a cosmetic in which lead entered largely as a constituent. This gave to her face a brilliant tint, which at once attracted the attention of the physician. The use of this cosmetic was at once interdicted, and in a few days the colic and the crying ceased.

— Instances of extreme old age are reported from Russia. The *Novosti*, a Russian journal, announces the death, in the almshouse of St. Petersburg, of a man, aged one hundred and twenty-two years, who had been an inmate since 1818. His mental faculties were preserved up to the time of his death, and his general health was excellent to the age of one hundred and eighteen, when he commenced to fail. There is in the same institution a soldier's widow whose age, as shown by documentary evidence, is at least one hundred and ten years. In our own country, at New Holland, O., Mrs. Arnold has just celebrated the one hundred and ninth anniversary of her birth ; and her two sisters are still living, aged respectively one hundred and six and one hundred and twelve.

— Dr. Barlow, in the *Lancet*, expresses the opinion, after a very thorough investigation into the nature of whooping-cough, that it is to be classed among the diseases which are caused by the irritation excited by the presence of parasites ; and that these are micrococci, which proliferate in large numbers upon the living membrane of the larynx and pharynx. He also claims for resorcine the power to greatly reduce the intensity of the disease, and to directly lead to its cure. This remedy, which is among the most recent introduced to the medical profession, is applied as a one or two per cent solution, either by a brush or in the form of spray, directly to the mucous membrane of the throat and the larynx.

— Some of the friends of M. Chevreul propose to present him a medal on his hundredth birthday, which comes the 31st of August. This medal will bear in relief a portrait of Chevreul engraved by M. Roty. Subscriptions should be addressed to M. Louis Passy, secrétaire perpétuel de la Société nationale d'agriculture de France, 18, rue de Bellechasse, Paris, France.

— The *Athenaeum* states that Mr. Blanford, the meteorological reporter to the government of India, has drawn up a memorandum to accompany the charts of temperature and rainfall. The temperature being reduced to its equivalent at sea-level, the hottest tract in India is a portion of the Deccan plateau between Bellary and Sholapore. The hottest region of the peninsula is really the eastern coast from Vizagapatam southwards and the plains of the Carnatic and northern Ceylon. In intra-tropical India, except as modified by the elevation of the country, the temperature increases from the coast inland, the west coast being cooler than the east coast. Sind and Rajputana are the driest portion of India. In the greater part of India. May is the hottest month in the year, except in the Punjab and Sind, where, owing to the lateness of the rains, June is hottest. Of those stations, the temperature of which has been pretty accurately determined, the hottest in May is Jhansi : the coolest region is Assam, where the May rains are very copious. The mean annual rainfall of the whole of India is about forty-two inches, varying from nearly five hundred inches at Cherra Poonjee, to about three inches at Jacobabad. The provinces most subject to famine are the north-western provinces, Behar, Rajputana, the Carnatic, the North Deccan, Hyderabad, Mysore, Orissa, and the northern Circars.

— M. E. Grimaux exhibited to the French academy of sciences, at the *séance* of June 15, some unpublished printed documents showing the action taken by the commission on behalf of Lavoisier, at that time (1792–93) under arrest as a farmer-general. From one of these documents it appears, that, in consequence of the said action, the illustrious names of Laplace, Delambre, Borda, and others, were themselves removed from the commission on the 3d Nivôse of the second year of the republic (Dec. 26, 1793).

— A few years ago Dr. J. B. de Lacerda of Rio de Janeiro made extensive experiments upon antidotes for snake-bites, and finally settled upon the hypodermic injection of a solution of permanganate of potash as being the most efficacious. This remedy has also been used lately in Brazil against hydrophobia. One planter reports having used it over a year ago in two cases of persons bitten by rabid dogs. So far, these persons have shown no symptoms of hydrophobia. A colleague of Dr. Lacerda, however, treated by this method two patients who had been bitten by a rabid cat. One of them received the hypodermic injection fifteen minutes after having been bitten. As yet he shows no ill effects from the wound. The second, a child, was treated twelve hours after having been bitten, and died seven weeks later with all the symptoms of hydrophobia.

— The Brazilian government has directed Prof. Emil Goldi to investigate the disease of the coffee-plants. This disease was investigated by Capanema about four years ago, but no satisfactory conclusion was reached as to its character or the remedy for it. In the mean while it has been spreading.

— The sundry civil bill, as considered in the senate, restores the pay of the coast survey officials (changed by the house) to the figures now existing ; it also appropriates $10,000 for salaries and expenses of the National board of health.

LETTERS TO THE EDITOR.

A most extraordinary structure.

Aside from the publicity which your theosophical correspondent has given the error which unfortunately crept into one of the plates in a recent contribution of mine to the Proceedings of the Zoölogical society of London (*Science*, vii. No. 177), the subject, I understand, has created no little comment in other quarters. Indeed, so thoroughly has it been discussed that I should have entirely disregarded this additional notice of it, had it not been that the attention thus called to it by this theosophist of the Smithsonian institution, placed it before your readers as 'a most extraordinary structure.' Surely it must be a structure most extraordinary to have excited any wonder in the eyes of a Smithsonian theosophist, when, in view of the fact that the published researches of Prof. Elliott Coues, another theosophist of the Smithsonian, called for no comment whatever. The succinct account of the researches I refer to, were published by Professor Coues in the New York *Nation* (Dec. 25, 1884), wherein this author in referring to his examination of ghosts, says "I myself, personally, have repeatedly by physical, chemical, and microscopical examination studied detached portions of them [ghosts], as hair, nails, or pieces of any substance which may envelop them more or less completely."

The fact of the matter is this, in both the figure and text I described the right humerus of a humming bird for the left. Mr. F. A. Lucas the osteologist of the Smithsonian discovered the error and courteously pointed it out for me. But Mr. Lucas did not write the letter in *Science* signed 'a theosophist,' and notwithstanding the fact that I am personally acquainted with the members of the staff of that institution, I know of no theosophist there who has made sufficient progress in the study of the morphology of the Trochilidae to have detected the error in question. If there be such a person he has not up to the present time communicated the results of his studies to the world.

As soon as the error was clear to me, I immediately made a full series of corrected drawings, which, with additional notes upon the subject, are now in the hands of Dr. Sclater, the editor of the Proceedings of the Zoölogical society.

It pains me far more that the plates of such an elegant publication as the Proceedings of the Zoölogical society is, should be marred, even to the slightest degree, through any error of mine, than I regard how that error may reflect or affect myself. Fortunately, in the present instance it in no way alters the conclusions arrived at, and so far as I am aware there are but few, if any anatomists, who have not at one time or another been equally unfortunate. Even Huxley's famous 'Anatomy of vertebrates' seems to fulfil a useful end, notwithstanding the fact, that this eminent biologist contends on the 322d page of that work, in describing the stomach of a ruminant, and referring to the mucous membrane of the reticulum, says "it is raised up into a great number of folds, which cross one another at right angles, and, in this way, enclose a multitude of hexagonal-sided cells." Still this statement would make no one believe that few people living could render a better description of the digestive apparatus of a ruminant than Professor Huxley.

R. W. SHUFELDT.

Fort Wingate, N. Mex., July 3.

Barometer exposure.

The discussion concerning this subject has thus far had regard mainly to the use of the mercurial barometer and for meteorological purposes. Possibly light may be shed on the general subject by a few observations made in the field with an aneroid. From the nature of its construction it yields more quickly to rapid oscillations of atmospheric pressure. Moreover, field-work presents greater variety of conditions of exposure, and is consequently more suggestive of the controlling circumstance in any anomaly.

The following observations derived from experience, upon the western prairies of the Mississippi valley, may not be without value in this connection.

1. In gusty winds the index of the barometer oscillates very perceptibly to each gust. A variation of .01 of an inch has been observed.

2. In steady wind the barometer reads very differently, according as it is held to the windward or leeward of the body. In a wind which I cannot characterize more definitely than as a stiff breeze, I have noted in such relations a difference of .02 of an inch, the barometer being about three feet above the level surface. When desiring accurate readings in a strong wind, the mean between the windward and leeward readings should be taken, and, if the wind be gusty, the maximum reading in each case.

3. Upon flat-topped buttes I have found the barometer indicating considerably less pressure in the calm just back of the windward edge than in the wind at the edge.

Such buttes offer an inviting field for experimentation on this subject. They are often quite symmetrical, frequently have horizontal strata running through them to serve as convenient planes of reference, and are not infrequently isolated upon an extensive plane.

Attention to barometer exposure is evidently as important to hypsometry as to meteorology.

J. E. TODD.

Tabor college, Tabor, Io., July 3.

A bright meteor.

Last evening at fifteen minutes past eight o'clock a meteor of unusual size was observed. Its apparent size was, by rough estimate, six times that of Venus at its (Venus') brightest; and that, though it was quite near the moon, which was past its first quarter. Its altitude was about 30°, and azimuth perhaps S. 10° W., and its motion downward and eastward at about 50° from the horizon.

Its disappearance was with a slight scattering of fragments, but no explosion was heard.

S. H. BRACKETT.

St. Johnsbury, Vt., July 12.

Inoculation for the prevention of yellow-fever.

It is generally understood among educated people in Rio de Janeiro that all persons are not equally liable to attacks of yellow-fever. I believe I am safe in saying that but few native Brazilians die of it, the greatest number of deaths being among the following: newly arrived foreigners, and especially those who live in the poorer quarters of the city, or who lead dissolute lives, sailors, and persons of a lymphatic temperament. If there is any foundation for these popular theories, might it not be possible for an observant person to inoculate seven thousand individuals from the same or similar localities in Rio de Janeiro without running an average risk or fairly testing the system employed?

The efficacy of Dr. Freire's inoculation against yellow-fever can scarcely be considered as having been put to a fair test, therefore, until something is known of the persons inoculated, their nationality, time of residence in Rio de Janeiro, temperament, occupation, circumstances, and personal habits.

JOHN C. BRANNER.

Indiana university, Bloomington, Ind.

Bird-killing sparrows.

So much has been said of late for and against the English sparrow, that the following note may not be uninteresting as evidence.

Quite recently, upon the Capitol grounds, I observed a sparrow in the act of slowly killing a brown humming-bird. When discovered, it had seized the struggling victim in its talons, and was picking it vigorously about the head. Whenever disturbed, it caught the neck of its fluttering prey in its bill, and, after flying a few feet, alighted, and renewed its bloody work. At first I supposed the victim to be a sphinx moth; but, although every attempt to release the captive was futile, the identity of the humming-bird was unmistakable. Soon the first sparrow was joined by another, and then the scene of murder was carried into a copse beyond the reach of my observation.

To those who attribute the destruction of our American birds entirely to the demand for wings for ladies' hats, as well as to those who deny the quarrelsome habits of the sparrow, this piece of information may be of value.

C. D. WHITE.

National museum.

SCIENCE.—SUPPLEMENT.

FRIDAY, JULY 16, 1886.

ON THE PRESENT ASPECT OF CLASSICAL STUDY.[1]

THE chance that made me the first professor appointed to a chair in this university has made it my duty to represent the school of letters on this festal day, which has been chosen for the commemoration of the first completed decennium of our existence as an institution. The work of the university, so far as it can be expressed by lectures and by publications, by the number of teachers and of students, by the hours spent in laboratory and seminary, is all of record. Judged even by the census standard of facts and figures, it will be granted that what has been done here in the last ten years does not fall short of the standard which was set up in 1876. Less measurable, but not less certain, are the indications of our influence on the whole circle of university work in America; and, whatever we may have failed to do, we have assuredly not failed in rousing to greater vigilance, and stimulating to a more intense energy in other parts of the wide field; and, whether in the way of approval or in the way of protest, our example has made for life and growth and progress. This life and growth and progress have found a material expression in the erection and equipment of model laboratories for biology, chemistry, physics. Departments that are less tangible in their material and in their methods have little to show the visitor except a few books and a goodly number of men, — ardent students, who are busy with old problems and new, enriching themselves with the spoils of the past, laying up store for those who are to come after them, in the present neither envious nor afraid. As to this whole department of letters, then, — that department which has naturally fallen most under my own observation, — I can truly say that the healthy increase in the schools of language and literature is something that has transcended my most sanguine expectation. In numbers we outrank many of the minor German universities; and in the more abstruse and recondite studies, such as Assyrian and Sanscrit, we hold our own with some of the leading schools of Europe. As for our American sisters, it is not so easy to separate graduate work from undergraduate work in other American universities as it is here; and hence the comparison of numbers might not be fair, and might be misinterpreted; and instead of emphasizing too much our large number of graduate students, it may be better to say in regard to all the schools of the country in which higher work is done, that we count their success as our success, for we are all helpers one of another. And here I would take occasion to echo the wish, which I have often heard expressed of late, that the university departments in all American institutions of learning might be so organized that students could pass from one to the other in the prosecution of a line of study just as they do in Germany, much to the advantage of their breadth of vision, their freedom from local or personal influence. For my own part, I have always congratulated myself that I was brought under the influence of three distinct and markedly distinct philological schools, — Berlin, Göttingen, and Bonn, — and I have no doubt that, when the time comes, there will be a university exchange that will help us even more than the measure of it that we have thus far enjoyed. We then of the department of letters have our success to speak of on this day when a little 'self-esteem grounded on just and right' may be pardonable, if not, as Milton says, profitable. But it is a success that carries with it the gravest responsibilities. The ark we bear contains more sacred vessels than it held when we set out; and on an occasion like this it becomes us not only to exchange hearty congratulations that we have been helped thus far on our way, but to renew our hold with greater vigor, and to plant our feet more firmly, with a clearer view of the path to be trod and the burden to be borne.

To some, I do not know to how many, certainly to some of those whom I am addressing, the special line of work to which my own life has been devoted may seem to have had its day; and to plan for the future of Greek is to plan for an elaborate structure on the foundation of some table rock, destined at no distant time to fall and disappear on the restless current of modern life. A monument was erected some years since to the memory of the last old woman that spoke Cornish; and it would require no great stretch of imagination on the part of some of our friends to fancy that some youth may be present here to-day who shall live to see the cremation of the last

[1] Address delivered at the tenth anniversary of the Johns Hopkins university.

successor of Sir John Cheke on this side of the Atlantic ; of the last old woman, trousered or untrousered, that shall have discharged the office of a professor of Greek in an American university. People who have reached a certain age, and have become somewhat reflective and prophetic, generally console themselves with Hezekiah's words. But I cannot content myself with the thought that there will be peace and truth in my days. There has not been much of either of these commodities in my first half-century, and I do not expect the market to be glutted with them in my second. Surely there is no sign that there will be any peace about Greek, or truth about Greek, in any period that I can reasonably hope to reach. But the peace and the truth that may be denied me from without are vouchsafed me abundantly from within ; and while many of my fellow-workers are in woe for the silver shrines of Diana, and mourn for the abandonment of Greek, and sorrow that the trade in text-books languishes, I am serenely standing where I stood many, many years ago, when I published my first article on the 'Necessity of the classics,' a title not to be confounded with the 'Necessities of the classics,' about which one hears far too much. I live in the abiding assurance that what is inwrought in the structure of our history and our literature must survive so long as the history of our race and the history of our language shall survive. To disentwine the warp of the classics from the woof of our life is simply impossible. One mediaeval writer every one must know, and, measured by modern standards, Dante was not a classical scholar of the first rank. His perspective of antiquity was false, his estimate of the poets of the past was far from being just; and yet what is Dante if you loosen his hold on the classic time? I will not speak of Milton, steeped in classic lore: I will speak of Shakspeare. None but those who have read Shakspeare with the eye of the classical scholar know how much the understanding of Shakspeare is dependent on training in the classics; and more than once when I have hesitated as to whether it was pedantry or not to use a Greek word in my English discourse, I have turned to Shakspeare.

Is this the judgment of a man who can see only through his own narrow casement? Scarcely had I set down those words, when the following passage fell under my eye. It is to be found in the recent introductory lecture of the professor of poetry in the University of Oxford. "The thorough study of English literature, as such, — literature, I mean, as an art, indeed the finest of the fine arts, — is hopeless unless based on an equally thorough study of the literatures of Greece and Rome. When so based, adequate study will not be found exacting either of time or of labor. To know Shakspeare and Milton is the pleasant and crowning consummation of knowing Homer and Aeschylus, Catullus and Virgil; and upon no other terms can we obtain it." [1]

To be sure, we have promise of mountains and marvels if we break with the past. What satisfied us in our boyhood no longer suits the fastidious taste of the present ; and the Phoebus Apollo of our youth, clad as to his dazzling shoulders with a classic cloud, is shown up as nothing better than a padded dandy. Our adored Thackeray is no longer faultlessly attired in a garb of perfect English : he is simply a stylistic old beau. The plots in which we once took delight are nothing but vulgar tricks, and the lifting of a teakettle lid and the setting down of the same are intrigue enough for the conduct of a two-year-long novel. All this new literature has nothing to do with the classics. Far from it. And yet I am not at all shaken by the self-satisfied edicts of those who rule so large a portion of the reading world ; and I maintain with unwavering confidence that all healthy literature must be kept in communion, direct or indirect, with the highest exemplars of our Indo-European stock ; and if any thing could prove the necessity of a return to healthy human nature, with its compassed form, its fair red and white, it would be the utter wearisomeness of so much recent fine writing, in which there is no blood, no sap, nothing but division and subdivision of nerve-tissue. 'A pagan suckled in a creed outworn' is a joy and delight in comparison with the languid, invertebrate children of the great goddess Anaemia.

I have watched with much interest the development of the study of artistic composition in English during the last few years. Indeed, it would have been necessary to stop one's ears to keep out the shrilling cicada-sound of 'art for art's sake,' and all the theoretical buzz of aesthetic criticism. The interest has not been unmingled with amusement, because the apostles of progress are preaching very old doctrine, — a doctrine which I shall be glad to re-enforce, so far as I can, before I acquit myself of this function. Art for art's sake involves the very hardest, the very driest study, the very kind of study for which we philologians and grammarians are contemned. The accomplished master in the art of dipping, who delighted the world a few weeks since by his 'Letters to dead authors,' made his swallow-wing strong on the Elysian fields of the classics ; and those who should hold him up as an example of the kind of classical scholar we ought to have, little know to

[1] F. T. Palgrave, 'Province and study of poetry.'

what severe studies is due that easy grace. It is so cheap to talk about gerund-grinding and root-grubbing, as if gerund-grinding did not lead to the music of the spheres, and root-grubbing to the discovery of the magic moly that guards against the spells of Circe, of 'euphrasy and rue,' that purge 'the visual nerve.' He who neglects the elements lacks the first conditions of the artistic life. In the old times great artists did not disdain to prepare their own varnishes; and the old paintings stand fresh to this day, while many of their modern rivals, scarce a generation old, are falling into decay beyond the hope of recognition. The fair dream was embodied in machine pigments, and the machine pigments flake off, and with them the fair dream vanishes. If grammatical research is pressed with regard to truth, to that which is, then the gerund-grinding, as the color-grinding, not only has its warrant in itself as a useful exercise, but it is sure to be available for higher purposes; and if it is not given to every one to make use of grammatical results for artistic ends, still no organic fact is without its value, none will fail of its appropriate place in the completed system of art as of science. To me, as an ardent lover of literature, as one who was led through literature to grammar and not through grammar to literature, the fairest results of a long life of study have been the visions of that cosmic beauty which reveals itself when the infinitely little fills up the wavering outline, and the features stand out pure and perfect against the sky of God's truth. Now, for the study of literature as an art, we have every thing to learn from the old critics; and what our own Sylvester, our own Lanier, have re-discovered as to the science of verse, is a chapter from antique rhetoric. Mr. Lowell has recently pointed out the great secret of Gray's abiding popularity. That consummate master did not disdain the close analysis of the sensuous effect of sound; and the melody of Coleridge is due in a measure to a conscious though fitful study in the same line. Of late an author, whose charm of style was first appreciated in this country, has written an essay in which he applies phonetic analysis to the works of our great prose writers, and strikes the dominant chord of what seems unconscious music. The essay might have been written in the beginning of the first century as well as the end of the nineteenth, and have been signed Dionysius of Halicarnassus as well as Robert Louis Stevenson.

Whether, then, it be for the historical unity of the race, whether it be for the human sanity of classical literature, whether it be for the influence on form either as example or precept, there is no danger that the ancient classics will be displaced from the list of studies necessary for the highest and truest culture. Nor do I think that the so-called hard and dry and minute research in this and cognate provinces of study will ever be abandoned in favor of a mere bellettristic phrase-mongery about half-understood beauties. What is hard, what is dry, what is minute, depends very much on the spirit in which it is approached by the student.

Some years since, I attended a lecture by a great master. The theme was the vanishing of weak vowels in Latin. Candor compels me to state, that, although I pride myself on being interested in the most uninteresting things, I should have chosen another subject for a specimen-lecture. Candor compels me to state also that I very much question whether the illustrious teacher would accept all his own teachings to-day, such progress do grammarians make in devouring themselves as well as one another. I was much struck with the tone in which he announced his subject. It was the tone of a man who had seen the elements melt with fervent heat, and the weak vowels vanish at the sound of the last trump. The tone, indeed, seemed entirely too pathetic for the occasion; but as he went on and marshalled the facts, and set in order the long lines that connected the disappearance of the vowel with the downfall of a nationality, and great linguistic, great moral, great historical laws marched in stately procession before the vision of the student, the airy vowels that had flitted into the nowhere seemed to be the lost soul of Roman life, and the Latin language, Roman literature, and Roman history were clothed with a new meaning. And so we of the language departments do not intend to be disturbed in our work by criticism on the arid details of our courses; nor, on the other hand, are we unmindful of the larger and more popular aspects of the wide field of culture which we occupy.

There is no form of art, no phase of philosophy, of ethics, no development of physical science, that is alien to the student of language; and the student of physical science, in his turn, needs the human interest of our study to save his life from an austere and merciless quest of fact and principle in a domain where man enters only as a factor like any other factor. But first and last, the scientific standard must be upheld for the university man, be he a student of letters, be he a physicist; and that standard is the absolute truth, the ultimate truth. 'Nothing imperfect is the measure of any thing,' says the prince of idealists.[1]

B. L. GILDERSLEEVE.

[1] ἀτελὲς γὰρ οὐδὲν οὐδενὸς μέτρον (Plato, Republic VI., 504 C).

MR. JAMES SULLY ON THE PRECOCITY OF GENIUS.

WHENEVER Mr. Sully turns his attention to a problem in psychology or anthropology, he is sure to give it a lively, interesting treatment, and to accompany it with a wealth of illustration. His paper on 'Genius and precocity' in the June number of the *Nineteenth century* is no exception to this; and it has the additional attraction of dealing with a question quite within the popular comprehension.

Mr. Sully says that the idea that genius reveals itself early in life is repugnant to common sense. It seems more fitting that genius should be the result of development and close application. To test the question, two methods may be pursued. First, it may be asked what proportion of those who have shown marked precocity have afterwards redeemed the promise of their youth? and, secondly, what number of those who have unquestionably obtained a place among the great were previously distinguished by precocity? The former line of inquiry is evidently of great complexity, and Mr. Sully therefore confines himself to the second question, and also examines only instances in modern times, where the evidence is reasonably full and accurate, and in the departments of art and literature. The field of practical affairs, including statesmen, soldiers, and ecclesiastics, is not entered upon. Mr. Sully's precise question therefore is, in what proportion of cases, in the realms of art and literature in modern times, has recognized intellectual eminence been preceded by youthful distinction and superiority to others. He distinguishes seven groups: 1°, musicians; 2°, painters; 3°, poets; 4°, novelists; 5°, scholars, including historians and critics; 6°, men of science; 7°, philosophers. Any manifestations in childhood or youth of an exceptional aptitude and bent, corresponding to the special direction of the later development of genius, are taken as indications of precocity. Childhood and youth end, in Mr. Sully's data, at the twentieth year of life.

In his first group, the musicians, Mr. Sully cites as precocious the well-known cases of Mozart, Beethoven, Mendelssohn, and Schubert; and the not so familiar cases of Meyerbeer, Hillier, Spohr, Méhul (who was an organist at ten), Schumann, Cherubini, Auber, Weber, David, Lotti, and Purcell. Rubinstein played finely at ten, Liszt at twelve. Of 40 musicians enumerated, 38 showed a decided bent before twenty. Of these 38, 29 are known to have had the gift as children, and there is reason to believe that others betrayed it by the age of twelve. In only two cases — the rather surprising ones of Rossini and Wagner — is there a lack of early manifestation of musical ability.

The second group includes painters and sculptors, and among the precocious are to be found Mantegna, Andrea del Sarto, Raffael, Tiziano, Michael Angelo, Murillo, Holbein, Ruysdael, Cornelius, Vernet, and Ary Scheffer. Of the great sculptors, Canova carved a lion at twelve, and Thorwaldsen began work at eleven. Of the 58 representatives of this group, 42 showed decided talent before fifteen, and 47 before twenty. In none of the instances was artistic fame acquired after the age of forty.

Among the poets, comprising the third group, Tasso wrote 'Rinaldo' at seventeen; Calderon composed very early; Goethe wrote dialogues at six; Alfred de Musset had written poems before fourteen. Beaumont, Cowley, Pope, Byron, and Coleridge were all precocious. Elizabeth Barrett Browning wrote poetry at eight, and Mrs. Hemans published her first volume at fourteen. Of 52 poets, 39 were distinctly precocious.

The fourth group, novelists, tells a similar story. Scott, Dickens, Lytton, Balzac, Hoffman, Charlotte Brontë, and Miss Burney are familiar instances of precocity. Of 28 novelists, 21 gave evidence of great imaginative power before twenty.

Of the fifth group, scholars, historians, and critics, Grotius, Porson, Niebuhr, Macaulay, and Thirlwall are well-known instances. Of 36 representative names, 30 showed preternatural ability in childhood or early youth.

The sixth group, men of science, has among the affirmative instances Galileo, Tycho Brahe, Newton, Thomas Young, Clerk-Maxwell, Sir William Rowan Hamilton, Cuvier, Haller, and Laplace. Of 36 cases examined, 27 gave evidence of a decided bent to science before twenty; of the remainder, 5 took to science after twenty, and 4 are doubtful.

The seventh and last group, philosophers, shows as precocious Berkeley, — who, as his commonplace-book shows, hit upon his new principle of idealism when a youth of eighteen at college, and who wrote his 'New theory of vision' at twenty-four, — Hume, Leibnitz, Schelling, and John Stuart Mill. Of 37 eminent representatives of this group, 25 showed marked philosophical inquisitiveness before twenty.

The summation of the seven groups is remarkable; for it shows that out of 287 names chosen, 231, or 80.48 per cent, were precocious. As a rule, the productive period also begins early. In a total of 263 cases, we find 105, or 40 per cent, produced works before the age of twenty; and 211, or 80 per cent, before the age of thirty. Moreover, a large majority of great men attain success in early manhood. Out of 258 cases examined, 101, or nearly 40 per cent, attained success before the age of twenty-five; and 155, or 60 per cent, attained it before thirty-five.

In viewing the statistics as a whole, we find the following results: —

1°. The proportions of the various groups showing distinct promise before twenty are, musicians, $\frac{19}{20}$; artists, $\frac{8}{9}$; scholars, $\frac{5}{6}$; poets, novelists, and men of science, each, $\frac{3}{4}$; philosophers, $\frac{2}{3}$.

2°. Taking the age of thirty as the limit, we find the following proportions of the various groups showing early production: musicians, all; artists, $\frac{41}{42}$; poets, $\frac{11}{12}$; scientists, $\frac{4}{5}$; scholars, $\frac{5}{7}$; philosophers, $\frac{5}{9}$; novelists, $\frac{9}{16}$.

This order in respect to precocity answers roughly to the degree of abstractness of the faculty employed. The musicians and artists, representing the sensuous faculty, are found at one extreme; and the philosophers, representing the highest degree of abstraction, at the other. Between them are the poets and novelists, the men of imagination.

Genius, Mr. Sully concludes, is essentially natural. A truly great man is born such; that is, he is created with a strong and overmastering impulse to a definite form of origination: so he usually evidences it early. But actual production implies also opportunity, physical vigor, and leisure; hence circumstances become of importance as aiding or delaying achievement. Allowing for all this, there are some cases which are explicable only as illustrations of a process of slow development. Sometimes, as was the case with Dante, Milton, and Cervantes, the postponement was volitional and not compulsory.

Genius is precocious, then, in the sense that it manifests itself early. But does it attain the summit of its development quickly, or does it go on improving as long as, or longer than, ordinary intelligence? This is a separate question, and one to which Mr. Francis Galton ('Hereditary genius,' p. 44) gives an affirmative answer. We hope that Mr. Sully himself will before long throw some light on this question too.

EVERY-DAY LIFE OF THE WOMEN OF INDIA.

THE Society of arts lately listened to a paper by Capt. Richard Carnac Temple on the life and habits of the women of India. The author's qualifications for writing such a work would seem to be excellent, as he has lived long in the country, and has an extensive acquaintance with its popular literature. He does not treat of all classes of Indian women, but chiefly of the higher-caste Hindus, who, however, as he tells us, practically set the example for all the rest.

An Indian woman's life, he says, in its ordinary course, is divided into two clearly defined parts, which are quite distinct, though separated from each other only by the fateful day on which she first goes to take up her abode within her father-in-law's family. Note that it is not called in the Indian languages her husband's family, for that, under the Indian family system, it can seldom be in the case of a bride. Childhood, rather than girlhood, is the heyday of the Indian woman. Free to play as she pleases, with plenty of companions (for children can hardly ever be wanting in a family where all live together, from oldest to youngest); free to run in and out of the houses of friends; never bothered to learn any thing, except what she can pick up from the women about her; never worried with caste restrictions; never asked to do more in the way of labor than to help in the housework; petted by her parents; spoiled by her aunts and uncles, and beloved by her brothers, — an Indian girl-child is indeed happy, as children count happiness. And then suddenly the curtain falls. At about ten years of age — earlier in some parts, and later in others — our spoilt child is old enough to work in earnest, and so she is packed off, sorely against her will, to join her husband's family, entering it not as our brides enter their future homes, at the head of the female community, but at the bottom.

At this stage it is necessary to consider two matters, so far as they affect an Indian bride; viz., the practice of infant marriage, and what is known as the joint-family. It need hardly be stated that the so-called 'marriage' of infants is practised among all classes in every part of India, though of course there are many exceptions to the rule. The term 'marriage,' as applied to this ceremony by us, is, however, rather misleading. It is in reality an irrevocable betrothal, — a bargain, not between the infants who are 'married,' but between those who control them, being often nothing else than a purely commercial contract. It arises out of the theory that a woman is for life under tutelage, and her 'marriage' is therefore merely a transfer of the right over her to another party, — a transfer naturally very frequently made in return for a pecuniary consideration. After this marriage, or betrothal, the girl usually remains with her parents, in trust for those to whom she is to be transferred, until the home-coming, or going to her husband's house, which may be looked upon as the real marriage, as we use the word. Until the second ceremony takes place, the child-wife is still a child to all intents and purposes, and treated as such, and it is only after it that she in any sense enters on the duties of female life. The family she joins is exactly like that she has left, only it is that of another; to her a vast difference, and one which she never forgets—indeed, it is not unfrequently made painfully apparent to her at every step. What may be called the regulation Indian joint-family is one composed of the paterfamilias, all his sons and brothers, and various extraneous relatives, such as nephews, cousins, and wife's kindred, for the male part; and all their wives, in addition to his own wife and daughters, together with a sprinkling of the family widows, for the female part. In this patriarchy there are grades upon grades, both male and female, dependent chiefly upon age and distance by blood from the head of the family; and as everybody is married in India as soon as the time for it comes, the chances are that the last-made bride is, in the nature of things, in the very lowest place.

In the average Indian family the strictest domestic economy is the rule of life, and the household work is done by the women of the household, not, as with us, by paid servants. Servants there are, of course, in all Indian families, but they are, as a rule, on a totally different footing from that of the European domestic, being for the most part independent persons with a *clientelle*, for whom they perform certain customary services for a customary wage. The distribution of the daily work, down to the most menial kind, lies with the materfamilias, who may be best described as the oldest married woman in the family proper, for widows can have no authority. The cooking, as the work of honor, she keeps to herself, but the house-cleaning, the washing, the care of the children, the drawing of the water, the making of the beds, and so on, is done by the less dignified members of the household, as she directs; and whatever is most menial, most disagreeable, and the hardest work, is thrust upon the bride.

Not only is our bride thus turned into a drudge, often unmercifully overworked, but from the day she gives up her childhood to the day of her death — it may be for sixty years — she is secluded, and sees nothing of the world outside the walls of the family enclosure. She is also, by custom, isolated as far as practicable from all the male members of that little inner world to which she is confined. Free intercourse, even with her own husband, is not permitted her while yet her youthful capabilities for joyousness exist.

Every person belonging to the European races well knows how much common meals tend to social sympathy; how powerful a factor they are in promoting pleasurable family existence, and in educating the young to good manners. There is nothing of this sort in Indian upper-class society. There the men and women dine strictly apart, the women greatly on the leavings of the men, and that, too, in messes of degree, very like those in a royal naval ship. Paterfamilias dines by himself; then the other men in groups, according to standing, waited on by the women under fixed rules; and lastly the women, when the men have done, our poor young bride coming last of all, obliged often to be content, it need hardly be said, with the roughest of fare.

Such, then, is one of those customs which go to make an Indian woman's existence less happy than it might be. Let us notice another, this time as to family intercourse. No imported woman may have any relations with those males who are her seniors. Every bride is such an imported woman, and all the household which she enters who are the seniors of her husband are her seniors. This at first generally includes nearly the whole family, and must necessarily for a long while include the major part of it. In all her life she never speaks to her husband's father, uncles, or elder brothers, though dwelling under the same roof, or, to speak more correctly, within the same enclosure, for an Indian house is what we should call a courtyard surrounded by sets of apartments. On the other hand, paterfamilias has not only never spoken to, but technically never even seen, any of the younger women of his varied household, except those born within it, though they all dwell under his protection and at his expense.

There is another custom regarding which it is useless to pretend that it does not lead to endless misery and family squabbling, — the absolute subjugation of the women to the materfamilias. The mother-in-law is indeed an awful personage in the eyes of her sons' wives, one against whose will and caprice it is hopeless to rebel. One cannot describe her power better than by noticing a daily ceremony which symbolizes it. It amounts to wishing 'good-morning,' is called in Upper India *máthá tekná*, and consists of bowing down to the ground and touching it with the forehead. All the women, except her own daughters, perform it daily to the materfamilias when they first see her, and a bride must do it practically to everybody.

An Indian woman's happiness in life immensely depends on her becoming the mother of a son. This at once raises her in the family estimation, which is all in all to her; insures her against the greatest bitterness of widowhood, in case that befall her; and procures her domestic authority should she survive the mature years with her husband still living. Materfamilias is a veritable queen in her own little world, often coercing her husband, commanding her sons, and ruling the rest as she pleases. The remarks just made apply, as above said, to the mothers of sons only.

Again, take the case of the widow from infancy: shorn of much that women value in the world, dressed in coarse clothing, deprived of her ornaments, compelled to fast till health breaks down, made to subsist on the coarsest of food, kept out of what amusements come in the way of the rest of the household, forced into being the unpaid drudge of the family, held to be the legitimate butt of the ill nature of all, considered fit only to amuse the children, openly called and taught to think herself a creature of ill omen, — this being the cause of all the rest of her sorrows, — superstition has indeed nowhere else shown more clearly its power to pervert the reason of man. How much the women dread widowhood is exhibited to the full in the fact that to call a woman a widow is to offer her a dire insult, and from her earliest childhood a girl is taught to pray that she may die while yet the red spot, which is the sign of the married state, remains on her forehead.

It must not be thought, however, that an Indian woman's life is necessarily all unhappiness. Human nature in her case is as capable of adapting itself to circumstances as elsewhere; and since the ultimate gauge of permanent individual happiness is suitability of temperament to immediate surroundings, many a woman in India must be so constituted as to be quite content with the life she is called upon to lead, and in fact to enjoy it. When a girl is naturally sedate, yielding, and good-natured, of blunt susceptibilities, limited aspirations, and strong religious emotions, she will give in to her mother-in-law, avoid quarrelling without effort, follow the course of life laid down for her without demur, thoroughly believe it to be the only desirable life to lead, find the innumerable restrictions imposed upon her not unwelcome, and become contented with her contracted sphere, and, if those about her happen to be kind, be quite as happy as any girl in the world. But the potentialities for misery involved in her surroundings are enormous, and, where such is the case, to argue that misery is not the frequent result would be to argue against human nature.

Such is the life of Indian women as described by Captain Temple; and there seems to be little to deprive it of its gloom, except the frequent holidays and the feasts that attend them. He tells us, however, that the women themselves are the strongest supporters of the social system which dooms them to such a life; and this he attributes in part to religious sentiment, and in part to the well-known fact, that women, all the world over, are the strongest advocates of social rules and ceremonies.

As to the best methods of improving the women's lot, the author of the paper spoke somewhat hesitatingly. He thinks that something may be accomplished by the native monotheistic church known as the Brahmo Somaj; and he alluded favorably to the efforts of certain missions of European origin, and to the society organized under the auspices of Lady Dufferin for furnishing medical aid to women. He took occasion to reprobate the practice of child-marriage, and expressed the hope that it may be disallowed by law. There is now pending in the Indian courts a case in which the question of the legality of such marriage has been raised; and if the decision should be against its legality, an important reform would thus be wrought. It is evident, however, that the main cause of the evils that Captain Temple has pointed out, is the system of caste; and so long as this system prevails, there can be no satisfactory improvement in the life of Indian women.

MINCHIN'S STATICS.

In the third edition of his valuable treatise on statics, of which the second volume has recently appeared, Professor Minchin has enlarged the work by about two-thirds of its previous amount. The new matter is almost all contained in the second volume, and consists largely in an exposition of the theory of screws, a chapter on astatic equilibrium, and very large additions to the chapters on the theory of attraction, electrostatics, and the theory of strains and stresses. There are also other important additions, notably in the chapter on virtual work. The theory of attraction is far more extensively treated than in the second edition, the space devoted to it being 122 pages as against 37. Spherical harmonics are introduced in the present edition, and it may be mentioned that the author proposes and employs the term 'Laplacian' to denote a Laplace's coefficient.

In the preface to the second volume the author lays stress on the fact that he has, in the chapter on attractions, explicitly adopted the C. G. S. system, in order to constantly fix the mind of the student on the concrete realities for which his symbols stand. This is undoubtedly most desirable; but we cannot help suspecting that the importance of this and similar points of discipline, as objects of a scientific treatise, are overestimated by Professor Minchin and other English writers. It is

A treatise on statics. By George M. Minchin. Vol. ii. Oxford, *Clarendon pr.*, 1886. 8°.

certainly going to great extremes to say, that, "without this definiteness of idea, no knowledge of the slightest value can exist." However, no harm would probably be done by this excess of what is certainly in itself a merit, were it not that the constant endeavor to insure the student's good grip of his tools throws into the background all considerations of elegance, and often interferes with unity of treatment and a harmonious development of the subject. In these features, Professor Minchin's work leaves much to be desired; but its comprehensiveness, the fulness and clearness of its explanations, and its richness in examples, make it extremely valuable both as a text-book and as a work of reference. Its usefulness in the latter capacity has been increased by the addition of an alphabetical index.

ROYCE'S CALIFORNIA.

THIS work is the seventh in the series of 'American commonwealths,' now in course of publication under the editorship of Mr. Horace E. Scudder. The author, who is already known to the readers of *Science*, is a native of California; and his work, as he himself tells us, has been a labor of love. It deals but slightly with the early history of the country, when it was under Mexican rule, but takes up the subject at the time when our government was seeking to gain possession. This was in 1846; and the work closes with the final establishment of order in the state in 1856, thus covering a period of ten years.

The work is properly divisible into two parts, the first treating of the conquest of the country by the United States, and the second of the politics of the state itself after the war was over. The reviewer is obliged to say that the book has grave faults of style and treatment, particularly in the earlier part. The style is verbose, and the chapters that treat of the conquest are carried to such a length that few persons will have the patience to read them through.

Mr. Royce, like most other people, regards the Mexican war and its accessories as little creditable to the American nation; though, of course, he recognizes the good results that have actually flowed from it. He thinks, too, that we might have got California by peaceful means, or at least with the consent of its inhabitants, if we had pursued the right course; and that we failed in this, he thinks is due to the misconduct of some of our military and naval officers. He is specially severe on Captain Frémont, whom he regards as mainly responsible for the fighting that occurred in California, and consequently for the animosities and race-hatreds that it engendered.

American commonwealths. California. By JOSIAH ROYCE. Boston, *Houghton, Mifflin & Co.*, 1886. 16°.

In the fourth and fifth chapters, the author treats of the 'struggle for order' between the law-abiding citizens on the one hand, and the criminal elements on the other. Congress having neglected to provide a permanent territorial government for California, the people met of their own motion in the autumn of 1849, and organized as a state, which was soon after admitted into the union. When this had been done, however, the struggle with the lawless elements of society was only just begun; and it took seven years longer to reduce the whole state to an orderly condition. The causes of the long continuance of social disorder were, in Mr. Royce's opinion, two, — the general sense of irresponsibility due to the irruption of a crowd of fortune-hunters; and the animosity of the American settlers toward the Mexican inhabitants on the one hand, and foreigners on the other; to which we would add the political incapacity of the Mexican inhabitants themselves.

In his last chapter the author treats briefly of the land question in California. When our government took possession of the country, there were many tracts of land the ownership of which was doubtful, and this would have caused much difficulty in any case. But our people saw fit to treat the ownership of all tracts as doubtful, and compelled the landholders to prove their titles in the courts as a prerequisite to having them recognized. The courts, however, sustained the vested rights of the proprietors; and Mr. Royce thinks that the whole history of California "has illustrated the enormous vitality of formally lawful ownership in land."

ACCORDING to official statistics, it appears, says the Journal of the Society of arts, that on the 31st of December, 1881, 382,131 persons were engaged in manufactories in Italy. Of these, 219,844 were spinners (69,447 being children); 77,779, weavers (13,628 children); and in printing 15,499 (618 children) were employed. In 1876 there were 229,538 weavers who worked at their own homes, chiefly in Sicily, Sardinia, Calabria, Apulia, and the Marche of Ancona.

— *Nature* states that during the present summer a university will be opened at Tomsk, in Siberia, the first of its kind in this part of the Russian empire. At first it will consist of two faculties, — an historical-philological one and a physical-mathematic. It already possesses a library with fifty thousand books, a very valuable paleontological collection, presented by Duke Nicolaus of Leuchtenberg.

SCIENCE.

FRIDAY, JULY 23, 1886.

COMMENT AND CRITICISM.

BY THE LAST STEAMER from Honolulu we received a letter from our correspondent giving an account of the present condition of the islands (p. 73). The great volcano Kilauea has just passed through a period of inaction. For seven years lakes of fire had been constantly visible. On the 6th of March last the amount of liquid lava flowing in various directions from the familiar lakes or craters called Halemaumau, New Lake, and the Little Beggar, was uncommonly abundant. The following day and night sharp earthquake shocks disturbed the residents at the Volcano house; and immediately afterwards the liquid entirely disappeared, leaving an irregular cavity 3,360 feet in length, and wide enough to embrace the areas of the three great openings. The greatest depth of the liquid removed was 580 feet. Quietness and darkness reigned till the 4th of June, when a new opening showed molten lava about forty feet in diameter. Three weeks later, June 25, the fire came back in earnest, filling up the old Halemaumau and some other portions of the caldera. For a long time to come, therefore, visitors may expect the old-time grand volcanic displays.

THE AMERICAN LIBRARY ASSOCIATION was organized in 1876 at Philadelphia, and the movement was followed at once in England by the founding of the Library association of the United Kingdom in the following year. Subsequent meetings of our own association have been held in New York, Boston, Washington, Cincinnati, and Buffalo, and the annual meeting of a year ago at Lake George. During all this period, Mr. Justin Winsor of the Harvard college library has been the president of the association. A great variety of circumstances has contributed to the interest and importance of the general meeting which was held in July at Milwaukee, under the presidency of Dr. W. F. Poole. To found libraries is the fashion to-day; and the librarians of our country have wisely organized to secure the best results from such splendid bequests as those of Pratt and of Peabody to the city of Baltimore, of the Seymour fund to Auburn, of the Forbes bequest to Northampton, and of the Newberry legacy to Chicago. Efficient management of such funds cannot fail to inspire a like generosity elsewhere. Also the movement toward a correlation of the public library and the public school is one whose success thus far appears to justify the confident expectation of future results of the highest moment.

The continued success of *The library journal*, the inception of a new periodical entitled *Library notes*, and the assured inauguration of the Columbia college school of library economy under the direction of Professor Dewey in January next, are among the noteworthy progressive features of library interests. We find the librarians insuring the success of their ventures in bibliography and indexing, through the co-operative method, now so thoroughly successful as a principle in matters commercial. The reforms of the last few years in library management are most encouraging, and the librarians are now suggesting the propriety of dignifying their work with the title 'learned profession.' We find them venturing, a little early, perhaps, the expression 'library science:' in short, their position has become largely aggressive. While, however, there is much in the new movement that is the subject of adverse criticism, no disinterested person can overlook the vast deal of good that has already been secured. There is, withal, need of continual care, lest, in the drudgery of endless details, the meaning of the proper integration of all these differentials be lost sight of; and there seems to be ground for the apprehension lest, with the rapidly increasing conveniences for library-work, the too great convenience of mere appliances may hamper individual freedom in the use of libraries. Also there is need of perpetual distinction between the mere reader and the thorough student; and in the equipment and management of a library, only the keenly discriminating intellect detects the proper relationship of the two. It very often happens that much of what the tools of the library will accomplish for the reader, the student whose aim is culture will prefer to do for himself. There is entire safety in predicting the ultimate outcome of all such issues: while the reader may himself be willing to work as a mere cog in the library wheel, the cultured student prefers to make the library merely an auxiliary in his own development.

NEW ZEALAND AND THE RECENT ERUPTION.

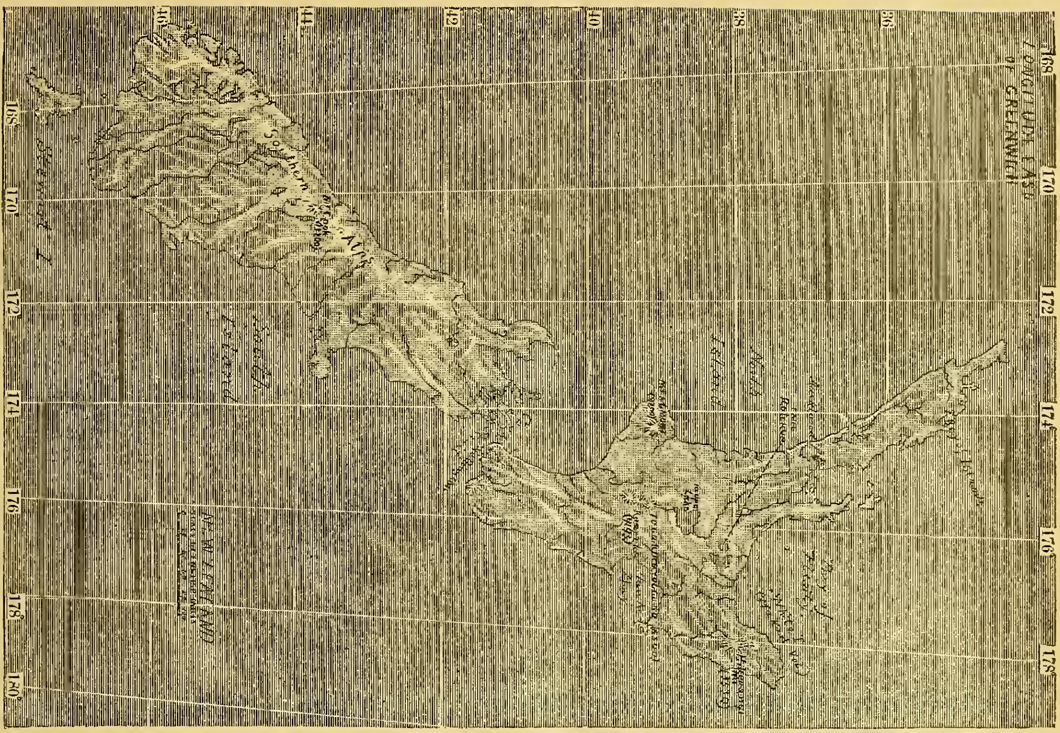
NEW ZEALAND forms one link of the great volcanic chain that girdles the Pacific Ocean, from South Shetland and Cape Horn up through the Andes, Mexico, British Columbia, and Alaska, crossing into Asia through the Aleutian Islands, and stretching south through the Kurile Islands, Japan, Ladrone Islands, Philippines, and West Indies, to Mounts Erebus and Terror, in the antarctic zone. The greatest volcanic energy is found where this great girdle crosses the torrid zone, — in the northern Andes, Central America, and Mexico, to the east; and in the Philippines and West Indies, to the west. Here the great stresses and pressures caused by the slow cooling and contraction of the crust of the earth are perhaps increased by others due to the centrifugal force of its rapid rotation on its axis. New Zealand lies a thousand miles south-east of Australia, in latitude 40° south, longitude 175° east, the antipodes of Spain, and comprises two large islands (North Island and South Island), with numberless smaller ones around their shores, — an area, in all, of about 100,000 square miles, or nearly that of Great Britain and Ireland.

The accompanying physical map of the islands will indicate at a glance the general topographic features. The centre of North Island is occupied by lofty mountains, which send off spurs in various directions to the coast, and are covered with forests from their bases nearly to their summits. The north-western peninsula abounds in fertile and well-watered valleys, and the main body of the island is characterized by gently sloping hilly ranges and low-lying tablelands, varied here and there by volcanic peaks, and covered with a luxuriant growth of timber. In the south centre is a wild highland region, seldom visited by travellers.

South Island is very different. The snowy peaks of the great southern Alps stretch along its western side, from ten to thirteen thousand feet in height, densely wooded to the snow-line. To the west are vast snow-fields and glaciers; and the coast is deeply and sharply indented by bays and fiords, which, with the numerous lakes of glacial origin, remind one strongly of the coast of Norway, although 30° nearer the equator. A low range lies along the centre of the island, with spurs at right angles, and numerous ravines through which the rivers break their way to the south-east. Farther east are terraces and plains.

North Island, the scene of the recent eruption, is somewhat smaller than South Island, and is about the size of Cuba, though stretching north and south, instead of east and west. The lake district, or region in the north-east centre of the island, has been well called the wonderland of the world, and for magnificent scenery and wonderful development of geysers, fumaroles, and hot springs, comes second only to our own Yellowstone park, if indeed it be not its peer. In the volcanic district, stretching from Mount Egmont, the western promontory, north-eastward through the centre of the island to White Island in the Bay of Plenty, there have been hitherto but two active volcanoes, — Tongariro (6,500 feet), a peak 30 miles south of Lake Taupo; and Wakari (860 feet), on White Island. The great snow-capped dome of Ruapehu, just south of Tongariro, and the highest point in the island (9,190 feet); Mount Egmont (8,200 feet), and the great volcanic promontory on which it stands; and hundreds of other extinct craters and vast fields of lava, tufa, and scoriae, — these all bear witness to the energy of volcanic action in comparatively recent time. And yet there has been no serious eruption till now, within the memory of European settlers, and even the Maori traditions give no account of one. Earthquakes, however, are not uncommon, though seldom sufficiently severe to cause great destruction, Cook Strait being regarded as the centre of the region generally disturbed: 342 were recorded from 1869 to 1879, and 28 in 1882, only one of which was at all severe, while ten were described as 'smart,' and the other seventeen only slight tremors. The most severe shock of which there is any record occurred the evening of Jan. 23, 1855, and caused great destruction in Wellington. Many fissures in the earth, landslides, and a great sea-wave were caused, and minor shocks followed it at decreasing intervals for about three months. There are many evidences that a gradual elevation of the whole country is going on; as, for instance, rocks are now visible in Cook Strait where there were none when the country was first discovered. This indicates that earthquakes or other disturbances are likely to occur, and helps us to understand the late eruption.

Lake Taupo, the great lake in the centre of the island, 1,250 feet above sea-level, 30 miles long, and 20 broad, covering an area of 250 square miles, occupies a depression caused by some great eruption, and is surrounded by cliffs of lava a thousand feet in height, with a little extinct crater



PHYSICAL MAP OF NEW ZEALAND.

GEOLOGICAL MAP OF NORTH ISLAND.

on an island in its centre — like Crater Lake, in Oregon, though on a larger scale. Out of it flows the Waikato River, running 200 miles northerly and westerly; and along its banks, some 25 miles from the lake, is one of the two great geyser districts of the island. The other and more extensive district is 40 miles north-north-east of Lake Taupo, and about the same distance from the shores of the Bay of Plenty. Here, among the mountains, lakes, and forests of the famous lake district of New Zealand, are the celebrated geysers, hot springs, mud volcanoes, and solfataras, which rank next to those of the Yellowstone in interest, and even surpass those of Iceland. Of the lakes the most picturesque is Tarawera, surrounded by rugged bluffs, with the mountain-peak of the same name close by, to the eastward. Next in size is Lake Rotorua, 6 miles in diameter, with a little extinct volcanic cone in the centre. Rotomahana, or Warm Lake, is surrounded by boiling springs and siliceous terraces, and the temperature of the whole body of water is always as high as 90° F.

It was here, then, in the lovely lake district, and from the 'not dead but sleeping' peak of Tarawera, that the great eruption burst forth on June 10, — an eruption unprecedented in the history or traditions of the island, though far surpassed by others that have left their ineffaceable record in the rocks. Two years ago, it is said, the water of Lake Ratakakahi, usually cold, grew hot; and there was a strong outflow down the Wairoa valley into Lake Tarawera for a day, when it resumed its normal condition. This was all the warning, so far as yet known, of this awful convulsion. At 1 A. M., the inhabitants of the little village of Wairoa were aroused by a violent shaking of the earth, followed by a continuous but not unpleasant motion. A bright red glow became visible about the top of the mountain, and vivid flashes of light seemed to shoot up into the air. In an hour the flashes of light became what seemed a massive pillar of fire, rising, increasing, and extending along the range. A dull rumbling accompanied it, and became a terrific roar, with continuous explosions, loud thunder, and vivid lightning, till heaven and earth seemed to be torn asunder. The air was filled with sulphurous odors, falling stones, mud, and lava. The village was annihilated, more than a hundred natives perished, and the fertile plains were buried in mud and ashes.

Such, briefly, are the first particulars that have reached us of this terrible convulsion. It has indeed given a temporary check to the progress of the island. But the mountain is now said to be quiet again, and perhaps not many years will have passed before the catastrophe is forgotten and its damages repaired, as has been so often the case with Vesuvius and Etna. Geology teaches that this is an old and dying region of volcanic energy, and that each eruption is less violent than the one preceding. We may therefore hope that this paroxysm will give relief, until the tension of the earth's crust, accumulated for another decade of centuries, shall again burst its bonds.

EVERETT HAYDEN.

THE AMERICAN LIBRARY ASSOCIATION.

THE ninth general meeting of this association was convened at Milwaukee, Wis., on Wednesday, the 7th of July, and was dissolved on Saturday of the same week. Dr. W. F. Poole, president of the association, and librarian of the Chicago public library, presided at all the sessions, of which the first were mainly devoted to the reports of committees, and the address of the president, which was brief and pertinent. Dr. Poole dwelt on the present urgent needs of libraries in general, and regarded it as a great misfortune that the plans for a building for the library of congress, presented to the association at its Washington meeting in 1881 and condemned by the unanimous voice of its members, and also the year following at Cincinnati, should have been definitely adopted by congress. The committee on the American library association catalogue reported progress in the work of formation of a catalogue of the works most suitable for the foundation of public libraries. The programme of the meeting was one of unusual interest, embracing about twenty-five papers relating in large part to special points in library management, though by no means wholly so. For example: Mr. Richardson's (Library Hartford theological seminary) paper, 'Why librarians know,' showed a very good basis for his modest plea for the recognition of librarianship as one of the learned professions. Whether they profess it or not, at all events librarians practise learning, and they have to do so, or they couldn't be librarians. The librarians of the new era are a long way from exemplifying the common insinuation that their knowledge relates rather to the outside of books than to their contents. Among librarians the number of book-producers is very large. Mr. Charles A. Cutter (Boston athenaeum) followed with a brief paper on 'Close classification,'— a problem which, more perhaps than any other, is agitating the librarians of to-day. Shall the library be divided into a few broad classes, — history, geography, science, art, literature, and the like; or shall these be broken into smaller parts, setting the history of England, Germany, France, etc., each by itself, and breaking up science into physics, botany, zoölogy, etc.;

or shall the subdivision be carried further, making periods in the history of countries, and dividing zoölogy into the orders and families of animals, and so on, or, even further still, allowing a place in the history of England, France, and Germany for every reign, also dividing mathematics into arithmetic, algebra, the calculus, etc., and breaking up orders of animals into genera and species? Each successive subdivision intensifies the difficulty of keeping all the books on a subject together. Grouping books does not remove them one from another at all: they are no farther off than before subdivision. Mr. Cutter was a strong advocate of putting by themselves all books on well-marked subjects. Mr. Lane (Harvard college library) submitted specimen sheets of an index for catalogues, which elicited discussion; following which was a paper on 'Close classification *vs.* bibliography,' by Mr. William I. Fletcher (Amherst college library). Classification as used in the sciences, he said, may be exact; but as used in a library it cannot be, for the reason that many of the best contributions to the discussion of a subject are not detachable from the books or sets of publications which contain them. The librarian must advise his readers to find in every possible way what is the actual literature of the subject he may have in hand. Bibliography is the watchword for the librarian of the future; and this, rather than classification, must furnish readers with the means of tracing the literature of their subjects. Mr. Fletcher regarded close classification as having fatal defects, as a system for the guidance of the reader to the resources of a library in a given subject; and it should be relegated to a subordinate place as a minor factor in library administration. The library system of our day has one important mission, that of furnishing the means of culture to a people whose life is in danger of being drawn into a fatal specialization. Mr. Fletcher characterized the prevailing system of classification as an attempt to substitute machinery for brains, and said that the greatest present needs of our libraries are intelligent librarians and assistants, and the best obtainable intelligence crystallized in bibliographic books.

Next came an elaborate paper on 'International copyright in congress,' by Mr. T. Solberg (Library of congress), who reviewed at great length the history and progress of congressional legislation on this subject. The paper was not read, but will be printed in full in the Proceedings of the association.

The evening session of the second day was entirely characteristic of the work of the association, being largely occupied with the technical details of library work, and embracing papers and talks by Mr. Cutter on author-notation for Greek and Latin classics, by Mr. J. N. Larned (Buffalo public library) on a few of the devices and arrangements in a library building, and by Mr. Melvil Dewey (Columbia college library) on 'Eclectic book-numbers,' illustrating simple methods of finding books on the shelves. Mr. R. B. Poole (Y. M. C. A. library, New York) reported, for the committee on congressional legislation, a resolution, which was adopted, recommending such legislation as shall enable libraries to send books to their outside clientage as second-class matter at one cent per pound.

The evening session of the third day was taken up with two noteworthy papers, — 'The first librarians' convention, 1853,' by Mr. E. M. Barton (American antiquarian society, Worcester); and 'The teaching of bibliography in colleges,' by Mr. R. C. Davis (Michigan university library), giving an outline of the system now employed at Ann Arbor.

Perhaps the most important matter coming before the meeting of the association was the report made at the morning session of the third day by Mr. Fletcher, on behalf of the committee on co-operative cataloguing, — a scheme which received some notice in *Science* a few weeks ago. The object in view is the preparation and printing of such catalogues, bibliographic guides, and indexes as shall serve to relieve the several libraries of a large share of the expense of the present system of publishing expensive individual catalogues. The committee had received replies from some seventy different libraries, favoring the organization of a publishing section of the association, after the pattern of the early English text and the Shakspeare societies. The association next heard the reading of a paper on 'Library buildings,' prepared by Mr. Eirikr Magnússon (Cambridge, England, university library), advocating the Archimedean spiral as the form most suitable for the library structure of the future. This plan was illustrated in the London *Athenaeum* some months ago, and may fairly be conceded to present certain advantages; viz., a maximum of book-space with a minimum of material used in construction, the possibility of enlargement of the original structure perpetually as required, without disturbing in the least the operations of the central library or its functions. But the association, while extending a cordial vote of thanks to Mr. Magnússon for his paper, was entirely unanimous in condemning his proposed library. In particular, Dr. Poole said the idea was substantially an old one, rejected long ago, and that the enforced sky-light for the book-stacks was a very serious disadvantage. Other members criticised the proposed building on the ground of supposed structural weakness, the unavoidable darkness of the stack when its roof might be under deep snows, and the impossibility of thorough ventilation, as no side windows or apertures could be provided.

The subject of the electric lighting and heat-regulation in libraries was next taken up, Dr. Poole relating his experience with both gas and electricity, and characterizing the latter as a luxury which none but the wealthier libraries could afford; while Mr. Dewey pronounced unequivocally in favor of electricity from experience with the Edison incandescent system in the new Columbia college library. Its absence of heat is greatly in its favor in the summer illumination of libraries; it gives off no products of combustion which, like gas, may injure the bindings of the finer volumes; and Mr. Dewey had found many people coming into the library to read by the electric light who were sufferers from eye-troubles if they tried to read by gas, or even petroleum illumination. No member of the association, however, could give precise information of the relative cost of gas and electric light, owing to the running of the dynamos for steam boilers used for other purposes. In recent issues of *Science*, the results of English experiments in this direction placed the electric light at very great disadvantage in point of expense, and made it cost at present about twice as much as gas. Mr. Cutter (Boston athenaeum) and Mr. Linderfelt (Milwaukee public library) explained the action of the apparatus employed in their libraries for the automatic regulation of the heat-supply, and pronounced it thoroughly satisfactory. The system involves the electric control of the registers and the openings in the windows, and is found to be competent to maintain the rooms at any desired temperature for which the indicator is easily set, as well as to effect a considerable saving of fuel. A delegate from Kansas said, that in his region natural gas is used over a large area, furnishing the library with both heat and light.

The other papers presented at the Friday session were by Mr. Woodruff (Cornell university library), on 'The relation of university seminaries to the university library;' and by Mr. Utley of Detroit, on 'The relation of the public library to the public schools,' in which it was stated that the supreme court of Michigan had ruled that the library is a part of the apparatus of the school, and the plan of reading and discussing the books in the schools during recitation hours had given admirable results. A vigorous discussion of the subject of binding books in libraries ensued; and the third day's session closed with the adoption of a resolution commending to states and institutions the trial of a plan for the collection and redistribution of documents, which had succeeded admirably under the direction of the secretary of the interior.

The untransacted business of the meeting necessitated a session on the fourth day (Saturday), when Mr. Green of the committee on public documents presented a report embodying the bill, now in the hands of the senate committee on printing, which will instruct the public printer to deliver to the interior department a sufficient number of copies of every government publication to enable every depositary of public documents to receive one. The measure is ably supported by Senator Hoar, for whom a vote of thanks was passed by the association. Mr. Green's report provoked animated discussion, and was followed by a paper by Mr. J. Schwartz (Apprentices' library, New York), which was mainly a satire on various prevailing systems of classification.

The secretary read a thoughtful paper on bibliography in general, and especially on the bibliography of the literature of science, by Mr. Mann of Washington, who remarked first the rapid rate of increase within the last few years of the application of bibliography to the work of the student of science — who is, nevertheless, apt to set too little value upon the refinements of the art of bibliography. The necessity of providing some method of indexing is the first lesson to be learned in the making of a useful bibliography, and such index should be very detailed. To secure the advantages of a condensed method of reference, some symbolism should be employed. The usual method of making citations in scientific writings is to refer to individual or separate works by the name of author, title, and page; to articles in periodicals by title of periodical, date (sometimes), and page. A very useful device is to give in a preface or appendix a list of all the works cited, with some symbol attached, and to refer to this symbol whenever references are to be made. Some authors have undertaken to accept some bibliography, the catalogue of the Royal society, for instance, as a standard, and to refer to the symbols employed in that; but there are many difficulties in the way of its use as such. Mr. Mann regards the arrangement of titles in a current bibliography as a matter of very little consequence. Nothing should be allowed to interfere with the practice of appending to each title a current numeral, the series of which should be continuous from volume to volume. As an aid to scientific investigation, the works enumerated in a bibliography should be analyzed, this analysis indicating the special phase of the subject treated in the work. Difficult analyses should be made by specialists. Each title in the bibliography should be confined as closely as possible to a single subject, even to the extent of entering the several chapters of the work as separate titles whenever they treat of distinct subjects. The whole work may be integrated under its own title by giving the list of its chapters in the analysis of the work itself.

Aside from its cost, the principal difficulty in the preparation of a bibliography like that described lies in getting any person or persons to undertake the labor and responsibility of writing or editing the work. The magnitude of the task is apparent. If, however, the work can be issued as a current bibliography, with no regard to the order of titles or the connection of subjects, making use only of such material as may be available at the time, and attaching to each title a current number to serve for reference from an index, no editor need feel oppressed with the magnitude of his task. Whatever is done will be a step in the right direction; and the work may, if need be, temporarily be abandoned, without a loss in value of what has already been accomplished. It is only necessary that the titles of chapters and articles be given accurately, and that the analytical references be made fully; while the rest may be left to others who for their own purposes will make indexes to take the place of any special analyses of contents.

The publishing section was duly organized before final adjournment, and this move on the part of the association is of the first importance. The section will begin at once the publication of indexes to scientific and other essays, and prosecute whatever work may be found practicable in the line of co-operative bibliography.

The association were handsomely received and entertained by the mayor, the Hon. Emil Wallber, and citizens of Milwaukee; and the success of the meeting was largely secured through the exertions of Mr. K. A. Linderfelt of the Milwaukee public library. On Monday, the 12th, the association left Milwaukee for an eight-day excursion in northern Wisconsin.

The officers elected for the ensuing year are, president, Dr. Poole; vice-presidents, Mr. Spofford (Library of congress), Judge Mellen Chamberlain (Boston public library), and Mr. W. E. Foster (Providence public library); secretary, Prof. Melvil Dewey; assistant secretary, Mr. Richardson; treasurer, Mr. Carr of Grand Rapids.

At the conclusion of its last session, the association was adjourned to meet at the Thousand Islands, in the second week of September, 1887.

David P. Todd.

HONOLULU LETTER.

The Sandwich or Hawaiian Islands, situated about 2,000 miles to the south-west of San Francisco, are commonly reckoned at twelve in number, four of them ranging from 500 to 3,950 square miles in area, and the entire group amounting to 6,040 square miles. On examining a good chart of the Pacific Ocean, one finds a row of small islands and shoals having the same trend with, and being really a north-westerly extension of, the Hawaiian group. There are fourteen of these in addition to those usually styled the Sandwich Islands, twelve of which are claimed by the Hawaiians, while the two most remote belong to the United States, and are known as Midway and Ocean Islands. The U. S. government is said to have expended $100,000 in improving the harbor of Midway Island, and coal is stored here also for the benefit of our war vessels and Japanese steamers. It would appear that this harbor has not answered expectations, and consequently negotiations have been commenced with reference to the cession to the United States of certain privileges at the Pearl Harbor district near Honolulu.

Two diverse theories meet us in the attempt to explain the origin of this extensive chain, between the meridians of 154° 30′ and 180°, and 1,725 miles in length. They are cones rising from a submarine plateau 16,000 to 18,000 feet below the surface. One view is that they are of volcanic origin, commencing as submarine volcanoes, and built up of their own ejecta, even to the height of 14,000 feet above the sea-level. The smaller ones are atolls, and are usually encircled by coral reefs; so that, after their original volcanic start, they must have been submerged for the accumulation of the organic growth. The other view ascribes their origin to an enormous subsidence, the several islands being supposed to be the summits of mountains, the apices of an ancient continent, capped by coral growth. If these were once a continent, we understand why the flora should be so much diversified, since the plants would be driven to the uplands by the gradual subsidence. In the same way it is easy to see how the Hawaiians themselves might have made their way here from the East Indies. The Hawaiian government has established a genealogical bureau at an annual cost of $5,000, which devotes much attention to the early continental condition of the kingdom, as well as the study of the ancestors of the royal family.

Wallace accepts the former of these theories, and finds, from a study of the plants and animals, affinities with America, New Zealand, and Australia, the relation to the first being the most remote. A botanist finds himself admiring the exaltation of our Compositae and lobelia into trees, and the violets, geraniums, and plantains into shrubs. The native phenogamous flora figures up to 554 species in Mann's catalogue, not including the grasses, and the ferns amount to nearly 150 species. Dr. Hillebrand, a former resident, has studied the plant-life most successfully, and has now in readiness for the press a complete description of all the Hawaiian plants. The government has declined to aid the publication of this volume, and it remains to be seen whether private enterprise will be adequate in bringing it before the public.

The most important scientific work done in the islands is of a topographical character, that of the government trigonometrical survey, under the very capable superintendence of Prof. W. D. Alexander. The annual appropriation has been $20,000 for many years. This survey was rendered necessary by the change from a feudal system of land-tenure to fee simple. In order to produce satisfactory results, the work must be like that carried on by the U. S. coast and geodetic survey. The boundary lines of the various tracts of land have now been drawn, and maps published of the islands of Oahu and Maui, and that of Lauai is ready for publication, while much labor has been expended upon Hawaii and elsewhere. The map of Maui, just published, is very creditable in every respect. The survey attends also to hydrography and to any special service required for particular purposes, as in the reconstruction of the large burnt district of Honolulu. The Hawaiians have two peculiar words to express the direction of boundaries, *mauka* and *markâi* (upward and downward), those being the most natural terms to express geodetic positions in oceanic islands.

Prof. L. L. Van Slyke of Oahu college recently made an elaborate chemical examination of the various waters used for household purposes in Honolulu. The high north and south ridge of Oahu causes the vapors brought by the south-west trade wind to fall upon it and to flow upon the surface and in subterranean channels to the western leeward shore where the city is located. The amount of rainfall varies greatly, according to the locality. Near the ridge the annual precipitation amounts to 150 inches; in the upper part of Honolulu to 70 inches; and at the harbor as little as 30 inches. As the rock is volcanic, there is a predominance of sodium carbonate in the springs, and sodium chloride and lime carbonate in the deep-seated waters brought up artificially. Fresh-flowing water is obtained from the sea-level to the height of 42 feet through artesian boreholes, and this altitude corresponds to a recent elevation of coral rock, all around the island. There is not enough of the salt and lime compound to injure the water for potable purposes, but sufficient to indicate its marine origin. There are 25 of these flowing wells, the water reaching the same level in every one, and in the very dry season they fall off about three feet. Those yielding water are generally from 200 to 500 feet deep. The layers passed through are separate layers of clay, lava, and coral rock, and the water rises immediately after striking a black basalt at the base of the coral. The deepest well was put down at the edge of a tufa volcanic cone known as Diamond Head to the depth of 1500 feet. As fragments of coral abound in the tufa, it is probable that the volcanic action interfered with the regular downward flow of the rain-water, and this explains the absence of water.

The Hawaiian government is a limited monarchy. It was not until the beginning of the present century that Kamehameha the First brought all the islands under his sway, and founded the kingdom. About 1820 the chiefs rebelled against certain idolatrous observances, just before the arrival of the first deputation of American missionaries. Christianity was soon accepted by the higher classes, and then by the mass of the people; so that in less than half a century the country was regarded as Christian, and the foreign clergy withdrawn. They had in the mean while been instrumental in framing an excellent constitution, and either the missionaries or their descendants have held many of the important offices.

On the first of July there was a ministerial crisis in the kingdom and a new cabinet formed, with the same premier as before, but with new men in all the other offices. The cause of the disruption was partly personal and partly financial. Political parties divide somewhat according to sympathy or opposition to the missionary *régime*. King Kalekaua and his friends exalt the native Hawaiians, and desire to restore old heathenish customs, thereby seeking to awaken sentiments of patriotism. Their influence is against the best form of Christianity, and the men best qualified for their respective offices are dismissed when they sympathize with the missionaries. The king is also desirous of controlling the pastors of the native churches, tempting them to give up the voluntary system of support, and rely upon the government for their pay. The expenses of the government are one and a half millions of dollars annually, — a larger sum in proportion to the population than is raised by most of the states of our federal union. As this income is chiefly raised from the foreign residents, they are much dissatisfied with the government.

Meanwhile the native population is steadily decreasing. In 1823 there were 142,000, against 40,000 in 1884; and the foreigners, including the half-castes, are now as numerous, the sum total of the population being 80,578. The Chinese are the most numerous of the foreigners, amounting to about 18,000. Of the Caucasian element the Americans exceed all others in number. In fact, the islands are practically an American colony, and hence are entitled to such consideration from the U. S. government as is afforded by the reciprocity treaty. The decrease of the native population is due to bad influences introduced by foreigners. If it were possible to enforce rigorous laws relating to intemperance, licentiousness, and leprosy, and to train up the natives to engage in the most suitable occupations, the decrease might be stopped.

The most extensive business is that of raising sugar and selling the raw product to the California refineries. About eighty companies and firms are engaged in the business, and it is estimated that 90,000 tons, worth seven million dollars, will be shipped the present year. The best machinery and the latest improvements are employed in the manufacture of a superior grade. Most of the companies are controlled by Americans or persons of American descent, and the money hired to carry on the business is also American. Some prejudice has been felt against the business, because of the connection with it, in a very prominent way, of Mr. Claus Spreckels, an American citizen who has been very successful. He formerly controlled the sugar business of the islands, and was able to dictate his own prices to the planters. But the planters are now independent of him, as a new refinery has been started in California which actually buys and refines more sugar than Spreckles' establishment. It is fortunate for the Hawaiian government that this gentleman is so largely interested in the islands, as he is able to assist them by loaning funds, though, it must be confessed, with large interest. Perhaps for this reason he has recently reaped a golden harvest by carrying out the principles of the silver metallists. He had the contract for furnishing the government with a million dollars' worth of silver coin, according to the American standard, and realized from the transaction the difference in value between the silver and the gold.

It is unfortunate that the politicians stopped the investigations of Dr. Arning into the nature and possible cure of leprosy. He had instituted experiments with animals and condemned criminals, illustrating the propagation of the disease, and had discovered methods of ameliorating certain stages of the malady. Nothing could contribute more to the welfare of the Hawaiian kingdom than researches of this character; and the removal of so efficient an experimenter for merely political reasons shows the prime cause of the decadence of the nation. What the government will be in the future, with its mixed population, no one can predict.

There is a social science club in Honolulu, meeting once a month, where questions of social, political, and physical science are vigorously discussed. The June assembly was held at the house of S. E. Bishop, whose name is familiar to the readers of *Science* as the discoverer of 'Bishop's rings' around the sun. Mr. Charles Cooke read a paper upon corporations, enumerating all the legal corporate bodies in the kingdom, followed by Chief Justice A. F. Judd upon the early history of the nation. The premier, Mr. Gibson, had said that the natives had done the most for the welfare of the nation, but Mr. Judd showed conclusively that the early missionaries had often saved the kingdom from destruction, especially when threatened by the irresponsible American, English, and French naval commanders. Had it not been for the prudence of Richards, the elder Judd, and other Americans, bombardment would certainly have followed the threats of those dissolute foreigners. The admirable constitution is due to the advice of the same missionary worthies. K.

Honolulu, July 4.

NOTES AND NEWS.

The U. S. geological survey has partially mapped out its work for the present year. It will extend over a large portion of the United States. There will be nine parties at work in Virginia, West Virginia, Kentucky, Georgia, North Carolina, South Carolina, Alabama, and Tennessee. Prof. A. N. Thompson will have charge of two field-parties in Oregon, two in California, one in Arizona, three in Texas, and three in Montana. Professor Renshaw will have charge of three parties which will do work in Kansas and Missouri. Four parties working in Maryland, Massachusetts, and New Jersey, will be under the direction of Professor Baker. The chemical laboratory of the survey, which is located in the national museum, will continue during the summer months the examination of rocks, minerals, soils, and other matters necessary before the survey's work is published.

— The coast-survey work is still embarrassed, owing to the lack of funds to continue operations; and no further instructions have been given for field-work, pending the passage of the appropriation bills. Mr. W. C. Hodgkins, who has been prosecuting the work of the survey on the North Carolina coast, near Cape Lookout, has returned to Washington, and is stationed at the office for the present. New editions of the charts of the north-west coast of America will be out within ten days.

— The total amount subscribed to date to sustain the Pasteur institute in France is $113,719. The sultan has presented Pasteur with the grand order of Medjidie, and $2,000, and will send a commission to Paris to study his methods of rabies prevention.

— Sixteen of the wolf-bitten Russians who were treated by Pasteur have reached Smolensk on their way home, and, being in perfect health, have telegraphed their gratitude to their preserver.

— Professor Ormond Stone has just issued part ii. of the first volume of the publications of the new Leander McCormick observatory. Part i., an account of the observations of the transit of Venus in December, 1882, was published in 1883. Part ii. is a small quarto pamphlet of seventeen pages, a series of notes on the tail of the great comet of 1882, accompanied by six plates of sketches made by the observers, Messrs. Leavenworth and Jones. These drawings will furnish useful material to those engaged in the interesting study of the theory of comets' tails, — a subject in which considerable interest has been aroused by the researches of Dr. Bredichin, director of the Moscow observatory.

— The Library bureau of Boston has issued the first number of a quarterly journal, *Library notes*, under the editorship of Prof. Melvil Dewey, librarian of Columbia college. While the journal is of especial value to the professional librarian, we should judge from an examination of the June number, and from what is promised for succeeding numbers, that it will also prove of considerable value to individual literary and scientific men who are interested in lightening the purely mechanical portion of their labors by the numerous ingenious devices which are constantly being brought forward. For instance, almost every scientific specialist nowadays finds it necessary to keep for himself a bibliography of some particular branch of his subject: he will find described in the number before us the size and quality of catalogue or index cards, with all the neat and convenient accessories which years of experiment or experience have pointed out to be best adapted to such purposes. The 'labor-saving notes' promise to be particularly useful to the lay readers, the aim being to bring to light, by co-operation and an interchange of ideas, the best literary tools and methods.

— The Spanish government has recently decided to establish a 'Maritime station for experimental zoölogy and botany,' to be in charge of a director, one assistant, and two fellows, all salaried. It is to be opened to students from all parts of the world, the results of all investigations to be published by the department of public works. In addition to the salaries of the officers, two thousand dollars annually will be appropriated for its support. The site has not yet been fixed upon, and *Cronica cientifica* justly complains of the inadequate provisions made for its establishment and support. Spain is almost the last of the chief civilized nations to found a zoölogical station.

— Roetheln, or German measles, has been very prevalent in Savannah, Ga., during the past year. This disease is very rare in the United States, and there are many physicians of established practice who have never seen a case. It prevailed in New York City during 1873 and 1874. As a rule children are attacked, but it is not exclusively the young; an old lady of seventy-seven was affected with it in the Savannah epidemic. It resembles both measles and scarlet-fever, so much so that the diagnosis is sometimes very difficult. It is contagious, and usually very mild, requiring but little treatment. Although it is doubtless a germ-disease, the specific microbe upon which it depends has never been identified.

— The legislature of Vermont at its last session passed a law prohibiting the adulteration of maple-sugar or honey, and punishing the offender with a fine of from twenty-five dollars to fifty dollars.

— M. Lessenne claims that a certain sign of death is the permanent gaping of a wound made in the skin by puncturing it with a needle. If the person be living, blood will usually follow the withdrawal of the needle, but whether it does or not, the wound will close at once. The puncture made in the skin of a dead person will remain open, as if made in leather.

— The North Carolina state board of agriculture, on Thursday, July 22, opened the new buildings of the experiment farm, near Raleigh.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Glaciers and glacialists.

IN a note on glaciers in the Alps in the number of *Science* for June 25, p. 570. are the following words: "The longest is the Aletsch glacier in Austria, measuring over nine miles."

The Aletsch glacier is far distant from Austria, descending from the Jungfrau into the Valais, not far from the glacier of the Rhone. Its length is over nineteen miles.

The misstatements, errors, and false quotations, with regard to glaciers and glacialists are somewhat astounding, difficult to explain, and more so to excuse; for the whole matter belongs to our century, almost to our own time. It would seem, that with the advantages of the long teaching of Louis Agassiz, and the constant flow of travellers toward the Alps, a little accuracy and exactness might be in common use, and by this time all the facts ought to be classic. But it is not so; and lately the amount of false notions has been lamentably increasing. I will signalize a few of the latest and most glaring.

"Glaciers have become so well known from the graphic descriptions of Carpenter, Forbes, Agassiz, Tyndall, and others," etc. This first sentence of 'Existing glaciers of the United States,' by Israel C. Russell (fifth annual report U. S. geological survey, p. 309, Washington, 1885), will mislead any one not very well acquainted with the history of glaciers and glacialists.

Carpenter is an English name well known in science. W. L. Carpenter and W. B. Carpenter are both naturalists of renown, and it would seem that one of these two Carpenters is referred to. But it is not so: the *savant* mentioned under this wrong name is simply Jean de Charpentier of Bex (Switzerland), the celebrated author of the glacial theory for the transportation of the erratic bowlders. It requires a certain effort of imagination to recognize him under the name given by Mr. Russell.

If his list is intended as a chronological series, it is altogether wrong and unjust. Forbes was not the first after de Charpentier to investigate glaciers. Agassiz called Forbes's attention to the glaciers, at Glasgow in 1840, and introduced him to his Aar's glacier observations, at the 'Hôtel des Neuchatelois' in 1841, one year after Agassiz's publication of his important 'Etudes sur les glaciers.'

Prof. J. S. Newberry, in his address before the Cornell university, at the unveiling of the tablet to the memory of Louis Agassiz, June 17, 1885, says, "In 1815, Charpentier, the director of the salt-works at Bex, and one of the most distinguished geologists of Switzerland, passing a night in the cottage of a mountaineer in the hamlet of Lourtier, was told by his host that he believed that the glaciers had formerly a much greater extent than at present, because, as he said, 'I find huge bowlders of alpine granite perched on the sides of the valleys, where they could only have been left by ice.' This remark excited the interest of Charpentier, and was practically the beginning of the investigations which have resulted in the theory of the ice period. In 1834, Charpentier brought before the Association of Swiss naturalists at Lucerne a report upon the evidences of the former extension of the Swiss glaciers, the result of his observations through many years. At that time a group of young, able, and enthusiastic scientists were gathered at Neuchatel, — Agassiz, Guyot, Schimper, Desor, Carl Vogt, Wild, and others. The new theory of Charpentier, that ice had once filled all the Swiss valleys, excited in them the greatest interest," etc.

De Charpentier, in his 'Essai sur les glaciers,' etc., took special pains to say in regard to the mountaineer Perraudin of the Bagnes valley, at the foot of the St. Bernard, that his hypothesis was so extraordinary, and even so extravagant, that he did not think that it was worth looking into and thinking of; and he adds, "J'avais presque oublié cette conversation [showing plainly that it was not practically the beginning of the investigations], lorsqu'au printemps de 1829, M. Venetz vint me dire aussi que ses observations le portaient à croire que, non seulement la vallée d'Entremonts, mais que tout le Valais avait été jadis occupé par un glacier, qui s'était étendu jusqu'au Jure et qui avait été la cause du transport des débris erratiques" (*Essai sur les glaciers*, pp. 242 and 243).

The order of priority of discoveries is, first, Venetz, who in a memoir written and read in 1821 before the Swiss naturalists, and published in 1833 under the title of 'Mêmoire sur les variations de la température dans les Alpes' (*Denksch. allgem. Schweiz. ges. gesam. naturw.*, Zurich), showed the greatest extension of glaciers and their gigantic thickness; second, Jean de Charpentier, who in 1834 read before the same Helvetic society of naturalists at Lucerne his memoir, 'Notice sur la cause probable du transport des blocs erratiques de la Suisse' (*Annales des mines*, 3e série, vol. viii. p. 219, Sept. et Oct., 1835; also *Bibl. univ. de Genêve*, 2e série, vol. iv. p. 1, 1836; and translated into German by Julius Froebel, in *Mittheil. aus dem gebiete der theoret. erdkunde*, p. 482); and, third, Louis Agassiz, who first announced the existence of the 'glacial epoch,' or 'ice period,' in his 'Discours prononcé à l'ouverture des séances de la Société Helvètique des sciences naturelles, à Neuchatel, le 24 Juillet, 1837' (Actes de la Soc. Helv. des sc. natur., 22e session, Neuchatel, 1837; also *Bibl. univ. de Genêve*, vol. xii. p. 367, 1837).

To Venetz is due the idea and proofs of gigantic glaciers, which transported the bowlders from the Alps of the Rhone valley to the Jura Mountains; to de Charpentier, the finding, accumulation, and the classification of material proofs (such as, the *moraines*, the *roches moutonnées, polies et striées;* the *cailloux striés* and *boue glaciaire*, etc), which constitute the 'glacial doctrine;' finally, to Agassiz is due the 'ice period' and the prompt diffusion and acceptance of the theory of Venetz and de Charpentier.

Professor Newberry seems to think that in 1834, when Charpentier brought his theory forward at Lucerne, there "were gathered at Neuchatel, Agassiz, Guyot, Schimper, Desor, Carl Vogt, Wild, and others." It is a great mistake. Agassiz alone, of all those named, was then living at Neuchatel; Guyot did not come to live there until 1839; Schimper never lived there; Desor came at the end of 1837, Carl Vogt in 1839; and Wild was an inhabitant of Zürich.

Mrs. Agassiz, in her charmingly written history of her husband's life, says, "Agassiz was among those who received this hypothesis (the ancient extension of the alpine glaciers to the Jura) as improbable and untenable. Still, he was anxious to see the facts in place, and Charpentier was glad to be his guide" (*Louis Agassiz, his life and correspondence*, vol. i. p. 261, Cambridge). De Charpentier was a great deal more than his guide: he was his teacher; for Agassiz then knew almost nothing about glaciers, and certainly nothing about the glacial theory of Venetz and de Charpentier.

In the summer of 1836, Agassiz established himself at Sallaz, near 'des Dévens,' the residence of de Charpentier at Bex, to study under his direction.

De Charpentier studied with his friend Venetz the whole question, and created the glacial doctrine between 1829 and 1834. Being twenty years older than Agassiz, de Charpentier, then aged fifty-two, celebrated as one of the best observers in geology, conchology, and botany, was considered as the first naturalist then living in Switzerland. *Savants* from any part of the world, calling on him, received always a very amiable and generous hospitality. His beautiful and rich collections were open to all; and many who came there for only a passing call remained weeks and even months.

Agassiz had that magnetic power which attracted every one to him: de Charpentier was as well gifted, being the most charming and spiritual converser imaginable. Besides, de Charpentier was without ambition, a true 'scientific epicurean,' as he was called. Agassiz, with his power of quick perception, his excellent memory, his perspicacity and acuteness, his way of classifying, judging, and marshalling facts, quickly learned the whole mass of irresistible arguments collected patiently during seven years by de Charpentier and Venetz; and with that faculty of assimilation which he possessed in such a wonderful degree, and his insatiable appetite, he digested the whole doctrine of the glaciers. Then once in possession of that new and certainly very original and attractive tool, Agassiz, with his extraordinary imaginative power, saw that the phenomenon of the extension of old glaciers was not to be confined to the Rhone valley, but must be general, and was a special period in the history of the earth, during which cold prevailed all over the world. In a word, Agassiz, with his far-reaching thoughts, added an entirely unexpected and then generally very unwelcome step to the different periods which the earth has passed through,— the 'ice age.'

Every one knows with what rapidity the mere suggestion — some may call it the inspiration of genius — made by Agassiz, in his celebrated 'Discours d'ouverture' before the meeting of the Swiss naturalists at Neuchatel in 1837, became an accepted truth. Discovery after discovery came in rapid succession, — first in the Vosges in 1838; then in Scotland, England, Ireland, the Pyrenees, the Jura, Scandinavia, Finland, Russia, the Ural Mountains, Auvergne, Britanny, the Sierra Nevada of Spain, the Atlas in Morocco, Corsica, the Balkans, Lebanon and Syria, the Caucasus, the Himalaya, Altai, the Thian-Shan, the Kuen-Lun, the Kamtchatka, Japan, Alaska, British Columbia, Washington Territory, Oregon, California, the Rocky Mountains, all the eastern part of Canada and the United States as far as New Jersey and Kentucky, Central America, Colombia, Ecuador, Peru, Chili, the Straits of Magellan, New Zealand, and even very strong suspicions of the existence of ancient glaciers in Brazil, in Guinea (Gold Coast), and in Australia. What splendid record! and almost all during the lifetime of Agassiz; himself having the honor to establish the existence of ancient glaciers in Scotland and England, in the eastern part of the United States, in the Straits of Magellan, in Chili, and probably in Brazil.

But that is not all. Admitting that Agassiz has a little too quickly digested and assimilated the glacial theory of de Charpentier and Venetz, we can say now with no less truth that his powerful intervention has greatly advanced the time of the acceptance of that theory, by thirty years at least, and that besides his great discovery of the glacial epoch or ice age, which is unquestionably his own, Agassiz has done more to make known the glaciers than any one else; although he was not a physicist, and his explanations were faulty and inaccurate on many points.

These explanations and appreciations are rendered necessary by criticisms and strictures on the part taken by Agassiz, and even entire omission of his name: his successor at Harvard college having denied *in toto*, in a publication founded by Agassiz, — 'The memoirs of the Museum of comparative zoölogy,'[1] — his great discovery of the 'ice age,' but having, more than that, ignored him altogether as the discoverer of the existence of ancient glaciers in the British Dominions, in New England and New York, in Brazil, in the Straits of Magellan, and in Chili.

On the other hand, some have gone too far in their eulogies. The part taken by Agassiz is grand and beautiful enough, without diminishing the great discoveries of Venetz and de Charpentier, both of whom were his teachers: for Agassiz was not alone in his visits at the house of 'des Dévens' in 1836; and all the explanations given by de Charpentier, and the excursions to the erratic bowlders, moraines, and glaciers, were made in company with several Swiss *savants*, — Venetz, Lardy, Mousson, Thomas, and Dr. H. Lebert. This last celebrated anatomist and naturalist has given his charming impression and souvenirs in his too short but excellent biography of Jean de Charpentier, read at Bex (Actes de la Soc. Helv. des sc. natur., Aug., 1877).

To be sure, Agassiz manifested his gratitude for the teaching of de Charpentier and Venetz in his 'Etudes sur les glaciers' (1840), dedicated on the first page, "A M. Venetz, ingênieur des ponts et chaussées au canton de Vaud, et à M. J. de Charpentier, directeur des mines de Bex." De Charpentier thanked him in his name and also in the name of Venetz, in the 'preface' of his 'Essai sur les glaciers' (October, 1840), a few days after Agassiz's work reached him at Bex. Notwithstanding this exchange of courtesies, an estrangement followed, due mainly to the interference of Agassiz's personal friends and collaborators; and after 1840 the friendship, or at least the relations, between de Charpentier and Agassiz, ceased entirely.

One more of the erroneous notices on glaciers and glacialists is in *Science* of April 30, 1886. At p. 385 we read, "Professor Dana's memoir gave an account of Guyot's early life which will be new to many of his American friends, and particularly called attention to the fact that Guyot had made a scientific examination of the Alpine glaciers two years before they were studied by Agassiz, and anticipated a number of his most important conclusions. In a paper read then before the Helvetic society, but never printed until 1883, Guyot pointed out that the upper portion of the glacier moves faster than the lower, that the middle moves faster than the sides," etc. It is difficult to imagine a more erroneous and unjust statement.

At Princeton Guyot was long isolated from intercourse with Swiss naturalists; and at the close of his life, while suffering under the malady which proved fatal in 1884, he put forth claims of doubtful value. These are the facts.

In 1838, Guyot, stimulated by Agassiz's constant conversation on the glaciers, passed five weeks among the glaciers of the Bernese Oberland and the Upper Valais. It was two years after Agassiz's study of the glaciers under de Charpentier, and one year after his

[1] *The climatic changes of later geological times.* By J. D. WHITNEY. Cambridge, 1880–82. 4°.

discourse at Neuchatel, — a sufficient answer to the claims "that Guyot made a scientific examination of the Alpine glaciers two years before they were studied by Agassiz."

On the 5th of September, Agassiz and Guyot were present at the Réunion extraordinaire de la Société géologique de France à Porrentruy; and at the meeting of the 6th of September we read the following remarks: —

"M. Agassiz présente à la société ses *observations sur les glaciers*, d'où il déduit d'importantes conséquences géogéniques relativement aux *blocs erratiques*. . . . M. Guyot ajoute aux observations de M. Agassiz de nouvelles considérations" (*Bull. soc. geol*, vol. ix. p. 407).

That is all. Guyot did not read a manuscript, but offered only a few verbal observations. He was not then a member of the society; and his remarks passed off unnoticed, although geologists were present, well prepared to discuss any point relating to glaciers, — Agassiz, Jean de Charpentier, Bernard Studer, Thurmann, Max Braun, Lardy, Buckland, d'Omalius, Nicolet, and finally Renoir and Leblanc, who announced at that meeting their discoveries of old glaciers in the Vosges.

On the contrary, Agassiz's communication attracted much attention, and was the subject of many discussions and commentaries. Agassiz, strengthened and animated by the presence of de Charpentier, surpassed himself in his clear and trenchant exposition of the 'glacial theory.' The impression left on all those who were present at the Porrentruy meeting was such, that years after, several of them told me that Agassiz was absolutely irresistible, and won the admiration even of his strongest opponent there, Bernard Studer.

Neither Agassiz nor Guyot gave their notes to be printed; and it was almost one year later that Agassiz's memoir, 'Sur les glaciers,' was deposited at the 'secrétariat' of the Geological society at Paris. It was published at the end of volume ix. p. 413, as late as the spring of 1840. The same memoir appeared first in the *Bibliothéque univ. de Genève* (tome xx. p. 382) in December, 1839; and it was reprinted in 1844, at the head of 'Excursions et séjours dans les glaciers,' etc., by E. Desor.

Many years after the death of Agassiz, and one year after the death of Desor, Professor Guyot claimed that he wrote Agassiz's memoir, and added that he was unable to finish the writing of his own memoir by an '*indisposition qui dura jusque tard dans l'été* (1839).' Guyot returned to Neuchatel, however, in good health, in the fall of 1839; and, if his memoir remained *inédit*, it was because he did not think his maiden notice was of sufficient value for publication; for both the *Bulletin of the geological society* and the *Bibliothéque universelle* were open to him, and ready to accept his remarks.

James D. Forbes having claimed the discovery 'of ribboned structure' of the ice of glaciers, Agassiz took from Guyot's notes his remarks, "sur la structure lamellaire de la glace du glacier près du sommet du Gries," and published them in a pamphlet dated 11 April, 1842, Neuchatel. At the same time Agassiz begged Guyot to put his manuscript in the 'archives' of the Société des sciences naturelles de Neuchatel. This was dono, and from that date the record of the existence of Guyot's notes is indisputable. Unhappily they were not published; and Guyot took them back in 1848, and carried them to America, whence, in April, 1883, he sent them again to Neuchatel, where they were finally printed in the *Bulletin Soc. sc. naturelles* (tome xiii. p. 156), the 26th of April, 1883.

It is impossible not to feel an uncertainty as to the primordial communication of Professor Guyot at Porrentruy, when we think of the delays in its publication, the travelling about, and the incompleteness of the notes. This feeling is increased by a remark of his widow, who says that Guyot did not send back to Neuchatel all the original manuscript, a part having been left in her hands (*The American journal of science*, May, 1886, p. 366).

But accepting the Neuchatel memoir of 1883 as correct, its scientific value is very small, and hardly justifies its publication. All that was truly of value was put in Agassiz's reply to Forbes; and even that is of small importance, considering that Rendu noticed more in detail the same phenomenon of veined structure of the ice, in his 'Théorie des glaciers de la Savoie,' published during the summer of 1840; and that Hugi, as far back as 1830, signalized the same phenomenon.

Accompanying his notes by a letter to M. Louis Coulon, president of the Neuchatel society, Professor Guyot claims that he has discovered not only '*la structure lamellaire de la glace des glaciers*,' but also the different modes of progression of the glaciers, the inclination of the beds at the end of glaciers, and the disposition of 'crevasses *en éventail*.'

These facts were known before, and were discussed almost daily in the house of de Charpentier, as is proved in the book of de Charpentier on the glaciers. Besides, Grüner, Hugi, Rendu, Bischof, and others have previously signalized the same facts.

Finally, Prof. Guyot, at the end of his letter to M. Coulon, makes statements entirely at variance with fact in regard to '*la distribution des blocs erratiques*.' For instance, he says, "The erratic map of the old glacier of the Rhone, published by de Charpentier (1840), stops it at Nyon, when by my latter observations I extended it far beyond Geneva to the Mont de Sion." Now, de Charpentier's map '*du terrain erratique de la vallée du Rhône*,' accompanying his celebrated book, does not stop the glacier of the Rhone at Nyon, but close to the city of Geneva, twenty miles farther south. As to bowlders of the Rhone valley as far as Mont de Sion, they have been described there by J. A. Deluc anterior to 1840; and R. Blanchet, in his 'Carte du glacier du Rhône' (Lausanne, 1844), extends the Rhone glacier as far as la Perte du Rhône, with a large moraine on the Mont de Sion.

From 1840 to 1847, Guyot, with great industry and perseverance, made a hypsometrical survey of the positions of the bowlders in seven of the erratic basins round the central Alps. Unhappily he only partially published his researches, in the *Bulletin des sc. nat. de Neuchatel*, without the map showing the distribution of those bowlders; reserving it, as he says, for an ulterior publication, in collaboration with Agassiz and Desor, which was never completed. If Guyot's map had been published then, it would have been an important contribution to the Alpine erratic phenomena. However, a great part of it — more than two-thirds at least — was anticipated by the issue in 1845, at Winterthur, of an anonymous map of the old glaciers of the central Alps, showing the extent of the ancient glaciers of the Arve, Rhone, Aar, Reuss, Linth, and Rhine, with their lateral and frontal moraines. That map is entitled 'Verbreitungsweise der Alpen-fündlinge,' and its author is the modest and very able geologist, A. Escher von der Linth.

Since 1850, Gastaldi for Piemont, Chantre and Falsan for France, and A. Favre for Switzerland, have given maps of the ancient extension of the Alpine glaciers, which render Guyot's manuscript map obsolete and valueless, except as an historical document.

To finish this already too long review of glaciers and glacialists, I will add, that, after the three original memoirs of Venetz, de Charpentier, and Agassiz, of 1833, 1834, and 1837, the other important works and landmarks in the discoveries and exposition of the glacial question are, by order of data, 1°, 'Théorie des glaciers de la Savoie,' by the Chanoine Rendu (September, 1840); of this most important and excellent work, Tyndall said to me at the Geneva meeting of the Swiss naturalists in 1865, "If Rendu had been trained and educated as a physicist, he would have left nothing for others to do;" 2°, 'Etudes sur les glaciers,' by Louis Agassiz (October, 1840); 3°, 'Essai sur les glaciers,' by Jean de Charpentier (Oct. 31, 1840; issued in December, 1840, with the date on the titlepage of 1841); 4°, 'Travels through the Alps of Savoy,' by James D. Forbes (1843; second edition, 1845); 5°, 'Nouvelles études et expériences sur les glaciers actuels,' by Louis Agassiz (November, 1847); 6°, 'The glaciers of the Alps,' by John Tyndall (1860).

Venetz was personally known to but few *savants.* I will add that he was a Valaisan engineer of great skill. He had the charge of rectifying and embanking the Rhone in the cantons of Valais and Vaud, from Sion and Martigny to the lake of Geneva, — works which he executed most successfully. Accustomed to observe all that relates to the freshets of mountain torrents and glaciers, a spectator of the great 'débacle de Bagnes' in 1818, he and his friend de Charpentier put a stop to the constant ravages of the Getroz glacier and the Dranse River, an affluent of the Rhone.

Venetz's modesty was extreme, and verging on great timidity, due perhaps, in part, to the infirmity so common in the Valais, and from which he was a sufferer. Not educated as a scientific man, but only as a road engineer, he did not possess the scientific method of marshalling and classifying facts and observations. But Venetz found in his friend de Charpentier the best man to systematize and construct a new science. In that respect de Charpentier, by his knowledge and education, was the equal and rival of his friends Alex. de Humboldt, Leopold de Buch, and Elie de Beaumont; and the association of Venetz with him was most happy and successful. Both without ambition, lovers of nature and truth, they created together what may be called now one of the most interesting branches of geology and physical geography.

JULES MARCOU.

Cambridge, Mass., July 7.

Barometer exposure.

It is gratifying to find that my brief letter calling in question the influence of wind on the indications of indoor barometers has elicited very satisfactory responses from Messrs. Gilbert and Clayton (*Science*, vol. vii. pp. 571, 572; and vol. viii. p. 14). There is one point, however, on which evidence is still wanting to fortify Mr. Clayton's induction.

As clearly indicated by Mr. Gilbert, it is evident, that, according to the conditions of exposure, the influence of the wind must tend sometimes to increase, and at other times to diminish, the pressure within the building in which the barometer is placed. Now, all of Mr. Clayton's experiments seem to indicate a lowering of the barometer-readings within the building. Perhaps he may be able to verify the deductions of theory by so arranging the conditions of exposure as to secure the opposite effect, and thus obtain a complete verification of his induction. If these opposite effects can be verified by experiment, while establishing the influence of wind as a true cause of barometric fluctuations, they would render it extremely difficult to apply a correction correlated with the velocity of the wind, except under well-defined conditions of exposure.

While seeking for possible causes of fluctuations of the barometric column in relation to wind-velocity, it may be well to recall the idea first broached by Hawksbee near the beginning of the last century, and more distinctly urged by Sir John Leslie, that the barometer is depressed by wind in consequence of the centrifugal force due to the horizontal current of air (Daniell's 'Elements of meteorology,' vol. i. pp. 4-9, London, 1845); for although Professor Daniell's criticism of Professor Leslie's theory is quite just, in so far as it relates to the idea that the effect would be 'accumulated by a long series of deflections,' yet the main fact, that the tendency to rectilinear motion would give rise to a centrifugal effect, remains a *vera causa* tending to depress the mercurial column.

A simple calculation shows, however, that the radius of curvature is so large, or the deflection from a tangent is so small, that a horizontal wind of 60 miles per hour, or 88 feet per second (assuming the whole thickness of the atmosphere to be involved), would lower the mercury in the barometric column only about 0.00875 of a millimetre, or 0.00034 of an inch, — an amount so small as to be far within the limits of observational error, and therefore quite inadequate as an explanation of the phenomenon.

JOHN LECONTE.

Berkeley, Cal., July 13.

Bright lines in the spectrum of β Lyrae.

A short study of the spectrum of β Lyrae presents the following bright lines as existing in her atmosphere. A portion are probably also found in the solar atmosphere. Referred to by their numbers in Young's catalogue, they are, 2, 3, 5, 22, 36, 41, 49, (58-59), 69, 74, 86, 100, (105-106), 115, (138-139), (140-141), 181, 189, 193, 198, 208, 248, (260-261), 267, (272-273?). Another portion find no place, or are infrequent, in the solar atmosphere, and, referred to by their approximate wave-lengths, are 59549, 58398, 57967, 57544, 56305, 55829, 54811, 51355, 51013, 50858, 50582, 49582, 47939, 47660, 47437, 46879, 45203, 43123.

Each of these appear in at least 40 per cent of the observations; none appear in more than 70 per cent. A number more are suspected, but are not clearly separated.

At present there would seem to be a connection between the variability of the star and the lines present in the spectrum; but on this point the observations are not final.

O. T. S.

New Haven, July 17.

SCIENCE.—SUPPLEMENT.

FRIDAY, JULY 23, 1886.

METHODS OF INVESTIGATION IN POLITICAL ECONOMY.

"DURING the last thirty years," says Sidgwick in his 'Principles of political economy,' "political economy has risen from the state of controversy on fundamental principles and method into that of an apparently established science, and again relapsed into the state of controversy." This statement is borne out by an examination of the literature of political economy during these years. It is full of controversy. Not only do writers fail to agree on practical economic questions, such as free trade and protection, mono- or bi-metallism, direct or indirect taxation, but they quarrel over the fundamental principles which are to be taken as the basis for the solution of these problems. We have the doctrine of *laissez-faire* on the one side, and of social expediency on the other. To some, economics is merely a science of wealth; to others, it is eminently social; and to still others, it is, in addition, ethical. Some stick to the principle of self-interest as the only one worth regarding; others take into account all the motives which influence economic action. Some seek for principles which shall be strictly true of an abstract 'economic man,' and then push all practical problems into an 'art' of political economy; while others desire principles that can be directly and usefully applied to existing human society, taking into consideration time, place, and circumstance.

It would be too much to say that this controversy over principles is at all ended. The conception of pure *laissez-faire* has, indeed, lost its position, and will probably never be reinstated; but the advocates of new and more liberal principles have not been able to agree among themselves. Some of them are nationalist, some socialist, some ethical; while they differ infinitely in the degree to which they still cling to the old ideas and the old formulae.

In regard to method as distinct from principles, on the other hand, we are beginning to see some light through the darkness. Men can acknowledge a change in method without giving up the validity of principles which they wish to maintain. Here the triumph of the new over the old has been complete; or rather there has been a vindication of the method of the master-minds over those disciples who by too close and dogmatic imitation had obscured the work of the fathers. Some of the keenest minds among students of political economy have worked at this topic; and owing to the efforts of such men as Knies, Wagner, Leslie, Jevons, and Ingram, we are reaching a substantial unanimity on the question of method.

How important this change is, and how fruitful of result it is going to be, will appear if we consider for a moment the difference between the old method and the new. Without going into the finer questions, and without being too exact in our definition, we may call the old method the deductive, and the new method the inductive. These terms will cover the other designations, such as '*a priori*,' 'abstract, 'philosophical,' sometimes applied to the old method; and similar terms, such as 'realistic,' 'historical,' and 'practical,' applied to the new.

The old method is essentially deductive. It finds certain premises which are true, and reasons from these premises to the solution of specific problems. These premises, as laid down by Cairnes, the most brilliant expounder of this view, and summarized by Cossa ('Guide to political economy,' p. 38), are as follows:—

"1. In the economic order of things the principal motive of human actions is *individual self-interest.* This induces man (*a*) to avoid pain (fatigue, work); (*b*) to desire pleasure (wealth); (*c*) hence to aim at obtaining the greatest amount of wealth with the least amount of labor, or, in more general terms, the greatest result with the least effort, which is, as it is now expressed, the law of least resistance.

"2. The earth, indispensable to man as a place in which to live and work, and as the source whence he may extract food and raw materials, is naturally limited (*a*) in the products which it contains; (*b*) in its actual extent; (*c*) in its relative fertility (different qualities of soil); (*d*) in its successive fertility (decreasing productiveness at a certain point with every new application of capital and labor).

"3. The physical and psychological tendencies of man lead him to multiply his own species with a rapidity which, if it met with no obstacles, would bring about an unlimited increase of population."

From these premises are deduced the three great theories of *value, rent,* and *population;* and by means of these theories concrete problems, such as free trade and protection, are solved.

It is not necessary here to describe how this deductive method of political economy has been overthrown. These assumed premises, although containing an element of truth, were in themselves incomplete and sometimes inapplicable. For instance, it is a matter of experience that men are actuated by other motives than self-interest, such as patriotism, charity, and custom. Again, common sense revolted against the assumption that these theories were universal and perpetual; that is, true everywhere and at all times. Experience showed that at different epochs in civilization, and among differently situated nations at the present time, the premises would require very great modifications.

The new method in political economy is inductive; that is, it proceeds from observation of facts to general rules and principles. It carefully observes the limits of time and place, and abstains from asserting its principles to be either universal or perpetual. It makes use of what knowledge we have of man and nature; but it uses this knowledge for the purpose of guiding and helping its investigations, not as *a priori* premises. It studies history for the purpose of discovering what blunders men and nations have made in their economic experience, and how those blunders may be avoided in the future. The inductive method is also comparative; that is, it compares economic institutions performing the same function among different nations of the same degree of civilization, in order to discover which is the best. The method is, finally, statistical; that is, it collects statistical data as a basis for its knowledge, in order to measure economic forces and gauge the results of economic action. The present method of political economy as recognized by the greatest modern economists, such as Wagner, Schmoller, Leslie, Jevons, Marshall, etc., is historical, comparative, and statistical.

I do not propose to defend this new method against the old, much less to vindicate it. Neither do I deny that the old method has had able representatives, and that in its time it has done good service. All I assert is, that it is now practically abandoned as a method by itself, and that the future of political economy depends upon the scientific application of the new method to the complex phenomena of modern civilization.

It will be useful, however, to describe more fully how the new method is actually applied, what sort of results it is able to give us, and some of the advantages which flow from its use. I propose, therefore, to discuss, 1°, how to investigate particular economic problems; 2°, how to reach general principles of economic life; 3°, what are the collateral advantages of this method; and, 4°, how to make method and results useful in the study of other social sciences and in guiding state action in economic affairs.

How to investigate particular economic problems.

Every reader of John Stuart Mill will remember the opening paragraph of his 'Principles of political economy:' "In every department of human affairs, practice long precedes science; systematic inquiry into the modes of action of the powers of nature is the tardy product of a long course of efforts to use those powers for practical ends. The conception, accordingly, of political economy as a branch of science, is extremely modern; but the subject with which its inquiries are conversant has in all ages necessarily constituted one of the chief practical interests of mankind, and, in some, a most unduly engrossing one."

In the same way it might be said that the solution of economic problems precedes the formulation of an economic science. Mankind has always had its economic problems, and philosophic heads have ever busied themselves trying to solve them. The method of doing this is both of very great importance in itself, and indicative of the character of the science which will by and by be formulated on the basis of this method. It will be of interest, therefore, to show how the inductive method of political economy attacks practical economic problems, and to see what sort of a science results from this method. In choosing my illustrations, I have purposely selected modern economic questions, and American and English authors, in order to escape the common slur that this method is fitted only for the antiquarian, and used only by learned but unpractical and idealistic German professors.

Mr. Sidgwick has remarked, that, in that portion of political economy dealing with the production of wealth, the inductive and analytical method has been much more used than in those portions dealing with exchange and distribution. Take, for instance, the question of land-tenure, — one which has interested political economy for a long time, and which is to-day one of the burning political questions in England. It is apparent at a glance that the method of holding land must have a great influence on its productiveness. We can even reason *a priori* that where there is absolute proprietorship on the part of the cultivator, or at least a long leasehold which will secure to him the reward of his labor, he will be apt to work harder, and that the gross produce will thereby be increased. But the English economists, even Mill, Thornton, and Fawcett, have approached the subject in a different way. They have studied the condition of the French and Belgian peasants where absolute ownership exists, and have pointed out the prosperous condition of these countries as the proof that peasant proprietorship is the best system. This is the pure comparative method in political economy.

Let us take a more specific question. The issue of bank-notes is a useful and at the same time dangerous function to intrust to a bank. Shall the issue of bank-notes be free, or shall it be regulated by government? How shall we answer such a question? If we examine the history of banking in the United States, as President Walker does in his book on money, or as Comptroller Knox did in his report for 1876, we shall find that freedom of issue has always been abused, and has always led to disaster, and that the only good bank money we have ever had in this country has been the national bank-notes secured by United States bonds. Study of the experience of England, Germany, and France will show that the liberty to issue bank-notes has everywhere been restricted, and is now exercised only by institutions under the direct or indirect control of the state. It can therefore be accepted as a rule that the privilege of issuing bank-notes should be carefully regulated by the state. This is the pure historical method in political economy.

Let us take a question which has not yet been solved, or where, at any rate, no practical solution has been reached by the legislature. Let us take, for example, the present silver question in the United States. Should the United States try to re-establish the silver dollar as a standard? There are two questions here. One is the question of the single or the double standard; the other is whether we can dispense with either one of the precious metals as money. The first, which is commonly known as bimetallism, although it is more properly the question of the single or the double standard, is already settled in the opinion of the best economists. One has only to read Professor Laughlin's book on the history of bimetallism to see that the double standard has been thoroughly tried in the United States from 1790 to 1873, and that it has signally failed. It always results in the presence of one metal and the absence of the other. At first, with a ratio of one to fifteen, we could keep no gold in the country: afterwards, with the ratio of one to sixteen, we could keep no silver. The history of France proves exactly the same thing, so that even professed bimetallists acknowledge that the double standard cannot be maintained except by international agreement. This, again, is the historical method.

The second part of the problem — viz., is there sufficient gold in the world to supply the demand for money, so that it is safe to demonetize silver? — is much more difficult to answer, and is, I venture to say, as yet unanswered. It can be solved only by the statistical method; viz., by showing that prices are declining, while at the same time the supply of gold is decreasing, and that the latter is the only adequate cause discoverable for the former phenomenon. As an example of an attempt to prove this connection, I may cite Mr. Giffen's well-known 'Essays in finance.' An even more noted example of the same style of applying the statistical method to economic problems may be found in the essay of Jevons, and also those of Cliffe Leslie on the effect of the gold discoveries in California and Australia on prices in Europe.

Finally, we may ask, what can the inductive method do when it faces some great economic problem which affects the whole community and civilization itself? Such a problem is the labor-problem. What is the condition of the laboring class? Has that condition deteriorated or improved? The inductive method has not shrunk from attempting to find an answer to even such questions as these. Thorold Rogers has laboriously traced the condition of the English laborer during the last six centuries, for the purpose of answering this question historically. Giffen has attempted, by statistics, to show that the condition of the laboring class has materially improved during the last fifty years.

These are examples of the historical, comparative, and statistical method applied to modern economic problems. In some cases the method has only confirmed what was known or at least surmised before; in most cases it has added directly to our knowledge; in a few cases it has given us results which could have been obtained in no other way. Such is the value of the method in these isolated cases. Can it be so utilized as to enable us to formulate a body of truth worthy to be called a science? This brings us to our second point, —

How to reach principles of economic life.

It is often said, that, although the inductive method may aid us in solving economic problems, it falls far short of what is required by a true science, because it does not enable us to formulate a body of principles which shall at the same time embody the highest truth, serve as a guide in future economic action, and be an explanation of all economic life. Nothing was more characteristic of the old school than the perfect confidence that they had the key to all knowledge on this subject. They were accustomed to speak of 'immutable laws' and 'eternal principles.' Self-interest, demand and supply, the law of diminishing returns from land, Malthus' law of population, Gresham's law, the wage-fund, equality of profits, — these were the touch-stones the application of which settled every problem. Is it a question whether strikes are able to raise wages?

According to the wage-fund theory, there can be no increase of wages except by increase of capital or diminution of the number of laborers ; and as, according to the Malthusian theory, population tends to increase to the limits of food-supply, there will be no diminution of population, and hence no increase of wages is possible. Can any solution of the labor-problem be easier? Do we ask if a country should protect its home industries? Self-interest, it is said, leads each man to make the best bargain for himself, therefore free trade should be the universal rule. This answers the question for Germany as well as for the United States ; for India as well as for England. Do we demand that the state control the charges of corporations? It is answered, profits tend to an equality in all employments : therefore, if in any one business profits are abnormally high, capital will rush into that business, and the charges will be brought down, and the public will be best served. Behold, the solution of the railroad question !

It is true that the new method does not give us principles which, like these (to use the expression of Ingram), are unchangeable, perpetual, and cosmopolitan. Neither does it lay down laws which can be applied by the rule of thumb to every new economic and social problem, wherever occurring, or under whatever circumstances. Such a science is, on the face of it, absurd. It is like introducing steam-engines where there is no fuel, or machinery where there is already an excess of hand-labor. It is like that pseudo-political science that desires to see representative institutions established in Egypt, or the trial by jury adopted by the Zulus. Such universal principles, like the *contrat social* and the theory of natural rights, have long gone by the board in social science. All we seek now are certain empirical generalizations which will guide our judgment in approaching practical problems. Such generalizations are not immutable laws ; but they are extremely valuable to philosopher and statesman, just as the knowledge of markets and business methods is of value to a business man.

The statement, however, that the inductive method does not enable us to formulate any general principles of economic life is not true for two reasons: 1°. There is absolutely nothing in the new method to prevent our accepting and using any facts of the human mind or of nature which will aid us in determining how men act in economic affairs. No economist would venture on the solution of an economic problem without taking into consideration the fact that men are ordinarily moved by self-interest, any more than a general would manoeuvre for a battle without taking into account whether his men were fresh or tired, well fed or half starved, in good spirits or depressed. The economist is supposed to know what the leading characteristics of the human mind are, and to calculate their probable influence. The chief merit of the new school is that it studies carefully to give due weight to all of these forces, such as degree of civilization, custom, law, etc., which the older economists neglected. 2°. The new method has not the slightest objection to reaching general conclusions from its inductions, any more than the natural philosopher hesitates to reason from the fall of an apple to the law of gravitation. On the contrary, the very object of political economy according to this method, is to reach such general conclusions as will be of aid in directing social activity in economic affairs. From the experience of different nations in tenure of land, we reason to the general desirability of peasant proprietorship, or some fixity of tenure. From the history of the double standard, we reach Gresham's law, that, where two currencies exist side by side, the baser will drive the good out. From the history of English poor-laws, we can reason to the general desirability of self-help ; and from the prosperity of England to the principle of free trade, at least for industrially developed nations. This is what Ingram calls reflective analysis, and is no more shut out from inductive political economy than it is from the natural sciences. To assert that the inductive method gives us merely sketches of economic history, or descriptions of economic institutions, or masses of economic statistics, is as wide of the mark as to call chemistry a mere collection of analyses of organic and inorganic substances. Science is systematized knowledge, and political economy seeks to systematize its knowledge gained through history, comparative study of institutions, and statistics, as rapidly as possible, so as to reach general principles of economic life. Only, by this method we escape the sterility which comes from following supposed immutable principles ; for every fresh induction very probably modifies or corrects our previous rule. The principles we reach are, as said before, empirical at the best. Like the rising of the sun, they may be of a very high degree of certainty ; or, like the predictions of meteorology, they may be of comparatively little value. We take them for what they are worth, and try by further observation to make them more exact.

The advantages of the inductive method.

It will strengthen our appreciation of the new method of political economy if we consider for a moment the collateral advantages which accompany it. In the first place, we acquire a great mass of economic information. The mind of the student is soaked with knowledge of the past experience of mankind, with descriptions of present institutions, and with statistical details of economic life. No one can teach a class of students without being amazed at the eagerness with which they absorb the details of economic history, such as the finances of the civil war, or the silver legislation of the United States; or the interest with which they listen to the discussion of economic problems now in course of solution, like the Irish land question; or the curiosity with which they regard even statistical data of the movements of population and the course of trade. This is not to be wondered at. Every active intellect has a natural curiosity as to the history of the race and the institutions and customs of other nations. The inductive method satisfies this legitimate curiosity in a systematic and scientific way. Whether we are able or not to solve the particular problem which we have set before us, we at least get an intelligent knowledge of its difficulties. Whether or not we arrive at general principles, we gain information which in itself will be of value. This is a great advantage over the old method, which, when it was wrong, was altogether wrong and misleading. The new method is at least fruitful, and we get some result from our labor, even if we do not attain all that we sought for.

Again, the use of the inductive method tends to broaden our views of the relations of society. It familiarizes us with economic problems as they have come up in history, and shows us how they have been solved at different times and by different nations. It teaches us to view them from all sides, — in the light of past experience; in connection with the present state of civilization; from the stand-point of different nations, classes, and individuals. The new method is radical, inasmuch as it shows that economic arrangements are founded partly on the nature of things, but are also due in great part to the present state of civilization, and, to a certain extent, to accident and chance. It makes us ready to acquiesce in the possibility of changes in the future even in some institutions hitherto regarded as fundamental: in other words, it makes us believers in evolution and progress. But the new method is even more conservative: for it teaches us that social institutions and arrangements are the result of long growth and evolution; that they are intimately connected with civilization, and, when once established, are not to be lightly overthrown. History shows this: for it reveals how slow a growth real civilization is, and by what hard struggles we have attained to our present state. Comparison of institutions shows it: for it proves how universal are the human wants which the present institutions satisfy. Statistics shows it: for it discloses how complicated and delicate the social organization is, and the danger of laying violent hands on it. Socialists and revolutionists are generally men of one idea, followers of one-sided abstract theories. The true conservatism comes, as Burke long ago pointed out, from that reverence for the wonderful machinery of social organization which study by the inductive method gives.

Another advantage of the inductive method is that it prevents the science from degenerating into a mere collection of stereotyped formulae, and the practice of the science into the mechanical application of these formulae to the facts of human life. The danger which besets political economy in this respect has been abundantly illustrated above. Nothing in literature is sadder than the fatalistic pessimism which John Stuart Mill finds forced upon him after considering the possibility of an improvement in the condition of the laboring-class, on the basis of the wage-fund theory and the Malthusian law of population. Nothing was more destructive to the influence of political economy than the positive condemnation of factory laws and national education, which its teachers drew from the principle of self-interest and free competition. It is desirable, of course, to reach principles which are stable and always applicable; but we must not close the doors too soon against further evidence, and treat our science as a final revelation instead of a body of empirical laws gathered from the experience of mankind up to the present time, and with our present means of knowledge. It is true that the law of gravitation never changes; but the laws of political economy are not of that kind. As Bagehot has clearly shown, even the law of self-interest has absolutely no existence, or is entirely in abeyance in many communities and under certain circumstances. The laws of political economy are secondary laws, and it is not to be supposed that we have formulated them exactly and finally. It is as if a hundred years ago physicists had laid it down as an absolute immutable law that persons could not be transported faster than twelve miles an hour, because horses could not drag stage-coaches over turnpike roads at a greater speed. The old political economy is full of such mistaken assumptions that the generalization from a narrow range of experience is a highest principle. The inductive method teaches us at least modesty and caution.

A final advantage of the new method, closely connected with the one just mentioned, is that scientific truths are not so easily used for selfish purposes when stated less absolutely. One great cause of the revolt against the old political economy was that it apparently taught the necessary misery of the greater part of the community. The socialists gladly seized on the 'iron' law of wages, and told the workingmen that either the political economy which taught it must be false, or that the civilization to which such political economy was applicable deserved only to be overthrown. A science which teaches that a great portion of mankind is destined to be miserable may not, for that reason, be unscientific; but it certainly ought to be very sure of its premises, and it cannot expect to be eagerly accepted. It may be a comfortable doctrine for capitalists, that strikes can, under no circumstances, permanently raise the rate of wages, and that factory-laws are destructive to the prosperity of industry; and they may utilize such doctrines to carry out their own selfish purposes. But it is a mistake to formulate scientific principles so absolutely that they can be used in this way. Under the old political economy, this was constantly being done. English factory-owners appealed to the principles of political economy against that legislation which is now universally admitted to be for the interests of the community. Free trade as much as protection has been the struggle of selfish interests. Even the skilful pen of Morley is not able to make of Richard Cobden any thing more than a 'Philistine' hero. We have at the present time editors of influential papers who see with ill-concealed satisfaction ignorant workingmen dash themselves against the stone wall of economic axioms. It is true, again, in physics, that, if you dash your head against a stone wall, you will get hurt. But the question is, Cannot the stone wall be removed? Is it necessarily and forever there? The absolute formulation of principles prevents even the asking such questions. It is for this reason that the inductive method appears much more reasonable. Political economy is neither a religious creed to be used to excommunicate all heretics, nor a legal code by which to condemn malefactors, but a body of experience to guide us in the conduct of social economic life. The inductive method forbids its being used for the private purposes of the priesthood or the judges, for new experience may teach us new solutions and new expedients.

Political economy and social science.

It has long been recognized that political economy is only one branch of social science, and it is an important question what its exact relation to the other branches of social science is. Social science as a whole may be defined as treating of human life in all its manifestations in society. It has numerous subdivisions (or, if you choose, you may say there are numerous social sciences), the principal of which are political science, jurisprudence, and political economy. The first treats of the governmental organization; the second, of the definition of rights and the conflict of wills; the third, of the satisfaction of material wants. The basis of the social organization is the economic; for man can reach no high development, either in state or law, until the material wants are satisfied. But the three sciences are intimately connected. The particular form of a state, nomadic chieftainship, monarchy, republic, etc., is commonly determined by the economic condition of the people; and law is often only the expression of such economic condition. Slavery is at the same time a political, a legal, and an economic institution. We cannot, therefore, cultivate political economy without at the same time cultivating the other branches of social science, especially political science and jurisprudence.

Such being the close connection between political economy and social science, it is an important question whether our method in political economy aids or hinders this correlation. The abstract method desires to put aside all this connection, and isolate the science of political economy. It expresses this desire in various ways. Commonly it formulates its theory as pure theory, and regards all other influences — political, legal, or social — as hinderances. The common analogy is taken from mechanics, the law of dynamics, which teaches that a body once set in motion will continue on in a straight line forever. But in practical life this is never realized, because there are always opposing forces, friction, etc. So the abstract 'economic man' would follow such and such a course of conduct, were it not for political, legal, and social influences. The artificiality of a scheme which treats the most powerful influences of human society — viz., those which hold men together in a state, and subject them to law, not to speak of family and social influences — as friction is at once evident. Another device is to say that there is a pure 'science' of political economy which treats only of the economic man, and that it belongs to the 'art' of political economy to consider these other influences. The trouble here, again, is, that, in the separation of the art from the science, the latter is almost sure to lose its vitality. Especially is it fatal when we try to connect political economy with politics and law, which have no sympathy with pure abstractions.

The inductive method avoids this artificial separation and distinction, this rupture between the theoretical and the real. It studies the facts of economic life as they actually exist, blended with the political, legal, and social life. It has no such abstraction as the 'economic man,' but thinks only of man living in state relations, under the bond of law, and surrounded by the influences of family, custom, and social habits. Political economy is thus not isolated from the other branches of social science, but finds a thousand points of contact with them. It adds to their knowledge, and in return receives from them the explanation of many of its phenomena. In fact, we may say that each set of phenomena is inexplicable without some knowledge of the others, and to isolate them is to make each incomplete in itself.

The value of this method of investigation is strikingly seen in the function which political economy performs in the study of political science. That function is a double one. In the first place, political history can never be understood without a knowledge of the economic condition of the community which we are studying. The feudal system was possible only at a time when land was the principal kind of wealth. Aristocratic city republics could exist only where the growth of industry and commerce enabled the burghers to make themselves independent of the feudal nobility. Absolute monarchy rested on a class sufficiently rich to pay taxes, and sufficiently interested in the preservation of law and order to be willing to pay them. Representative institutions arose only when at last the industrial and commercial class was strong enough to assert itself against both kingship and land-holding aristocracy. The first function of political economy is purely historical. It investigates economic life in past ages for the purpose of explaining political history. When it gets down to the present time, it is purely descriptive, for the political institutions of different nations at the present time are conditioned by varying economic circumstances.

But political economy has a second function in connection with the study of political science. Every state action, every law that is passed, or ordinance enforced, or treaty negotiated, has economic consequences sometimes of the highest importance. Political economy must here direct state action, must say what will be the consequences of such action, and whether it will be for good or evil. It can do this only by appeal to history, by comparison of the experience of other nations, and by the use of statistics. In other words, we find that the most faithful ally of political science is the use of the historical, comparative, and statistical method of investigation in political economy.

RICHMOND MAYO SMITH.

RECENT BOOKS ON PSYCHOLOGY.

WHEN a very successful English translation was made some years ago of Ribot's 'La psychologie Anglaise contemporaine,' it was a matter of surprise that his 'Psychologie Allemande' also was not translated as soon as it appeared. For though we may agree with Mr. James Ward, that the latter book is in a measure superficial and sometimes misleading, it is nevertheless the only compact summary of that psychological activity in Germany that began with Herbart; and that is that represented to-day by Professor Wundt of Leipzig. We are very glad that it is now put into the hands of English readers. M. Ribot has found that the advance in psychological investigation between 1879 and 1885 has necessitated the rewriting of his original work; and it is from this second French edition that the translation before us is made.[1]

This second edition is without the brief but interesting chapter on Beneke which was included in the first edition, but as compensation it covers the latest discussion of Weber's law and the more recent investigations of Wundt. Ribot is very clear as to what he means by the German psychology of to-day: he calls it the 'new' psychology, but rather exults than otherwise in the idea of 'a psychology without a soul.' He describes the new psychology tersely, thus: "It has for its object nervous phenomena accompanied by consciousness, finding in man the type most easy of recognition, but bound to pursue the investigation through the whole animal series, however difficult" (p. 8). This is explicit enough surely, but has a strange sound to the student of English psychology, who is accustomed to the discussion of problems which the Germans, since Kant, have relegated to a separate branch of mental science called *erkenntnisstheorie.*

For the older school of psychologists, M. Ribot expresses what we may best designate as respectful contempt. "We owe to it good descriptions, excellent analyses; but its work is done. Its province now is simply details, shades of meaning, refinements, subtilties" (p. 3). This is, in its way, exquisite, and is one of the many passages in which M. Ribot implies that Locke, Leibnitz, Berkeley, Hume, Reid, Stewart, and Hamilton can be called psychologists only by historical courtesy. With this narrow conception of psychology we are not going to quarrel: we merely point it out as the key to understanding M. Ribot's excellent accounts of Herbart, Lotze, Fechner, and Wundt. Nowhere else are their investigations and teach-

[1] *German psychology of to-day: the empirical school.* By TH. RIBOT. Tr. by T. M. Baldwin, B. A., with a preface by James McCosh, D.D., LL.D., Lit. D. New York, *Scribner*, 1886. 8°.

ings brought together so clearly and so compactly as in this little book. It should be in the hands of every student of psychology, and most of it will appeal even to readers who are without special philosophical training. Of the translation we can speak cordially, but not enthusiastically. It is clear and accurate enough for all practical purposes, though more attention to literary form would have improved it. The unpardonable lack of any index to such a book as this should be remedied without fail, if a second edition is ever called for.

Dr. McCosh's new book[1] would undoubtedly incur M. Ribot's condemnation; for while recognizing the work of the new school in investigating the relations of mind and brain, in measuring the duration of psychic acts, etc., it views psychology from the old-school stand-point. It is refreshing to read a book so clear, so candid, and so self-confident; and, even when disagreeing with the positions of the author most completely, we cannot withhold our admiration from his vigor of thought and expression. This book is the final expression of President McCosh's well-known psychological views. It is based on his academic lectures, and is a direct, simple, and dogmatic presentation of his system. Dr. McCosh does not beat around the bush. He defines the soul as "that self of which every one is conscious" (p. 1); self-consciousness, as "the power by which we take cognizance of self as acting; say, as thinking or feeling, as remembering the past or anticipating the future, as loving, fearing, and resolving" (p. 2). We have intuitive evidence of the existence of the soul (p. 7). "It is not the exact or full truth to say that I feel an external object, or that I have an idea of it (which I may have when it is not present), or that I apprehend it, or have a notion of it, or believe in it: the correct expression is, that I have knowledge of it, or that I cognize it" (p. 20). These are Dr. McCosh's postulates, and on them his system is built up. We believe that it is coherent, but that it is not scientific. Its fundamentals are assumed, not proven. It is a system that will not allow the question, 'How is knowledge possible?' to be raised. It follows Reid and Hamilton in assuming the famous distinction of primary and secondary qualities without meeting the arguments of Berkeley, Kant, and Spencer. Yet we fully admit that it is far easier to find fault with Dr. McCosh's system as a whole than to replace it. Perhaps the time has not yet come for building a complete system of psychology on the new basis.

In this book Dr. McCosh deals only with the cognitive powers, reserving his treatment of the motive powers for another volume. This we hope will be issued before long, and enable us to view entire the venerable author's psychological teaching. When the history of philosophy in America comes to be written, it will be found, that, right or wrong himself, no one has contributed so much, or given such an impulse, to the study of philosophy and psychology in this country, as the distinguished president of Princeton.

[1] *Psychology: the cognitive powers.* By JAMES McCOSH, D.D., LL.D., Litt.D., New York, *Scribner*, 1886. 12°.

Of Mr. Jones's 'Human psychology'[1] we need not say much. It is principally a compend of other persons' views in other persons' words. It is not unskilfully put together, but cannot expect recognition as an original or independent treatise. It is of no use to the trained philosophical teacher, and a poor manual to recommend to an untrained student.

[1] *Human psychology: an introduction to philosophy.* By E. JONES, A. M. New York, *Baker & Taylor.*

MR. GRABER has recently described, in the Transactions of the Vienna academy, the results of observations indicating that eyeless animals are sensible to light. In a box divided into compartments, and each furnished with two openings, he distributed equally a number of earth-worms. One of the openings in each compartment he obscured or concealed, and exposed the box to the light, examining the worms from time to time, and adding new ones every four hours. By repeated observations he found that they showed a decided tendency to withdraw to the darker parts of the compartments, only forty out of a total of two hundred and fifty remaining in the light. He also studied the influence of different rays upon them, and found them susceptible to the different colors. When the openings were covered with blue and red glass, they manifested a marked preference for the red light.

— Mr. A. Sanson, in an article in a recent number of the *Revue scientifique*, states, that, from a comparison of animal and steam power, in France at least, the former is the cheaper motor. In the conversion of chemical to mechanical energy, ninety per cent is lost in the machine, against sixty-eight in the animal. He finds that the steam horse-power, contrary to what is generally believed, is often materially exceeded by the horse. The cost of traction on the Montparnasse-Bastille line of railway he found to be for each car, daily, fifty-seven francs, while the same work done by the horse cost only forty-seven francs; and he believes, that, for moderate powers, the conversion of chemical into mechanical energy is more economically effected through animals than through steam-engines.

SCIENCE.

FRIDAY, JULY 30, 1886.

COMMENT AND CRITICISM.

The annual report for 1885, of Prof. J. P. Lesley, state geologist of Pennsylvania, contains a review of the conditions of the survey since its re-establishment in 1874 that does not show a highly enlightened policy on the part of the Pennsylvania legislature. The total appropriations for the thirteen years from 1874 to 1886 were $545,000, averaging $42,000 a year; but for 1885 a total expenditure of under $24,000 was allowed, and at the beginning of this year there was a balance of less than $36,000 on hand for the expenses of all of 1886 and the first part of 1887. So small a sum is entirely insufficient to insure proper official care of the enormous mineral interests of the state. The reduction of the appropriation for last year and this is the more embarrassing on account of the requirement that the work done shall include a greater variety of investigation than had been planned by the survey. The more important subjects reported upon for 1885 are the oil and rock gas about Pittsburgh, by Carll; the structure of the Pittsburgh coal-region, by d'Invilliers; the origin of coal-beds, by Lesquereux; and the anthracite survey and the kaolin deposits of Delaware county, by Ashburner. The anthracite survey, of the greatest technical and practical value, has been seriously hampered for want of funds. The same report gives an account of the method of distribution of the survey publications followed until lately, which, to put it mildly, does not reflect credit on the legislators at Harrisburg. The original regulation in 1874 ordered, that, after supplying a very moderate number of persons and institutions at the cost of the state, all others should obtain the desired volumes only by purchase at cost. But there was little or no sale, because citizens of the state were well accustomed to obtaining state documents free of cost from their representatives: consequently, when the first volumes appeared in 1875, and a demand for them was made on the members of the legislature, an act was at once passed providing for *a special edition* of 5,000 copies of every report, for the use of the senate and house. In this way, 425,931 copies have been distributed by the legislators; and it is safe to say that a good part of this distribution has been made indiscriminately, while the survey has had practically no copies to dispose of; and of the editions published for sale, counting up to 110,569 copies, there remained unsold 43,118 copies in 1885. In view of this, an act was passed last year disposing of reports as follows: 500 copies to the senate, 2,000 to the house, 150 to the state geologist, 600 to the board of commissioners, for local institutions and general exchanges, 250 to certain state officials. This will greatly reduce the careless distribution by the legislature, and will allow the board of commissioners an authority that should have been theirs from the first. The attempt to establish a topographical survey of the state has been unfortunately a failure. The coast survey is proceeding with the triangulation of the state, and has covered about one-third of its area; but the legislature would not accept the offer of the U. S. geological survey to assist in carrying on the topographic work, even though the survey agreed to expend $30,000 a year while the state should expend only $10,000. The proper mapping of the state will cost, it is estimated, half a million dollars, and, if supported only by state appropriations of ten thousand dollars a year, would require half a century for its completion. That is too long for an intelligent state to wait.

COMPOSITE PORTRAITURE.

The composite portraits which are published to-day were made from groups of undergraduates of Smith college. Figs. 1 and 2 each contains forty-nine members of the last senior class; fig. 4 is a composite of a selected group of the same class, containing twenty individuals; while fig. 3 was made from ten members of the class of '85, who formed an elective division in physics. The average age of all the groups is about twenty-two years.

These portraits may serve as text and illustration for a few remarks on some points of interest in this method of obtaining 'pictorial averages.'

The great difference between figs. 1 and 2 strikes one at once, and yet they were both made from exactly the same negatives and under the same conditions, except that in fig. 2 the negatives were so adjusted that the pupils of the eyes in each case fell upon the same points of the sensitive plate, while in fig. 1 the distance from the line of the eyes to the mouth was made constant.

The result of these different modes of adjustment is apparent in the multiple mouth which disfigures fig. 2, and in the less clear definition of the eyes in fig. 1, in which the component eyes fell upon slightly differing points in the same horizontal line.

The question at once arises, which of these faces, if either, in its general outline and expression, is the true average of the group? In seeking the typical features should we choose fig. 1, and correct the dimness of the eyes, or take fig. 2, and substitute a single mouth in the middle of the blur? As far as I can learn, this question of adjustment and its results has not before been raised. It is, however, a question of importance to all who are interested in composite photography; for only those composites which are made according to the same method of adjustment can be properly compared as types.

In any group of persons not chosen with special reference to facial symmetry, the ratio of the distance between the pupils of the eyes to that between the line of the eyes and the mouth is a variable one; and adjustment to either distance as a constant for the group will give its corresponding and differing composite. Mr. Galton makes the distance from eyes to mouth constant ('Inquiries into human faculty,' p. 359). The portraits of American men of science (*Science*, v. No. 118) seem (from the tendency to multiple mouths and noses, especially noticeable in fig. 1) to have been made, as fig. 2 was, by matching the eyes, though in these cases the beard prevents the prominence of the disfigurement which this adjustment gives in the case of smooth faces.

If a fixed distance between eyes and mouth be taken for adjustment, the composite will have a single distinct mouth, but will differ in form according to the distance chosen; if it be that of the shortest or of the longest face in the group, the composite face will be correspondingly short or long, and the indistinctness of the eyes at a maximum. But if, on the other hand, a component face of average length (i.e., one in which the ratio of the distance between the pupils of the eyes to that between the line of the eyes and the mouth is a mean one) be chosen, the resultant portrait will show a minimum indistinctness of eyes, and give what we may fairly call the pictorial average of the group. The average ratio which must serve for fixing the fiducial lines can be obtained from direct measurements on the negatives. This will not be a formidable task, if, as is usual, the negatives are taken so that the distance between the pupils is the same in all; since in this case it is only necessary to measure the distance from eyes to mouth in each, and take the mean.

This point is one which should be carefully attended to in making composites, for it would seem to be the only normal method of adjustment; all other adjustments giving more or less pronounced variants from the type.

Composites made in this way lose something of the deep-eyed, earnest expression, which is the result of superposing all the eyes of the components on exactly the same points. This loss, however, is a real gain in the truthfulness of the composite portrait, for the deep dark eyes do not represent the average, but rather a summation, and hence exaggeration of earnest expression. The face in fig. 1 is, I believe, a fairly normal composite of the group of forty-nine from which it was made; fig. 4 is from a group selected for facial symmetry, i.e., constancy of the ratio indicated, and is a type of this group with the exaggeration which comes from superposition of the eyes. Questions as to the possible dependence of the result on the order in which the components are taken, and on the time given to each exposure, occur to every one who interests himself in composite photography. In Mr. Galton's earliest paper on the subject, he speaks of six composites made from the same three components taken in their six possible combinations, and says, "It will be observed that four at least of the six composites are closely alike, . . . the last of the three components was always allowed a longer exposure than the second, and the second than the first, but it is found better to allow an equal time to all of them. In a later experiment, composites were made of four differently colored disks, whose images were superposed in four different orders, while the times of the successive exposures were equal. The result was four composite disks 'of precisely uniform tint.' The inference from this is, of course, that the order of exposure makes no difference when the times of exposure are equal (equal illumination of the image is assumed). The experiments which I have made on this point by taking composite portraits from the same components in different orders (with equal times of exposure) have shown that the order of exposure does affect the result. I have also repeated Galton's other experiment in several modified forms, both with disks of colored paper and with colored glasses (by transmitted light), and obtained results which, especially in the case of the

Fig. 1.—Forty-nine members of the last senior class.

Fig. 2.—The same as fig. 1, but adjusted for the eyes.

Fig 3.—Ten members of the same class, forming division in physics.

Fig. 4.—Twenty members of the last senior class.

COMPOSITE PORTRAITS OF SOME SMITH COLLEGE STUDENTS.

colored glasses (by far the fairest test), confirm those of Galton.

Experiments of this kind are far more satisfactory than those in which composite portraits are made from the same components taken in different orders: for one has to decide in the one case merely on the identity or difference of tint of disks or rectangles placed side by side on the same plate; in the other, of faces with their manifold detail.

Answers to both of these questions as to order and time of exposure would be found in knowledge of the rate at which light acts upon the silver salts of the photographic plate.

If the rate of this action is constant up to the point of a 'full-timed' plate, then the order in which the negatives are taken can make no difference, provided each successive fractional exposure is of equal length, and the image is in each case equally illuminated. If the velocity with which the chemical action proceeds is not constant, then the order will obviously make a difference in the result, unless the exposures are prolonged or shortened, or the illumination made stronger or weaker, as the velocity decreases or increases.

As far as I am aware, we have no knowledge of the rate of chemical action in this instance, except that which is given by the experiments above referred to, and which points to a constant rate of action within the limits of ordinary photographic exposures. Thus Galton's process appears as a valuable auxiliary in the investigation of an interesting point of the obscure field of photographic chemistry.

The possibility of the 'prepotency' of some individual of the group as a disturbing element was suggested in *Science*, v. No. 118, and has since been discussed by Mr. Jastrow in vol. vi. No. 134. Since the composite portrait is the result of the action of light on the silver salts, it would seem plain that no one face, however 'individual,' 'powerful,' or 'characteristic' it may be, can be prepotent in controlling the result. We must conclude that the apparently prepotent face is merely a close approximation to the type or average of the group.

In the hope that more may be induced to do something in composite photography, I would say that excellent results can be obtained with an apparatus which is by no means elaborate or costly. A camera for the purpose can be made of soft wood by any skilful carpenter. It need differ from the usual form only in having a mirror which is hung within so that it can swing down to an angle of 45° for the adjustment, and up against the top for exposures; and an opening in the top, over which a ground-glass plate is fixed. On this ground glass the fiducial lines are drawn in lead-pencil, and the images focused and adjusted. It must be at the same optical distance from the lens (the light being reflected to it by the mirror) as the ground glass at the back of the camera. A piece of ground glass placed behind the negatives will serve very well in place of a condensing lens for lighting them, and it is not necessary to enclose the gas jet in a lantern.

In order to give accurately timed exposures, I use a pendulum consisting of a wooden rod with sliding weights above and below the point of suspension, and having an arm at right angles to it. At the extremity of this arm is a screen of card or ferrotype plate, which, when the pendulum is swinging, plays up and down in front of the camera tube. Matters are so arranged, that, when the pendulum is at rest, the lower edge of the little screen lies across the horizontal diameter of the tube. After the negative is adjusted, the screen is held down so as to cover the end of the tube, while the slide in front of the sensitive plate is drawn, and then released and allowed to make a double vibration. The time of exposure is that of a single vibration of the pendulum, and this is regulated by adjustment of the sliding weights.

I find, as others have doubtless found, that the best composites are obtained from very 'dense' negatives. Those from which the composites in this number were taken were made for me by Mr. Lovell of Northampton, who succeeded admirably in obtaining strong negatives of very uniform density.

John T. Stoddard.

NATIONAL EDUCATION ASSOCIATION.

In point of numbers, the National education association meeting at Topeka, Kan., was among the most important ever held. As far as permanent educational literature is concerned, however, the contributions hardly correspond to the size of the gathering. The real value of such meetings must always be found in the quiet friction of mind with mind, and in the informal talks where men learn the experience of their fellow-teachers and become acquainted with the educational sentiment of distant sections. There is no better place than these to feel the educational pulse, and learn the temper of teachers on mooted points.

Both in the association and the council that preceded, the subject of industrial education was discussed at great length and with the widest divergence of opinion. Dr. S. H. Peabody of Illinois presented the report, which was an admirable paper, clearly and without prejudice outlining the theory of industrial education. To an outsider this whole question seems unnecessarily forced to the front. Only three per cent of our population are living by the branches of industry in which it is proposed to establish departments of instruction. Still further, one who watches the boy of to-day will hardly find him lacking in practical ability. The great need is rather moral and political training and general culture. Principal Council of the Alabama (colored) normal school at Huntsville gave explicit and convincing testimony to the value of manual training in his school; but the condition of the south, especially that of the colored people, is so abnormal and so different from that in other parts of the country, that a general argument cannot be fairly based on it. The negro is not simply illiterate, he is ignorant, — ignorant of thrift, of ways of living, of all that goes to make a prosperous citizen; and industrial education is simply one of many ways to help him. Besides, the educational system at the south is a bare outline. It will stand some filling up. But in the north, and at the east especially, the school system has taken on load after load, until its friends momentarily wait in anxiety lest it reach the breaking-point. The enemies of the public schools are foremost in insisting that its load be increased, doubtless not without sinister reasons.

Pres. William Preston Johnson of Tulane university, Louisiana, in his paper on education in his own state, spoke of Louisiana as lowest in the scale of literacy, only forty-nine per cent of its population being able to read and write. He pleaded for the national aid proposed by the Blair bill. There was, however, in his paper, nothing to offset the arguments that have been urged against the bill. It is hard for a close student to see how the mere lavish outlay of money is greatly to overcome conditions which money can only indirectly and remotely affect.

In the department of higher education Dr. Mowry of *Education* read a paper on 'The college curriculum.' The subject was well thought out, but presented from the ultra-conservative point of view, which is meeting such sharp criticism in many quarters at the present time. The sense of the crowded meeting in which Dr. Mowry's paper was read, was, however, clearly with him. The discussion was sharp.

The subject of alcohol and narcotics occupied large space in the meetings. The presentation was vigorous, though nothing was set forth new to those familiar with the work.

A department of secondary education was formed at the request of the high school and academy men present. It will be restricted exclusively to work between the elementary schools and the colleges.

The department of musical education suffered a serious loss in the absence of its president, Dr. G. Stanley Hall, who was detained at Ashfield, Mass. The papers read offered no noteworthy addition to the present literature of the subject.

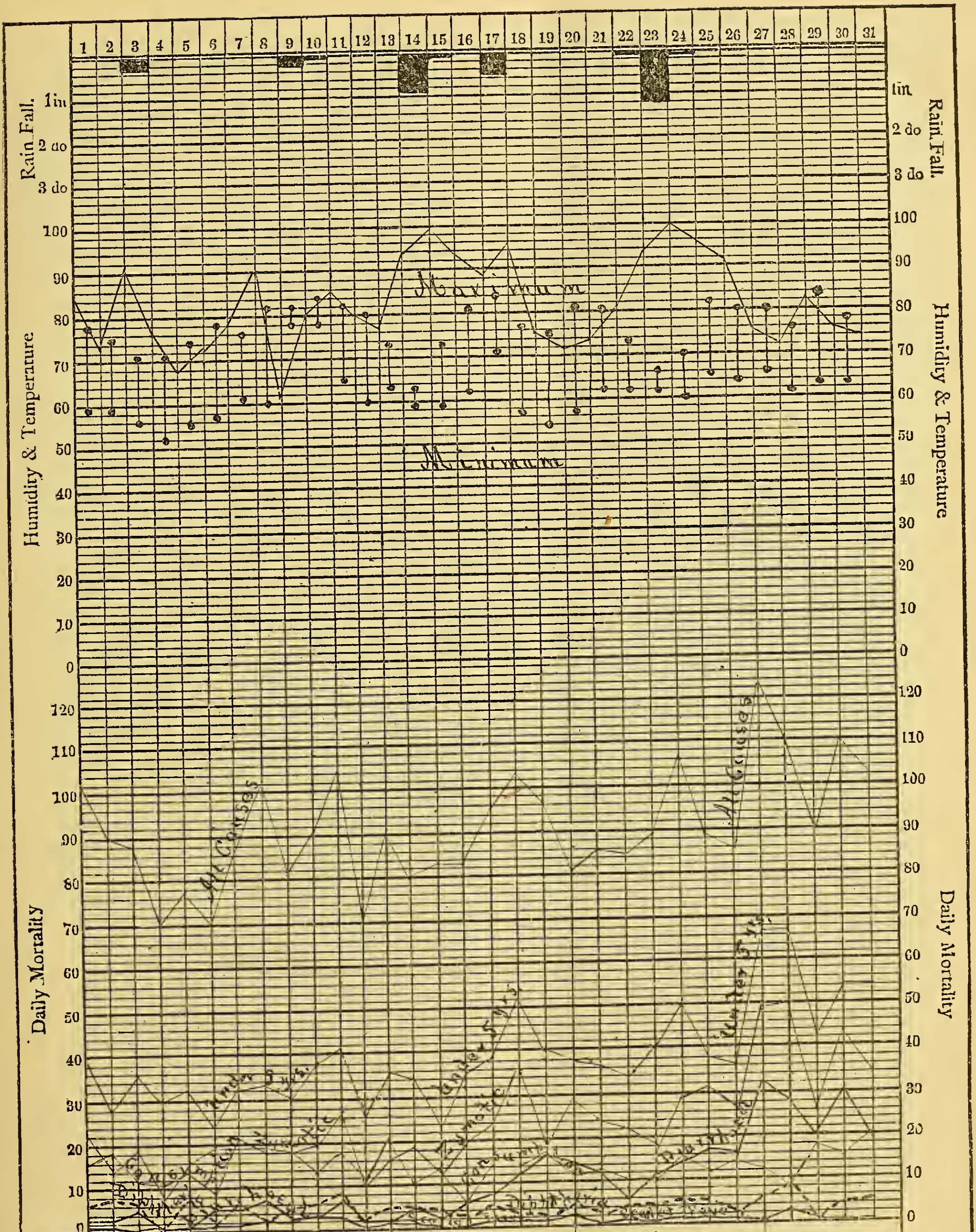
The kindergarten and industrial displays were unusually attractive; the Kansas agricultural college occupying a prominent place, and displaying some excellent work.

Altogether the meetings may be held a success. The place chosen was hardly fortunate, public accommodations were frightfully limited, and the heat at times was appalling. But western hospitality never showed itself in a more enthusiastic and delightful way. Houses and hearts were cordially open, and the torrid weather was cool compared with the welcome extended an all sides.

THE HEALTH OF NEW YORK DURING JUNE.

THE population of New York on the first day of June may be considered as 1,435,290. Of this number, 2,762 died during the month, an excess of three as compared with May. While, however, the total mortality for the two months was so nearly the same, the number of deaths of children under five years in June greatly exceeded that of the preceding month: the deaths in June being 1,375, as compared with 965 in May; or, to represent it in another way, had the conditions in June been the same as in May, 410 children whose deaths are recorded at the health office would now have been alive. The greatest daily mortality from all causes occurred on the 26th. On that day 124 persons died, 43 of them being under one year of age, and 66 under five, or more than one-half of the total mortality being children of this tender age. The causes of death on this day were as follows: 32 persons died from diarrhoeal diseases, 13 from consumption, 12 from diseases of the brain and nervous system, 8 from diseases of the kidneys, 5 from diphtheria and the same number from cancer, 4 from pneumonia, 3 from croup, and 2 from rheumatism and gout. Consumption still leads the list as a mortality factor; taking the month as a whole, 423 persons having succumbed to that disease, 72 less than in May. Diarrhoeal affections increased more than fourfold, these deaths being 303, as compared with 73 in May. Diphtheria, with 130 deaths, showed a reduction of 35 deaths; while scarlet-fever is charged with but 29 deaths, as against 44 in the month preceding.

The meteorology of the month is full of interest. The mean temperature for the year has been as follows: January, 26.79° F.; February, 27.45° F.; March, 37.60° F.; April, 52.87° F.; May, 60.18° F.;



Weekly Mortality	577	627	620	665	
Weekly mean Thermometer	66.5	68.8	67.3	68.4	
Weekly mean Barometer	29 908	29.905	29.822	29.911	

June, 68.03° F. As compared with the preceding sixteen years, June of 1886 was a cool month : in but two years, 1879 and 1881, has the mean been so low. The maximum temperature was 84° F.: this was reached on the 10th at 5 P.M., on the 17th at 1 P.M., and on the 29th at 5 P.M. In no year since 1869 has the maximum been so low for the month of June, the lowest being 88° F. in 1881, while it has in thirteen different years since 1869 been in the nineties, and in 1874 was as high as 98° F. The rainfall for the month was 3.35 inches, slightly above the average for sixteen years, which was 3.01 inches : it was less than that of May by 2.05 inches, but greatly in excess of that of June, 1880, which was only 1.32 inches. The number of days on which rain fell was nine.

It is of interest, in connection with the subject of temperature, to compare the maxima as recorded in the cities of New York and Brooklyn. The meteorological observations for the former city are made at Central park at a height of 97 feet above the sea : those for Brooklyn are made at Prospect park, 220 feet above the sea-level. The following table shows the maximum and minimum temperature for each day of the month of June at these two recording-stations, and the mean for the weeks ending June 5, 12, 19, and 26.

1886	Max. temp.		Min. temp.		1886	Max. temp.		Min. temp.	
	N. Y.	Bkln	N.Y.	Bkln		N. Y.	Bkln.	N.Y.	Bkn
June 1	78	74	59	53	June 16	81	77	62	60
" 2	75	69	59	57	" 17	84	82	71	66
" 3	71	70	56	62	" 18	77	82	57	63
" 4	71	72	52	55	" 19	75	74	54	57
" 5	74	72	55	57	" 20	81	79	57	59
" 6	78	75	57	57	" 21	80	78	62	65
" 7	76	71	61	55	" 22	73	72	62	60
" 8	82	79	60	62	" 23	66	72	62	60
" 9	78	78	59	61	" 24	70	69	60	64
" 10	84	79	59	64	" 25	82	77	65	61
" 11	82	80	65	65	" 26	80	79	64	63
" 12	80	76	60	64	" 27	80	79	66	63
" 13	73	70	63	62	" 28	76	74	61	62
" 14	63	64	59	57	" 29	84	83	63	65
" 15	73	72	59	57	" 30	78	77	63	66

Mean for the week ending

June 5.		June 12.		June 19.		June 26.	
N.York	B'klyn	N.York	B'klyn	N.Y.	B'klyn	N.Y.	B'klyn
66.5	65.98	68.8	68.86	67.3	65.98	68.4	67.19

It will be seen that Brooklyn has, as a rule, a lower temperature than New York. Whether this is due to the difference in elevation of the reading-station, or to some other cause, we do not know. At some future time we hope to be able to give the record of temperature as observed in the hearts of the two cities, which is really the temperature which has a direct bearing upon the public health, rather than that which obtains at such salubrious localities as Central and Prospect parks.

PARIS LETTER.

As the centennial anniversary of the French revolution is to be celebrated here with great display, the government is pushing on with great eagerness all preparations concerning the exhibition of 1889. The plan of the buildings is not yet exactly chosen, but will be soon. It is, however, already decided that a large and very high tower shall be erected in the middle of the exhibition buildings. The Eiffel tower — as it is called, after the name of the man who is to build it — will cost a million of dollars. It is to rest on two legs, which meet and coalesce to form a single tower supported by them. The arch thus formed will be wide and high enough to allow a free and easy passage to the whole of Notre Dame, if this cathedral were to come and ramble about the exhibition. The whole tower will be seven times as high as the *Arc de triomphe.* At present the question is how one shall get up to enjoy the very fine view that will be afforded from the top. An elevator can be used only in the vertical part of the tower : in the two legs, one must devise some other plan, on account of the incline. It is believed that in the first, non-vertical part, a funicular railway will be used ; in the other an elevator will do very well. But, of course, both systems must be very well combined, and every thing possible must be done to insure the safety of the amateurs who wish to ascend the tower. This is not the easiest part of the task of M. Eiffel. The building is to be begun as soon as the necessary funds have been voted by the senate.

A very interesting meeting was recently held at the Academy of inscriptions. Some days after I sent my last latter, it was rumored that M. Maspéro, the very modest and able director of the Boulaq museum of Cairo, had found some very antiquated and interesting mummies. These were found, as he wrote to the academy, in a *cachette* of Deïr el Bahari, not at all in their tombs : they had been hidden to prevent violation. The mummies were undone in presence of Nubar-Pacha, Sir Drummond Wolff, and the khedive.

It was then easily ascertained, by means of the inscriptions on the cloths surrounding the mummies, that one of them was the body of Ramses II. This is certainly a very interesting fact ; and it is easily believed that to assist at the unveiling of the corpse of a great conqueror, such as Ramses, who died forty centuries ago, causes an emotion of a rare and novel nature. A photograph of the mummy was produced at the meeting of the academy, and created quite a sensation. Although forty centuries have passed over this dead body, the face is in an excellent state of preservation. The expression is that of a man of high blood, grave, and full of will. The head is rather small; the hair white and rather thin, especially in front. The jaw is very strong: there are no teeth in the mouth. The hands are very elegant, and are yet reddened by the *henné*, which was used for the body's last toilet.

Two other corpses have been found. One was in the sarcophagus containing the remains of Ramses II. The body was not as well preserved. It is believed to be one of the sisters or daughters of Ramses. The other corpse is that of Ramses III. The face is that of an intelligent and refined man, but the expression of power and will is less pronounced. The mouth is very large, and the teeth are all in good order. M. Maspéro intends to have these royal corpses renovated and set in good order: they will then be exposed in the Boulaq museum, where everybody can look and wonder.

Apropos of the recent census of Paris, the full results of which I have not yet seen, some papers have recalled some peculiarities of the last census, taken in 1881. At that time there was one married man of seventeen, one married woman of fourteen, three widowers of eighteen, and two widows of sixteen. Instances of old age were pretty frequent: 6,386 persons were aged over 80 years; 2,747, over 85; 640, over 90; 138, over 95. There were twenty centenarians, — four bachelors, one married man, six widowers, one unmarried woman, one married one, and seven widows. It seems that conjugal life is not very favorable to old age: misanthropes, or rather misogyns, may take a hint, and philosophers may moralize on this statistical fact. Although the full results of the 1886 census are not known, it is certain that the population of Paris has increased by a hundred thousand persons since 1881. Artists of all sorts are very abundantly represented in Paris; the number being 42,626, of whom over 20,000 are women.

A surgeon of Tours, Dr. Thomas, has recently communicated a very interesting fact concerning the surgery of the fingers. A man, while passing over a gate, lost the whole skin of one of his fingers; a ring around one of them having got caught between the gate and an iron bar, and the weight of the man while jumping having forcibly dragged the finger through the ring. The ring and the skin remained an entire hour on the gate. Dr. Thomas secured both, and reintroduced the scalped finger into its normal envelope. Although the whole skin did not adhere, a good part of it was restored to life; and it is possible, that, if the operation could have been performed earlier, the result might have been quite satisfactory.

M. Grancher, professor in the medical school of Paris, and medical assistant of M. Pasteur, especially in anti-rabid inoculations, — Pasteur not being legally qualified for medical practice, — recently gave a very interesting lecture at the Paris exhibition for hygiene, on rabies. He divides the persons who apply to Pasteur for treatment into three classes, — 1°, those who have been bitten by dogs positively rabid, which have communicated rabies to other dogs, or from whose nervous system rabbits have been rendered rabid; 2°, those bitten by dogs pronounced rabid during life or after death by veterinarians; 3°, those bitten by dogs of which nothing is known. Putting aside persons bitten recently, and whose fate is yet uncertain, M. Grancher says that the total of persons coming under the three preceding classes is 1,335. As to the first category, according to a very severe and strict statistical review by M. Leblanc, the usual death-rate of persons bitten and not inoculated is 16 per cent. When Pasteur's method is employed, this death-rate is only 1.04 per cent. In the second category, with Pasteur's treatment, it is only 0.46 per cent. No account is taken of the third category, for reasons easily understood. Now, if account is taken only of the persons that have been bitten in the face or on the hands, it is known, on the authority of Brouardel, that the usual death-rate is 80 per cent. With Pasteur's method, the death-rate becomes 1.80 per cent for the first category, and 0.75 per cent for the second. As to wolf rabies, the preventive inoculations seem to exert a very powerful and useful influence. The normal death-rate is 66 per cent; on inoculated persons it is only 14 per cent.

Upon the whole, the more time advances, the more Pasteur's method seems to be a really useful one, and one of which much is to be expected in the future as well as in the present. But this success must also be a very forcible incentive to the study of the manner in which other parasitical diseases may be prevented. Rabies is certainly a very terrible disease; but it must be said, that, although very deadly, it is not an important cause of death. It would be much more useful for mankind to be able to cure tuberculosis, diphtheria, cholera, or the yellow-fever; and it is to be hoped that Pasteur and others will give their attention to the subject. Pasteur's splendid success is well fitted to give an impulse to new studies and researches, and we sincerely hope that it will. Much is done, certainly, by Jenner's and Pasteur's work, but much more remains to be done. The only difference is, that future experimenters are in possession of a method of study which had hitherto been totally wanting. From a theoretical point of view, there is no *a priori* reason against the possibility of preventing or curing parasitic diseases, such as tuberculosis, cholera, diphtheria, etc.

At the last meeting of the Academy of medicine M. J. Rochard gave some very interesting notes concerning the consumption of alcohol in France. During the last forty years, the annual quantity of alcohol which is used for drink has nearly doubled, but the evil which has resulted therefrom has more than doubled. This is due, according to M. Rochard and others, to the impure quality of many alcoholic drinks or liquors, and to the fact that amylic alcohol is often added to ethylic. It is well known that amylic alcohol is a dangerous and deleterious liquid, and even in small quantities a real poison. Since 1880 the number of *cabarets*, or wine-shops, has become very great: the number is 320,000, and it is calculated that there is one *cabaret* to twenty-five persons. The great abundance of deleterious alcohol may be explained in part by the decrease of production of ordinary wines, due to the ravages of phylloxera. The result is, that a great amount of Spanish or Italian wines of inferior quality are brought into France: as they have no taste, alcohol is added, and almost always amylic alcohol is used. As the senate asked the opinion of the Academy of medicine concerning the question, the academy has answered as follows: First, the addition of alcohol ought to be forbidden; sugar only ought to be added during the fermentation process. Government ought to prevent all introduction into France of alcoholized wines, and prevent the traffic in wines containing over twelve degrees of alcohol: twelve degrees must be the utmost allowed, instead of fifteen as at present. Lastly, the number of *cabarets* ought to be much diminished, and they ought to be very well and frequently inspected. Such is the course proposed by the Academy of medicine. The different conclusions adopted by a special committee will be discussed at the next meeting, and the opinion of the academy will then be sent to the senate. In our next letter we shall let you know the result of this discussion.

In another recent meeting of the same society, M. Andouard of Nantes communicated an interesting note concerning some cases of excellent preservation of dead bodies, notwithstanding exposure. It has long been well known that corpses become mummified in dry sand or earth, or in heated deserts. It may be so in constantly heated rooms; but it has not been ascertained yet that a dead body exposed to open air can also escape decomposition, or rather putrefaction. It is well known, however, that in Toulouse, for instance, dead bodies are very well preserved in open air, when they have been entombed for a year or two in an hermetically closed vault; that at the great St. Bernard pass in Switzerland the bodies of the travellers killed by avalanches, or frozen during their journey, as well as those of the monks who live in the *refuge* of the pass, are never buried, but simply laid out in small buildings or underground cellars; and they never decompose, on account of the dryness of the air, and the cold which always prevails, — a very singular and interesting sight which travellers ought not to forget to ask for when they cross the pass in summer. But in both of these cases there is a reason for non-decomposition. In the first, corpses become saponified by remaining in dry air; in the second, cold is the agent of preservation.

M. Andouard recently met with a case in which a young girl remained a whole year in the place in which she was murdered. The body, one year after death, was so very well preserved that it was thought that some chemicals or antiseptics had been used. In fact, none had been used; and the preservation of the body — in a cellar — was due to the fact that the temperature was low, that ventilation was very imperfect, hardly possible even, and that the cellar was very dry. In fact, there was in this case a natural combination of the conditions favorable to non-decomposition. The changes in the tissues of the corpse were very curious. The body had lost a great deal of weight. The skin was hard, dry, and rigid. Muscular and vascular tissues underneath had all disappeared: in place of these was found a sort of fibrillar substance, of a spongy nature, made up of dried cellular and conjunctive tissues, and of a sort of dust. This dust was the result of an incalculable amount of dead *acarii* and of their eggs; and the presence of these insects is the reason for the preservation of the body. They absorbed all liquid and putrescible structures. M. Andouard's paper is a very useful one, and it would be very interesting to meet with other similar cases. In fact, the decomposition process of dead bodies, either buried or unburied, is not very well known, and the matter is worth studying.

Professor Mosso of Turin has recently made known, in the *Archives italiennes de biologie*, many interesting results of his experiments on the respiratory function. His conclusions are new, and the facts he has discovered had hitherto escaped observation. First of all, he noticed that there is no regular respiratory rhythm, but that there are some pretty regular irregularities in the way we breathe. During heavy sleep, these irregularities are very noticeable, when Marcy's pneumograph is used. There are regular series of deep and strong inspirations, followed or separated by series of shallow and weak ones ; and in both of these series the diaphragm and thoracic muscles do not take equal parts. When the diaphragm works much, the other muscles take some rest, and reciprocally. When mind and body are quiet, the respiration is less deep and more frequent, and the diaphragm is somewhat lazier than usual. But a more important fact is, that the number and depth of the respiratory movements are not proportioned to the needs of the organism, and the conclusion drawn therefrom is, that we usually breathe more than is necessary, when in ordinary conditions under the sea-level barometric pressure. For instance, on high mountains we breathe less air than on the sea-level, and do not find ourselves any the worse for it. M. Mosso gives many other very interesting conclusions, some of which refer to the Cheym-Stokes respiratory rhythm ; but we cannot give more than the principal facts in this letter. However, we must quote the singular and unexpected conclusion, that there is no unique respiratory centre. This conclusion seems rather difficult to admit, but the matter is worth investigation. Professor Mosso's memoir is a very long one, and cannot be easily reviewed in a short space.

Another interesting paper on the biological sciences is that of Professor Sanson, on 'The comparison of the living organism as an animated motor with the steam-engine.' His conclusion is that the animated motor is more economical than the engine, if it is asked, not which of the two gives most work, but which gives the kilogrammetre at least cost-price. But this conclusion applies only to cases in which a great expenditure of force is not required. For instance, in cases where twenty horses can do as well as a steam-engine, it is more economical to use the horses, and it is all the more so that less energy is required ; but if fifty horses can do the work of a steam-engine, it is better, that is, more economical, to have it done by steam. Professor Sanson's paper has been published in the *Revue scientifique* of June 19, 1886.

An interesting thesis was published some days ago by M. L. Boutan, assistant of Professor de Lacaze-Duthiers. The subject of it is the 'Anatomy and development of Fissurella,' a gastropod mollusk. The most important fact is, that in larval development, Fissurella passes by two stages which very much remind us of two adult gastropod forms of life : one resembles Emarginula ; the other, Bimula.

Among the recent publications I will point to the supplementary volume published for 1886 by the *Archives de zoologie expérimentale et générale.* As this scientific periodical is now overcrowded, some contributors conceived the idea of publishing their own memoirs at their own expense, and making a volume identical with the ordinary one ; as is often done by the *Zeitschrift für wissenschaftliche zoologie* when papers are too abundant. This supplementary volume. printed and bound exactly in the same style as the ordinary ones, contains four memoirs. One is by Y. Delage, professor of zoölogy in the Sorbonne, on a Balaenoptera musculus found on the Normandy coast. It contains a number of new anatomical facts concerning this animal, and is accompanied by a series of very fine plates. The second memoir relates to the physiology of muscular contraction of invertebrated animals (with thirty-five *graphiques*), by H. de Varigny. D.Sc. The third is by J. Deniker, D.Sc., and is an excellent monograph of a Gorilla foetus, from an anatomical point of view. Very little has been known hitherto on that subject. The last one is M. Boutan's memoir, of which we have just spoken. This supplementary volume is a very big one, and contains a great many more engravings and plates than the ordinary ones do. It is to be hoped that the enterprise of the authors will prove successful, and encourage other similar experiments. V.

Paris, July 10.

NOTES AND NEWS.

Professor Weichselbaum of Vienna has recently collected the opinions of the leading medical authorities on the causation of pneumonia, and regards the proof of its bacterial origin as abundantly established. He has investigated one hundred and twenty-seven cases, besides having made a large number of experiments, using the material obtained from lungs affected with this inflammation. As a result of his labors, he finds four varieties of micro-organisms in this affection: 1. The diplococcus pneumoniae, which occurred in ninety-one of the cases (these are oval, elliptical, or round cocci, and are sometimes in pairs and sometimes form chains); 2. Streptococcus was found in twenty cases (this microbe resembles the first variety, but is, as a rule, more spherical); 3. Staphylococcus aureus s. albus was detected only in secondary pneumonia ; 4. Bacillus pneumoniae, as its name implies, is rod-shaped (this form was found in nine cases). Whenever other affections co-existed with pneumonia, and appeared to be secondary to it, as in meningitis, pleurisy, or pericarditis, they were determined to be due to these micro-organisms.

— The senate conferees on the naval appropriation bill have receded from their disagreement to the clause making provision for the new observatory buildings. This practically insures the appropriation of fifty thousand dollars to start the work, the entire cost of which is estimated at nearly six hundred thousand dollars.

— Dr. George L. Fitch has for five years been in charge of the lepers in the Sandwich Islands. He gives it as his opinion, based on careful study and attempts to inoculate the virus into healthy persons, that leprosy is not a contagious disease.

— A new and interesting form of stereoscope has recently been described by Mr. Stroh, before the Royal society of England. The apparatus consists of two dissolving-view lanterns placed side by side, each of which throws a magnified stereoscopic picture on the screen. In front of these lanterns there is a rotating disk, portions of which are cut away, alternately shutting off the picture from each lantern. By so arranging the rotating disk as to permit each eye to see only the view from one of the lanterns during its very brief exposure, a stereoscopic effect is produced, the impression of each picture remaining upon the retina of the corresponding eye long enough to appear to be continuous.

— Prof. Charles Upham Shepard, jun., has deposited his collection of meteorites in the national museum at Washington. The collection represents nearly two hundred distinct falls, and contains many exceptionally fine specimens. The iron from Dalton, Ga., weighing one hundred and seventeen pounds, is the largest meteorite in the display, and is almost perfect. Only a small piece has been cut from the lesser end.

— Dr. William L. Dudley, late Miami medical college, Cincinnati, has accepted the chair of chemistry in Vanderbilt university, Nashville, Tenn.

— The volume of the Ray society (England) for 1885 is made up of the late Mr. Buckler's life-histories of British butterflies, with colored plates of their earlier stages. Most of the descriptions have appeared piecemeal before; but the work is rendered more complete by additions from his note-book, and new observations by his friend and colleague, Mr. Hellins. Seventeen plates, with two hundred and fifty-five figures, are given, and the drawings are better than the average. The industry of Mr. Buckler, who made all the drawings, is shown in the remarkable fact that some part, at least, of the history, is given for fifty-eight of the sixty-three British species. It is a pity that no drawings whatever of eggs are given.

— The lectures now being delivered at Oxford by Professor Sylvester on his new theory of reciprocants will appear in the coming numbers of the *American journal of mathematics*. The lectures are presented in quite simple style, and will be exceedingly interesting to all students of the modern algebra, or, more accurately, of the theory of invariants. The first eight or nine lectures will appear in the forthcoming number of the *Journal*, vol. viii. No. 3.

— 'Solar heat, gravitation, and sun spots,' by J. H. Kedzie (Chicago, *S. C. Griggs & Co.*, 1886), is certainly a book which deserves little praise. If one is not convinced by the title alone, he will find, in the rambling speculation of the author, sufficient evidence that he is treating of theories far beyond him, and of the history and development of which he knows nothing.

— The *Sanitary engineer* has collected and published in book form a number of articles which have appeared in that journal upon 'Steam-heating problems.' This collection is published partly because their previous book upon 'Plumbing and house-drainage problems' was well received. The book is intended to be useful to those who design, construct, and have charge of steam-heating apparatus.

— 'Laboratory calculations and specific gravity tables,' by John S. Adriance (New York, *Wiley*), is intended to aid students and analytical chemists in their calculations. The author has collected those tables which are constantly needed in the laboratory, has edited them with care, and it is probable that the book will be found to fill its place satisfactorily.

— Prof. B. O. Peirce of Harvard has recently published 'The elements of the theory of the Newtonian potential function' (Boston, *Ginn*), as he calls it. The book is made up of lecture-notes used by the author during the last four years, and can be used by those familiar with the first principles of the calculus. The author found it difficult to find in any single English book a treatment of the subject at once elementary enough and at the same time suited to the purposes of such as intended to pursue the subject further or wished without making a specialty of mathematical physics to prepare themselves to study experimental physics thoroughly and understandingly. The book is divided into five chapters, — on the attraction of gravitation, the Newtonian potential function in the case of gravitation, the Newtonian potential function in the case of repulsion, the properties of surface distributions (Green's theorem), and electro-statics. There are certainly few better able to produce such a book than Professor Peirce.

— Messrs. J. B. Lippincott & Co. have in press a 'Manual of North American birds,' by the eminent ornithologist, Prof. Robert Ridgway, curator department of birds in the Smithsonian institution. The work is to contain some 435 illustrations suitably executed, and will conform to the geographical limits, classifications, numeration, and nomenclature adopted by the American ornithological union. We doubt not it will be a most important contribution to the literature of the subject, and presume that naturalist and sportsman alike will find in it an aid.

— Mr. N. S. Goss's revised list of the 'Birds of Kansas' gives notes on three hundred and thirty-five species occurring in that state, one hundred and seventy-five of which are known to breed within its limits. This little work contains the results of a large amount of labor, and is highly creditable to its author.

— 'The young collector' (London, *Sonnenschein & Co.*) is the title of a very cheap and convenient series of small handbooks designed for the amateur, tastefully and neatly gotten up, and issued at one shilling each. Four of them, so far, have appeared, on 'Mosses,' by J. E. Bagnall; on 'British butterflies, moths, and beetles,' by V. F. Kirby; on 'Seaweeds, shells, and fossils,' by Peter Gray and B. B. Woodward; and on 'English coins and tokens,' by L. Jewitt and B. V. Head. These little handy handbooks contain simple directions for the collection and preservation of specimens, with a general introduction to scientific classification, habits, etc., interpersed with numerous engravings. To the boy or girl with an awakening propensity to collect (and every healthy boy at some period of his career has a more or less enduring hobby of some sort or other), these little works will serve as useful guides even in America. Why cannot some publisher get out similar and as cheap handbooks, more expressly serviceable for the young American collector?

— The longest clock pendulum known is said to be one in Avignon, France, measuring sixty-seven feet, to which is attached a weight of one hundred and thirty-two pounds. Its movement is slow, passing through an arc of between nine and ten feet in four seconds and a half.

— Mr. J. H. Long, in a recent paper on the microscopic examination of butter, arrives at the conclusions, that, "taking all things into consideration, we have no absolutely certain method of distinguishing between butter and some of its substitutes, and that, of all methods proposed, the microscopic are perhaps the least reliable." These conclusions are similar to the ones reached by Prof. H. A. Webster, but are directly opposed to those of Dr. Taylor.

— The mortality of horses in New York City during 1885 reached nearly seven thousand; and during the past six years nearly forty thousand dead horses were received at the receiving-docks.

— Recent researches by Messrs. Coleman and McKendrick of England, on the effects of extreme cold on certain microbes, especially those concerned in putrefactive changes, show that the organisms are killed by exposure to a temperature of from 80° to 120° F. below zero, though their germs are unaffected, and speedily develop after an increase of temperature.

— We learn from the *Athenaeum* that the necessary funds have been granted for the expenses of the British expedition to observe the total eclipse of the sun on Aug. 29. The party, which will probably include Mr. Maunder and Mr. Turner of the Greenwich observatory, will occupy three stations on the island of Grenada in the West Indies. Totality occurs there about quarter-past seven o'clock in the morning, and lasts very nearly four minutes. A proposal was made some time ago to despatch a German party to Benguela on the west coast of Africa, the most favorable point from which observations could be made; but we have not heard that it has assumed a tangible form. The bill introduced in congress for fitting out an American expedition seems to have been buried with some committee, and it is now, of course, too late for proper preparation, even if the bill could be pushed through.

— The president of the province of the Amazonas, Brazil, has authorized the employment of Francisco Pfaff, of Geneva, Switzerland, as the chemist of the botanical gardens established at Manaus a few years ago. It will be the duty of the chemist to study and report upon the medicinal and industrial properties of the plants of the Amazon valley.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Sea-level and ocean-currents.

The subject of sea-level and ocean-currents is not so simple that there is not room for differences of opinion. It is not to be denied that exceptionally strong winds, such as Texas northers or those of violent cyclones, often cause considerable changes of sea level in shallow water like that of Lake Erie, or of the thin stratum of the same depth, and much less near the shore, along the Atlantic coast and the border of the Gulf of Mexico, extending mostly to a distance many miles from the coast, where the bottom of the shallow water drops off abruptly into deep sea-water. But the effects of winds of the same strength upon deep sea-water are comparatively very small.

If we suppose Lake Erie to be two hundred miles in length and two hundred feet in depth, and a wind with a velocity of forty miles per hour to blow over it from one end to the other, we have, no doubt, approximately the conditions under which Dr. Newberry made his observations. Such a wind, then, causes a surface gradient in Lake Erie of four feet in two hundred miles. The first effect of the wind is to drive the surface water from one end of the lake toward the other, and thus to cause a gradually increasing surface gradient. The difference of pressure arising from this gradient causes a counter-current in the lower strata of the lake, and the static condition with regard to change of gradient takes place when the force arising from this gradient is sufficient to overcome the friction, and maintain a counter-current sufficient to return the water below just as fast as it is driven forward above by the wind. This is required to satisfy the condition of continuity, — a condition which, in all such cases, must be satisfied after the maximum gradient has been reached, and there is no further accumulation of water at the one end or a diminution at the other.

The force of the wind is applied directly to the surface only, but is communicated to the strata below by means of the friction between the successive strata of gradually decreasing velocities with increase of depth in the upper strata, and gradually increasing velocities in the contrary direction at depths below the neutral plane which separates the direct from the counter currents. If we assume, as usual, that friction is proportional to the relative velocities between the strata, then, in order to distribute equally the force at the surface to the strata below, it is necessary for these relative velocities to decrease in proportion to increase of depth, and finally vanish; and consequently the absolute velocity must be comparatively very great at the surface, and diminish, rapidly at first and then gradually less, until the neutral plane is reached, when this velocity vanishes, and changes sign at lower depths. Since the direct velocities in the upper strata are very great in comparison with those of the retrograde motion below, it is evident that the neutral plane cannot be at any great depth in comparison with the whole; since where the velocities are least the transverse sectional areas must be greatest, in order that there may be as much flow in the one direction as the other.

Upon the hypothesis of no frictional resistance from the bottom to the counter-flow below, the relative velocities between the strata would vanish, and the maximum velocity of the counter-current would take place, at the bottom. In this case the force by which the water, held at a certain gradient by the force of the wind, tends to be restored to its level, is an exact measure of the force of the wind. This force, it is well known, is measured by the product of the mass into the acceleration of gravity along the descending gradient. But the mass for the same lake being proportional to the depth, and the acceleration proportional to the gradient, a relative measure of the force of the wind is the surface gradient multiplied into the depth. For the same wind, therefore, the gradient is inversely as the depth.

In the case of frictional resistance to the counter-current at the bottom, as there always is, of course, the maximum velocity of the counter-flow, and the vanishing of the relative velocities, take place at a plane a little above the bottom; and in this case the static gradient must be such that the force arising from it must not only be sufficient to overcome the force of the wind, as communicated by friction to the several strata down to the plane of the greatest velocity of counter-flow, but likewise to overcome the friction of the bottom, communicated in like manner upward to the strata above, as far as to the plane of greatest velocity of counter-flow, where the relative velocities vanish, and where, consequently, the effect of friction from the bottom must stop. But this is small in comparison with the whole force, and for different depths is proportional to the gradient. We therefore still have, for a relative measure of the force of the same wind, in the case of varying depths, the product of the gradient into the depth, and consequently the gradient inversely as the depth.

If, then, we suppose the depth of Lake Erie to be increased 60 times, or to the depth of 12.000 feet, a wind with a velocity of 40 miles per hour would cause a gradient of only the one-sixtieth part of the observed gradient, or 0.8 of an inch, in 200 miles; but, on the other hand, if the depth were less, the gradient would be proportionately increased. Hence it is seen how greatly the gradient, and consequently the change of sea-level, belonging to a given wind, depends upon depth. But the difference of sea-level, of course, other conditions being the same, is proportional to the length. Hence, if we increase the length of the lake 15 times, or to a length of 3.000 miles, the difference of level then would be 15 times 0.8 of an inch, or one foot With the depth increased 60 times and the length 15 times, we have approximately the conditions of a section of the Atlantic Ocean extending from New York harbor to the coast of France; and a westerly wind. therefore, of a velocity of 40 miles per hour. would cause the sea-level to be one foot higher at the latter place than at the former. But the average wind blowing across the Atlantic we know is very much less than this, and therefore its effect cannot be nearly so great as this.

The mean annual velocity of the wind across the Atlantic in middle latitudes is approximately known from the mean barometric gradient. The difference between the annual mean of the barometer at Iceland and the parallel of 35° is about 10 millimetres; and this gives a gradient on the parallel of 45° which corresponds to a westerly wind of about 8 miles per hour. The relation between wind friction upon water and the velocity of the wind is somewhat uncertain; but it increases at least at as great a rate as the first power of the velocity, and probably at a rate considerably greater. But, assuming it to be as the velocity, then the average westerly wind between America and France causes a difference of sea-level between the two of only 2.4 inches. If wind-friction were as the square of the velocity, it would be only a half-inch. It undoubtedly falls somewhere between these two values, but even by the former the effect of the average wind in causing a difference of sea-level is very small.

But there is another argument, entirely independent of the observations on Lake Erie, or any absolute wind velocities, from which we deduce about the same conclusions. It is well known from barometric monthly averages that the barometric gradient between Iceland and the parallel of 35° is at least twice as great, on the average, in January as in July. Whatever the absolute velocities of the wind corresponding to given gradients may be, we know that they are proportional to the gradients, and consequently the westerly winds must be at least twice as strong in January as in July, notwithstanding Dr. Newberry seems to think there may not be much difference. If the annual average velocity of wind, therefore, whatever it may be, causes a difference of level between America and France of 2.4 inches, then this difference in January is 3.2 inches, and in July only 1.6 inches, and consequently a change of difference of sea-level of 1.6 inches between the two seasons. The discussion of long series of tide observations on both sides of the Atlantic gives a small annual inequality of sea-level with a range of several inches; but both the ranges and the epochs of maximum height of sea-level are nearly the same on both sides, the latter occurring in the fall; and so there can be, at most, only a very small change between January and July, not possibly as much as 1.6 inches, and therefore the average wind of the year cannot cause a difference as great as 2.4 inches, deduced from the preceding argument upon the hypothesis that wind-friction is in proportion to the velocity. It is admitted that some of the data upon which these results are based are somewhat uncertain; but if some of them are in error, a fourth or even a third part, it affects the argument very little.

Upon the usual assumption that friction between the different strata of water is proportional to the relative velocities without regard to difference of pressure at different depths, it is readily inferred, from what precedes, that the absolute surface velocity is independent of depth of water, and so a westerly wind of 40 miles an hour across the Atlantic would give rise to the same surface velocity as on Lake Erie. Dr. Newberry has not furnished us with any observation of surface velocity, and therefore we cannot infer what the velocity of surface water on the Atlantic, corresponding, say, to the average velocity of about 8 miles per hour, would be. This, if wind-friction is proportional to the velocity, would be one-fifth of that on Lake Erie corresponding to a velocity of 40 miles per hour. If the wind does not blow the water against a barrier, but in circuits, of course the case is very different.

In the trade-wind latitudes the westerly component of motion is perhaps about the same as the easterly component of the middle latitudes in the North Atlantic; and, as the tropical sea between Africa and the Gulf of Mexico is much deeper, we may infer, from what precedes, that the trade-winds cannot possibly cause a difference of sea-level of two inches, and hence raise the level of the Gulf of Mexico as much as one inch above the normal undisturbed level. The winds, therefore, can have no sensible influence in producing the Gulf Stream, for this deep and rapid current can only be caused by a difference of sea-level between the Gulf and the parts in higher latitudes toward which it flows.

WM. FERREL.

Washington, July 18.

Neff's gas-wells.

In the geological map of Ohio, showing the positions of the oil and gas wells (*Science*, June 25, 1886), there is a circle enclosing these words, 'Neff's gas-wells.' This region was discovered in 1864 as geologically, and in many particulars physically, the duplicate of the Venango county, Penn., region. In 1865 well No. 1 was bored, proving the substratification of the subcarboniferous shales and sands to be the equivalents of those in Pennsylvania; but, in place of striking oil, there was developed a remarkable gas-well, which has been described by tourists and scientific men as a geyser of great violence. A full account of all the wells has been published in the Ohio state geological survey, and quite recently in the tenth volume of the Tenth census of the United States, by Prof. S. F. Peckham.

Some of the wells discharge a few gallons of oil each day, of a superior lubricating quality, gravity 32°.

The analysis of the gas is as follows: —

Marsh-gas	81.4
Ethyl hydride	12.2
Nitrogen	4.8
Oxygen	0.8
Carbon monoxide	0.5
Carbon dioxide	0.3
	100.0

There is also a small amount of free hydrogen which is carburetted before burning.

The analysis of the carbon, known as an article of commerce by the trade-mark, 'Patented diamond black,' produced from the gas of these wells by patented processes granted the writer, is as follows: —

Carbon [1]	95.057
Hydrogen [1]	0.665
Nitrogen	0.776
Carbon monoxide [2]	1.378
Carbon dioxide [2]	1.386
Water	0.682
Ash (Fe_2O_3 and CuO)	0.056
	100.000

The pressure on these wells is not the same in all. There is a pressure for each well; at which degree of pressure there is an equilibrium between the generation or discharge of the gas, and the well's state of rest or quiet. Very little salt water is found in these wells, and it gives little trouble. Observations show that the supply increases in warm weather and in the heat of the day, and regularly with the variations of the moon, being strongest at the full moon. The gas is a rich illuminating hydro-carbonaceous gas, and, even when mixed with seven parts of atmospheric air, is a good illuminant. Well No. 2 has been systematically examined; and there is no apparent diminution in the supply of gas, during the past fourteen years of the twenty years the well has been 'blowing.' Where is it from?

That there is a limit to the supply of petroleum or gas cannot be questioned; but, with proper scientific and economical use of wells and territory, the life of a well can scarcely be measured or computed: it is too great in quantity, and too long in time.

Fresh water will 'drown out' a well. Will not holding a well under pressure until its equilibrium between a state of rest and production is about established, injure the well? It is an injury; therefore transporting gas through long lines of pipe, by an initial potential force amounting to several hundred pounds' pressure at the wells, is not the correct way. There is a reduction of pressure of about eight pounds to the mile in pipes. For long distances it will be proven that gas can be blown more economically, and to better advantage to wells and transportation, through the pipes, than be forced by its

[1] Including the C and H of 0.024 solid hydrocarbon.

[2] These gases were doubtless partly formed from solid carbon and occluded oxygen by the heat applied *in vacuo*.

initial pressure. The use of a fan-wheel may be applicable.

Although here, in and about this circle in the said map, no paying oil-well has been struck, nor does any great 'gas-gusher' 'blow,' yet good oil-sands, saturated with petroleum, are found, and a gas-belt is developed of most remarkable persistency and continuance; and the separated and scattered wells demonstrate a territory in which good paying oil and gas wells are liable anywhere to be struck. This territory embraces about the highest lands above Lake Erie, in the state of Ohio. This region gives proof of an abundance of gas for ages to come, for the supply of the surrounding manufacturing towns for light and heat.

The location of 'Neff's gas-wells' is in the eastern part of Knox and the western part of Coshocton counties, O.

PETER NEFF.

Gambier, Knox county, O., July 15.

A remarkable swarm of Sciara.

In *Psyche* for September, 1880, Dr. Hagen, in discussing a swarming species of Sciara from South Carolina, made the statement, based upon Weyenbergh's list of swarms of Diptera (*Tijdskrift v. entom.* 1861), that the swarming of Sciara is new. In the *American naturalist* for February, 1881, Professor Riley states that he has frequently observed them in swarms so dense as to appear at a short distance like smoke, and quotes a letter from Dr. S. S. Rathvon concerning the swarming of a species of this genus in the upper room of a building in Bethlehem, Penn., where they were observed to issue between the floor-boards. These records indicate that some interest will attach to the following facts: —

Tuesday evening, July 20, I was sitting in my library of the second floor, when I became conscious of a humming noise, as of a distant army of flies. The noise gradually increased for nearly half an hour, when I went to the window to investigate. Outside I heard only the customary night noises; but, as I drew my head in, I saw that the ceiling of the library was covered with tens of thousands of minute midges of the genus Sciara. Except immediately above the lamp, the white ceiling was tinted brown with them. They made no attempt to reach the light, but clung to the ceiling around the edges of the room, extending down on the walls for several inches, and massed a dozen or more deep in the angles. All were in constant motion, and the noise was loud enough to drown the sounds of the crickets and tree-toads outside. The sound, as a whole, was a distinct musical note, varying but a fraction of a whole tone, and corresponded, as nearly as I could place it, with E flat above middle C. The number was beyond compute. I at once closed the windows, and in ten minutes they became almost opaque from the numbers which settled upon them. On going below stairs, I found, that although doors and windows were open, and a bright light was burning, very few of the midges had entered. I easily rid the library of those which had entered, by lighting a spoonful of pyrethrum in my ash-receiver. They fell as fast as snowflakes, and in the morning were swept up by the dustpanful.

The house is a new one, finished in April last, and is situated on a level, nearly clear plateau on Washington Heights. The gnats entered only at the second-story windows. The night was clear and not sultry, and the wind was north-east. Later in the evening a heavy shower fell. The midges were not noticed on previous or succeeding nights. From these facts it seems quite plain that the gnats were flying in an immense swarm at some distance from the ground, and either met the house in the direct course of their flight, or were attracted from their regular route by the light.

L. O. HOWARD.

Washington, July 23.

Another carnivorous rodent.

Over a year ago I recorded in this journal the carnivorous habits of several of the Rodentia (*Science*, v. No. 114). In that communication I called attention to the meat-eating propensities of the muskrat (Fiber zibethicus), and a species of field-mouse, that I then had in captivity. Since writing that, I have described the field-mouse, for it proved to be a new species, and it is now known as True's Piñon mouse (Hesperomys truei). No doubt others of the same genus will be found given to a similar diet when the opportunity offers. But here comes another rodent that strongly asserts his taste in that direction, and will consume raw meat even in preference to his regular diet list, as we have always conceived it to be. This is no less an animal than the 'prairie dog' (Cynomys ludovicianus). I have at the present writing a pair, half-grown, of these engaging little pets; and for the last two days they have been fed on raw meat, refusing their ordinary food served to them at the same time. They tell me that the Navajo Indians, when they keep them in captivity, feed them with raw meat half the time, and the little marmots eat it with avidity.

As I have noticed elsewhere, rats will devour raw meat whenever they can get it, and usually in preference to other things.

In time, no doubt, it will be proved that it is a universal habit of the order Glires.

R. W. SHUFELDT.

Fort Wingate, N. Mex., July 16.

Germ of hydrophobia.

I see in your issue of July 9, p. 23, that the credit of having at last discovered the germ of hydrophobia is claimed by the London *Lancet* for Dr. Dowdeswell, who finds it in a micrococcus in the medulla and spinal cord of animals affected with this disease.

I do not remember that the attention of your readers has been drawn to the fact that this discovery had been previously claimed, with much show of reason, by Professor H. Fol of Geneva (*Archives des sciences*, vol. xiv. p. 449, 1885, and vol. xv. p. 414, 1886). According to Fol, also, it is a micrococcus found only in this disease, and so minute that it requires a good $\frac{1}{12}$ objective to see it at all. Of this micrococcus he has made pure cultures, which by inoculation communicate the disease with certainty.

JOSEPH LECONTE.

Berkeley, Cal., July 19.

A bright meteor.

The meteor recorded by Mr. Brackett as having been seen at St. Johnsbury, Vt., on the night of Aug. 11, agrees as to size and direction, as well as date and time, with one seen at Salem, Mass.

E. S. M.

SCIENCE.—SUPPLEMENT.

FRIDAY, JULY 30, 1886.

ANOTHER VIEW OF ECONOMIC LAWS AND METHODS.

WHEN the editor of *Science* invited me to take part in a discussion upon economic principles and methods, I at first declined, because of my doubt whether any fruitful results would follow; and my final acceptance was due to the thought that the professed economists in this country were not so widely apart in their views as the expression which they sometimes use would seem to indicate, and that through discussion they might perhaps become better acquainted with each other's purposes and methods. It would be premature to say that there is no hope of realizing such an expectation, although the rigidity with which the lines between the old and the new in economy are drawn is not very encouraging. Nor is this impression wholly the result of the aggressive statements of the representatives of the 'new school;' the criticisms offered by Mr. Hadley under the title 'Economic laws and methods,' present views which by universal consent are the exclusive property of the 'old school.'

Mr. Hadley's paper is professedly a criticism upon my presentation of the relation that exists between economics and jurisprudence, but it suggests much more than was directly touched in that discussion; and, in meeting the editor's request for a 'reply,' I may perhaps be permitted the same liberty, and state, in as concise a manner as possible, the views which I hold respecting the nature and purpose of political economy, and the method of study which its profitable prosecution imposes.

If asked to define political economy, I should say that political economy treats of industrial society. Its purpose as an analytic science is to explain the industrial actions of men. Its purpose as a constructive science is to discover a scientific and rational basis for the formation and government of industrial society.

But, it may be asked, under what conditions can political economy be said to have attained its scientific purpose? When is an industrial fact satisfactorily explained? I answer, when it is referred to some general truth which, either for the sake of convenience or because our limited intelligence will not permit us to press the inquiry further, must be regarded as final. Truths of this sort are fundamental in economics, and are capable of being classified under three heads. (*a*) The first class embraces what is ordinarily called the laws of human nature. Such truths are discovered by a study of one's self, by a study of history, and by a study of statistics. There can be no quarrel between the old and the new economists as to the propriety of admitting such facts. The quarrel begins when the members of the old school assert that 'a few simple laws of human nature' furnish adequate material out of which to construct an economic science capable of explaining all industrial facts. (*b*) The truths of physical nature to which all industrial activity must conform are likewise final for purposes of explanation. Why do men go west to take up new lands? Because, to quote from Mr. Hadley, they desire "to obtain the maximum of satisfaction for the minimum of sacrifice." This, however, does not explain the fact of migrations. One does not understand why a given quantity of satisfaction can be secured for less sacrifice by an agriculturalist in the west than if he increased the numbers already living on the lands of the east, until he discovers the physical law of the productivity of land known as the law of diminishing returns. Again, it is an industrial fact that the Christian world is growing rich. Is it enough to trace this fact to the permanent desire on the part of men to grow rich? Do we not understand it better when we learn that the latent energy in a ton of coal is equal to eleven million times its own weight, and that the available energy when the best machines are used is equal to one million times its own weight? If, then, physical laws are essential to a satisfactory explanation of industrial facts, and if such explanation is the scientific purpose of economics, are we not justified in admitting such physical laws as material for the construction of the science? But, says the objector, English economy recognizes physical laws. The law of diminishing returns is called by Mr. Mill the fundamental law of economy. This is certainly true, and this is why it is so difficult for me to understand the plan of architecture according to which English economists have built their science. I cannot appreciate the necessity of bringing in at the back door any facts essential to the explanation of industrial phenomena. (*c*) The third class of final truths is disclosed when once the explanation of observed facts is traceable to the legal structure of society. Why were wages in England between the years

1200 and 1400 permanent? Why has the principle of competition exerted a greater influence since 1500 than before? Why in the year 1800 in England was the woollen industry largely controlled by journeymen, while in the cotton industry the majority of workers had never served an apprenticeship? If these questions are not legitimate ones to put to the economist, I do not know who is to deal with them; nor do I know how he can answer them except by referring them to the legal structure of society which prevailed at the time considered. For the same reasons, therefore, as were presented above, the lego-historic facts — to borrow a phrase from Lasalle — are material out of which to construct an economic science. It is true that such facts are not permanent, and when we call a truth which rests upon them a final truth, our language must be accepted with limitations; but it is a distinctive feature of the historical school to recognize limitations in periods studied. Its members are not ambitious to cover all times and all peoples with their generalizations, for they well know that such generalizations would be too thin for any use. I have brought this classification prominently into view, because Mr. Hadley insists so strongly that economics "is built out of a few simple laws of human nature," and criticises me for adding to this, as equally necessary for explaining the phenomena of industrial society, the physical and legal surroundings of men. The expression used in my former paper must have been loose, or so candid a critic and so clear a thinker would not have thus shot by the mark. And I am inclined to the opinion also that the real difference here brought to view pertains primarily to form of presentation; its discussion, therefore, would be scholastic rather than scholarly.

Still there are certain radical differences between the views expressed or implied in Mr. Hadley's paper and those which I entertain; and, should circumstances ever render it necessary for me to nail a thesis on his lecture-room door, it would include the following protests.

I protest, in the first place, against such free and unguarded use of analogy as argument. Because certain things are true in physical science, it does not follow that similar things are true in social science. One may be well versed in the methods of successful investigation in the physical sciences, and yet not possess the mental equipment necessary to arrive at truth through the intricacies of social relations. And why? For two reasons. In the one case, the forces considered are permanent and reliable; in the other, some of the forces are subject to constant variation. Development of a physical science consists in the discovery of truths which are assumed always to have existed, nor has such an assumption so far in our experience proved the source of error. Development of a social science, on the other hand, consists partly in the new discovery of old truths, and partly *in observing new truths to emerge from the growth of the social organism.* If this be true, is it not illogical to rely upon analogy? Again, the study of physical science is not complicated by the fact that the forces considered have a conscious purpose, and, within limits, are self-directing. But in social sciences this is unfortunately the case, at least the theory of social science with which the latest phase of economic science allies itself holds strenuously to the idea of a self-conditioning social organism. In this respect, therefore, analogy fails.

I protest, in the second place, against the relation that is assumed to exist between the science and the art of economics. It appears to me that they who make most use of these phrases fall also into the error of relying too implicitly upon analogy. What is said of the bearing of a science on an art, which is quite fruitful when applied to a physical science and the art of mechanical invention, ceases to have any clear-cut meaning when imputed to social relations. The reason is, that what is termed 'the art of economics' is itself one of the elements which must be admitted by the 'science of economics' in order to explain the laws of its own development. If this be true (and it must be admitted if society is an organism of conscious purpose), there is no such sharp line of distinction between the science and the art of economics as has been commonly supposed. Without denying an element of truth to what Mr. Mill so admirably states in the last book of his 'Logic,' I still insist that it is preferable to speak of a science of economics which is at the same time analytic and constructive.

I protest, in the third place, against the use of the astronomical method of investigation in the social sciences. Should my readers desire to know in what this method consists more perfectly than may be learned from Mr. Hadley's paper, they will find it presented at length in Cairnes's 'Logical method of political economy.' Indeed, that book might well be termed a handbook for the use of students in economic observatories. The method, in short, consists in this: to build a system of thought on the assumption that a certain line is straight, and then to take a squint to see how crooked it is. I would not, of course, deny that this method is, in itself considered, logical, nor that it is fruitful when employed in astronomy: my only objection is, that in economics it is of no sort of use. It has not led to a single discovery worth the mention since the time of Mill. Ideas may have been born to those who have spent the night-watches with this method, but, if so, no one ever heard the children peep.

There are other protests which might be added. Economy is not an independent study ; it is a dependent subordinate study, which first finds its true place when framed into the study of society as a whole. But says Mr. Hadley, "a scientific part is a better starting-point than an unscientific whole,"— a conclusion which he reaches after discussing the undulatory theory of light, and a conclusion which shows how dangerous it is to depend on analogy rather than on analysis. There is no such thing as a scientific treatment of one function of a developing organism which does not recognize the essential and permanent relations of that function to other forms of activity by the same organism. Nor are all economic truths 'authoritative and rigid.' Most of them are dependent and relative. There is no meaning in the science of history otherwise. Henry C. Adams.

CHINESE REVENUES AND SYSTEMS OF TAXATION.

The pecuniary relations which China is now more rapidly developing with foreign nations, together with the greater demand for foreign capital, will make of interest the following account of her revenues and systems of taxation, for which the writer is indebted to an extended article in the late numbers of the Austrian *Monatschrift für den orient.*

At the outset many difficulties are encountered in the endeavor to obtain a just conception of Chinese revenues and resources, not from any dislike on the part of the government to hinder the acquirement by foreign nations of such knowledge, but because the details of the antiquated and involved systems are not understood by the authorities themselves, notwithstanding their earnest desire to introduce a thorough reform. The imposition and control of taxes rest wholly and absolutely in the hands of the central government, under the administration of the financial minister at Pekin. What the revenues from any given province may be, the central officials, however, can give no definite information ; a certain amount is demanded and usually obtained, but the details are left in the hands of the subordinate officers. The methods require an army of officials, who often make themselves enormously rich at the expense of the tax-payers. They are unusually crude in many respects, the outgrowth of old customs and habits, which, unfortunately, do not encourage much hope of improvement so long as the ultimate authority rests, as it does now, absolutely in the fiat of the chief ruling power.

The chief disadvantage under which the taxation system labors consists in the fact that the raising of taxes is farmed out. The contractors bind themselves to furnish a certain quota or sum, but at the same time enjoy the monstrous freedom of levying what they can from the people, and placing the excess in their own pockets. This may not have been the original intent, but it has become so virtually. It is not in human nature to expect, that when, in any given year, a deficit has been made up from the contractor's own resources, the following year he will carefully account for every cash[1] that he may have received in excess. It thus results that there is a constant dispute between the central and provincial authorities. The former, for instance, may demand a sum of 50,000 taels, for the emperor's household expenses, from the salt director of some province, who calls heaven and earth to bear witness that he cannot furnish another cash without bankrupting himself ; nevertheless he complies with the required demand, and grows old and fat in the bargain.

Such singular, one may say pitiful, systems for a nation in many respects so intelligent as the Chinese, furnish many erroneous opinions of the nation's poverty, although there can be no doubt that the government has been in a continual state of impecuniosity since the beginning of the present century, existing from hand to mouth, and not becoming involved in debt for the simple reason that it cannot. Had the government not found in recent years a new resource in import duties, to which indeed it was compelled to take recourse, it would have been reduced to very great straits.

Two notable events in the last few decades have contributed to bring about a partial revolution in the financial systems, viz., the Taiping rebellion, and the opening up of the country to foreign nations. The first caused the almost entire abolition of the old systems of land-tax over a large part of the empire ; the latter opened up the new resource of import duties, — a source of income which, were it properly managed and husbanded, would soon exceed all the others together. Yet another development since the Taiping rebellion is the so-called arbitrary *likin*, or toll-tax, which has become a very important source of revenue. All these changes render the older accounts of Chinese revenues and taxation unreliable and incorrect for the real condition of affairs at present.

The state revenues consist in, 1°, the land-tax ; 2°, inland and import duties ; 3°, the salt-tax or monopoly ; 4°, various smaller taxes and licenses

[1] 1600 cash = 1 tael = about $1.43.

from pawnbrokers, merchants, etc. ; 5°, inland transport duties, the *likin*, or toll-tax. Some other, unimportant, sources are the sale of offices, 'contributions' from wealthy citizens, etc.

As in all oriental lands, the land-tax forms the chief source of state revenue. At the close of the last century it furnished two-thirds of the entire Chinese revenue, but it has dwindled down so that at present it does not furnish more than one-third.

This tax is levied by a district chief directly upon the tilled land. In each smaller province there is an especial department for land registry, in which, in order to be legal, every transfer of land must be entered, and paid for by a certain fee. This registry shows what land and how much each piece shall be taxed. Unfortunately, a great looseness prevails in recording the sales and transfers of land,—a looseness which has now reached such an extent that it would be difficult and unjust to attempt its remedy. As a result, great irregularities prevail in the raising of the land-tax. This tax is collected by the provincial officers through the subordinate 'land overseers.'

The entire levied tax from this source, as given in the state almanac, amounts to about thirty-three million taels in silver, and four and a half million piculs[1] of rice, making a sum total of about forty million taels ($57,100,000). This tax was very seriously affected by the Taiping rebellion, which desolated nearly half of the land, including the best cultivated part of the empire. From the effects the country was a long time in recovering, nor has it by any means fully recovered yet, a proof of which is afforded by the fact that several large cities in the neighborhood of Shanghai are yet in large part fields of extended ruin-heaps. From these circumstances it is evident that the figures, as given by the national authorities, are too high, illustrating the thorough unbusinesslike methods of the government. How much they are too high cannot be definitely said, but from an estimate of the actual differences between the returns of various provinces and the levied taxes for the same, they must be decreased by at least one-third. The central government, moreover, is continually called upon to furnish relief to different provinces suffering from famine, or from damages by storms and floods, so that scarcely a year goes by in which a million taels are not thus expended.

It is also difficult to estimate with accuracy the income derived from the tax on natural productions, the so-called grain or rice tribute. A portion of this is devoted to the sustenance of the imperial army, and, like all the other taxes, is distributed unequally in the different provinces. There is a tendency to commute this tax by the payment of silver, but the monstrous abuses which such commutation opens up on the part of the officials is the greatest drawback. The total amount reaches about five and a half million piculs, worth seven and a half million taels ($10,000,000). This, however, represents the sum received by the government, by no means what is paid by the people. An evidence of what the people are really compelled to pay will be best shown by the following incident. A foreigner was required to pay a certain toll-tax of 12,000 cash on a chartered junk, which he did, but demanded a receipt. This was furnished him, but only for 6,400 cash. The discrepancy not at all suiting his ideas of business, the owner applied to his consul for relief, who, after correspondence with the officials, ascertained that the latter sum represented the actual tax; the remainder, the cost of freight on the money, the loss and cost of melting the coin and transforming it into Pekin taels, and various other expenses. One cannot but be amused at such exorbitant charges, though perhaps we in America are not wholly above reproach in similar charges on non-dutiable imports. The incident, however, only illustrates the condition of affairs over the whole kingdom. For every tael, for every picul of rice, there are added so many charges and counter charges, that the sum is more than doubled. A yet greater evil is the one already mentioned, by which every district chief or tax-receiver is allowed so much liberty in the imposition of taxes. The officers all receive like salaries and perquisites, but there exist vast differences in the value of the different posts. Each district chief must furnish a certain definite quota. The excess belongs to himself, not always to go into his private pocket, for the powers that be, whether city, state, or judicial, all come in for *douceurs*, and vice-kings, governors, judges, and commissioners all wax equally and enormously rich.

The average ground-rent for cultivated rice-land is about one dollar per acre. Of the eight hundred million acres of land in the empire, one-half is tillable; and allowing in the most liberal way for all contingencies, and estimating the average tax at less than half of that mentioned above, the amount paid by the people must reach one hundred million dollars, of which the government receives not over forty million. All the rest of this vast sum represents the cost of collecting and the aggregate stealings of the collectors.

The salt-tax or monopoly is one of the most peculiar, as it is one of the most important, sources of revenue. The empire, in its salt administra-

[1] 1 picul=100 catties=60.45 kilogr.=133.13 lbs.

tion, is divided into seven chief departments, each in control of government officers, and each possessing its own places for the production of salt. Each department has its own defined limits, and the salt manufactured in one cannot be transported or sold into another. The salt is obtained by evaporation from sea-water, or from that of salt wells and marshes; and there is no restriction as to the amount and the methods of obtaining it, except this important one, it can only be sold to the government officers at a certain price fixed by the directors. From the central depots the salt is distributed to the various provinces by the salt commissioners or dealers. The amount that will be consumed is estimated, and on this basis a number of perpetual, transferable certificates are issued, worth as high as fifteen thousand dollars each, each of which empowers the possessor to buy a certain quantity, not exceeding 3,760 piculs, at a certain price, to convey it whither he will in the department, and sell it at a fixed price. He cannot, however, dispose of it direct to the consumer. In every place of any size there are storehouses under the control of government officers to which it must be conveyed. Here he deposits it, first giving up his certificate, which he does not receive back till all the salt is sold. The dealer's profits are, of course, derived from his quickness in disposing of his goods. The system is a singular one, yet not such a bad one, were it properly managed. The chief drawback that it has is the small army of detectives required to prevent smuggling between adjacent departments, an illicit traffic caused by the very great differences in price that often prevail in contiguous provinces. This tax produces the government about nine and one half million taels, only a small part, however, of what it costs the people.

The income from duties has increased rapidly since the admission of foreign trade, and now reaches about thirteen million taels annually from foreign goods, with an additional four million from opium and inland duties. The office of collector of customs and duties, as in other nations, is one of the most desirable in the government service. Well it may be, for the perquisites and stealings usually enable the possessor to retire wealthy in two or three years. The collector of Canton, for instance, spends the income of the first of his three years of service for the acquirement of the post, that of the second year in presents, and in the third and last year lays by — about three hundred thousand dollars. Many of the directors in the other ports enjoy an income of from seventy-five to a hundred and fifty thousand dollars. As in the other taxes, the loosest of systems prevail. Every collector is required to furnish the government a definite sum annually: whatever else he can get he has for himself. Even in those ports where the rates of duty are prescribed, and under the charge of foreign officers, he is not to be cheated out of his perquisites. The foreign officials have no control of the money received, which is paid over to the Chinese collector, who absorbs three-fifths, and places the rest at the disposal of the government. The central government has, however, recently expressed a desire to receive a larger share of the income: that it can fully reform the abuses is not possible.

The income from taxes on opium has very materially increased since the opening up of foreign traffic. The import duties are only moderate in amount, but, as soon as the opium comes into the immediate hands of the Chinese, it is taxed repeatedly, and to a much greater extent. About seventy thousand chests are brought in annually, each paying a tax varying from twenty to sixty taels. This income, though, is looked upon as an especial perquisite of the collector of customs, who absorbs the larger part of it.

Of the various smaller taxes, the least important are the ones on the transportation of tea to those provinces where it is not grown, and on mines. Those derived from the licensing of merchants and pawnbrokers are more important, especially from the latter, each of whom is required to pay a license of from one thousand to five thousand dollars, and yearly dues of one or two hundred dollars. Another source of income, that of the payment for registry in land transfers, would be important were the laws enforced, which they are not. The fees amount to three per cent of the sale-price, but they are often evaded by an understatement of price, or even by the neglect to record the sales at all, though non-recorded sales of land are illegal.

The most characteristic Chinese tax is the *likin*, a toll-tax, or duties on inland transportation. This tax has given rise to dispute on the part of foreign governments on account of its illegality, or, rather, perversion of international treaties. That it is illegal in any other sense cannot be said, for the simple reason that in China the highest form of legality is the emperor's decree.

This tax, which is of recent introduction and has only assumed importance within the last twenty years, is imposed upon certain classes of goods in their transportation across the country. An imperial decree authorizes the levying of it in any given province, whereupon a central provincial office and toll-stations are established, their number depending upon the amount and kind of traffic, averaging upon the most important thoroughfares, whether by land or water, one in about every ten miles. The tax at each station is small, but, when the distance traversed is great, it may reach fifty per cent of the gross value. No definite control can be had over the income of these stations, as there is little or no check upon them. In fact, the officers in charge generally get what they can from the transporter, whose willingness to pay depends very much upon whether he can evade the tax by going round the station. Often the carrier and collector wrangle over the price, and finally settle upon one much less than first demanded. The data for estimating the sums derived from this tax are more reliable than those of any other. The minister at Pekin gives between seventeen and eighteen million taels as the annual income from this source, and his figures are probably nearly correct. Of this amount, about one-half is derived from *likin* on salt and opium, the remainder from various other goods.

The entire amount of all the taxes which have been spoken of reaches the sum of sixty-eight million taels, or ninety-seven million dollars. The amount which each province has to furnish is estimated annually by the minister of finances. Should some extraordinary necessity, as famine or war, require larger contributions than are laid down in the annual budget, those provinces most likely to respond are called upon for additional amounts. When the last cash is exhausted from these sources, then recourse is had to extraordinary means, appeals to wealthy citizens, requests couched in such urgent terms that a disregard of them is perilous.

Not many reforms can be expected in China's financial systems. The absolute monarchical government, the hordes of mandarins who find their living in the present systems, and the yet general distrust of foreign advice and counsel, all hinder the empire from throwing off the shackles that now impede her every movement. S. W.

DRAWING IN PUBLIC SCHOOLS.

For many years past, those who are most interested in improving the elementary education of this country have been agreed that far more attention ought to be bestowed upon the art of drawing. Those especially who are interested in schools for manual training and in scientific schools have been firm in demanding that all young scholars should be encouraged, if not required, to attain some proficiency in this useful art. Many have insisted that drawing should be placed next in importance to reading, writing, and arithmetic, and have regretted that the children in public schools have been forced to give so much time to acquiring a familiarity with geographical nomenclature, when an equal amount of labor would have trained the eye to observe with minute accuracy, and the hand to delineate with truth that which the eye has seen. Notwithstanding this unanimity of opinion among those who are qualified to give advice, the schools of the country are in general far from doing what they ought, to provide instruction in drawing. Great advances have been made within the past fifteen or twenty years; and in certain schools, and even in certain groups of schools, good results have been attained. It is now most important that the experience which has been acquired, and the methods which have been successfully employed, should be ascertained, compiled, and promulgated in such ways as will secure the widest consideration.

For many years past, Mr. Isaac Edwards Clarke, of the Bureau of education, has been engaged in compiling such a report. Two or three times his work has been made ready for the printer; but its issue has been postponed for the lack, we believe, of adequate appropriations from congress. At length we have before us a volume of a thousand pages, distributed in four parts. There is, first, a series of papers by the author on 'The democracy of art;' then an account of the efforts which have been made to secure instruction in drawing in the public schools; third, a series of statistical tables illustrating the condition of art schools and museums; and, finally, an appendix, occupying four hundred pages, and including a great variety of reports, lectures, and schedules pertinent to the subject of art education. The work is very comprehensive, being evidently designed for very different sorts of readers, — those who are interested in the historical aspects of the subject, those who need to be persuaded of the importance of art education, and those who require to be enlightened in respect to methods of instruction which have been employed. By the use of the elaborate index, readers of all these classes may derive from this volume much useful information not otherwise accessible; but the author would have rendered an additional service if he had added with greater freedom his own critical comments upon the various plans which have been adopted. His preliminary essays reveal the mind of one who has long been familiar with the progress of the fine arts, and who has been accustomed to reflect upon their relation to the progress of society. He points out with clearness the influence of taste and skill upon the enjoyments, the trade, and the prosperity of the people. He touches with facility upon all the indications which are to be seen, especially

Industrial and high art education in the United States. By I. Edwards Clarke. Washington, *U. S. bureau of education*, 1885.

in architecture and manufactures, of American progress. He writes with enthusiasm and sympathy, aiming to encourage what is good rather than to contemn what is bad. He has apparently in view as his readers the managers of public education, and he strives to incite them by the description of what has been accomplished, and by gently persuasive illustrations, to 'lend a hand' in the new educational movement. His purpose is deserving of the highest commendation; and the facts and figures which he has brought together, with a vast amount of painstaking, will prove to be a store of arguments and examples to be drawn upon by innumerable commissioners, superintendents, and directors of education in schools of every grade, from the kindergarten to the university.

TRIUMPHANT DEMOCRACY.

Mr. Andrew Carnegie is well known as a shrewd and successful business man, a capitalist of great wealth, a traveller of experience, and an American citizen of public spirit. He is an excellent type of a class more numerous and more influential in America than in any other country of the world: he is eminently a practical man. There is a wide-spread impression that the practical man is not only more competent to carry on affairs, but that he has a great advantage over the theorist, buried in his books and unacquainted with human nature, in the theorist's own walks in life; that he can, if he tries, run a better newspaper, secure better legislation, and write a better book. When the practical man, therefore, enters the field of literature, and discusses important public questions, much is expected of him: his knowledge of affairs should give him a broader point of view; his observation should be keener; his information should be more exact and more complete; he should have a better grasp of the principles which have grown to be axiomatic, a greater power of combining facts and principles into general statements; his views should be more vigorous and more lucid than those of the ordinary writer.

Judged by this high standard, it must be frankly confessed that 'Triumphant democracy' is not successful. The author's point of view is sufficiently set forth in the dedication, the keynote of the whole work: "To the beloved republic under whose equal laws I am made the peer of any man, although denied political equality by my native land, I dedicate this book with an intensity of gratitude and admiration which the native-born citizen can neither feel nor understand." To make the native-born citizen appreciate the full measure of his birthright, and to teach the foreigner the blessings of the American system, the first requisite is accuracy of statement. If grave errors of observation and of statement of fact are found, the effect of the book is marred, if not wholly taken away. What will the native prohibitionist think of the statement that 'drunkenness is quite rare' among American workmen (p. 125)? What will the Norwegian say to the assertion that 'the lumber-trade is an industry peculiarly American' (p. 219)? How will the man who remembers the Mexican war accept the glorification of "the American people [who] have never taken up the sword except in self-defence or in defence of their institutions" (p. 265)? Can the author ever have been in Germany without knowing that the United States is not "the country containing the smallest proportion of illiterates" (p. 489)? Does any man who thoughtfully considers the present state of public feeling in France believe that 'the reign of the masses is the road to universal peace' (p. 102)? Is the practical man satisfied that "the theatres and opera-houses of the principal cities in America are, of course, much superior to those in Europe because they were built more recently" (p. 336)? The passages just quoted are fair examples of recurring errors, mistakes, incomplete statements, and hasty generalizations.

The idea of the book — to put into readable, entertaining form the causes of the marvellous growth of America — the idea is not a bad one: the execution is totally inadequate, and inadequate for a very simple reason. Mr. Carnegie has been too busy in doing other things to give the necessary time for reading and reflection: his knowledge is insufficient. That the United States is triumphant we all know: that the triumph is wholly or largely due to democracy may or may not be true; but Mr. Carnegie has not proved it: if it is ever to be proved, it must be by the despised theorists, who are willing to spend a lifetime in grovelling after the dry details of the history of many nations.

A. B. Hart.

Triumphant democracy; or, Fifty years' march of the republic. By Andrew Carnegie. New York, *Scribner*, 1886. 8°.

PRESTWICH'S GEOLOGY.

The reputation of Professor Prestwich as a geologist lends an especial interest to the appearance of a general treatise from his hands, embodying the facts and theories that his long experience has led him to regard of the greatest value to the student. The first volume of the work, lately issued by the Clarendon press, treats of subjects chemical and physical. The second volume, not

Geology, chemical, physical, and stratigraphical. By Joseph Prestwich. Vol. i. Oxford, *Clarendon pr.*, 1886. 8°.

yet published, will include chapters on stratigraphy and paleontology, and a discussion of theoretical questions connected with historical geology and the evolutions of the earth. This will therefore probably be the more entertaining of the two; but the book now before us is attractively written and makes easier reading than most geological manuals. Its style is between the extreme condensation of the encyclopedic text-books, and the more literary form of Lyell's 'Principles.' Except in the chapters that are necessarily occupied with simple definition and tabulation, there is a satisfactory amount of argument and discussion, and a careful presentation of both sides of a question; so that the learner's attention is held to the facts long enough to allow him to acquire them familiarly, and to perceive that their proper understanding requires a higher mental process than mere memorizing. The work is further intentionally a statement of the evolutionary rather than of the uniformitarian view of geology, which Lyell's leadership so long in England placed too prominently before many students: there was under Lyell's teaching no room between uniformitarianism and catastrophism for the safer middle ground which Prestwich clearly states, and which is now certainly the dominant view held by working geologists. The change in the rate of denuding processes and of eruptive action from ancient to later geological times may be named in illustration of this. Under the latter subject, it is an additional satisfaction to see prominence given to the mechanical origin of eruptions, and only a subordinate importance attached to Scrope's theory of the action of steam and other gases; and to find definite statement of the metamorphism of eruptive as well as of sedimentary rocks. Indeed, it would be easy to name many more examples of treatment that must commend themselves to the American as well as to the English taste, while there are only two sections that are likely to excite any general dissent,—one on the origin of valleys, which attributes too much influence to fissures to find full acceptance, at least in this country; and another in which much importance is attached to Elie de Beaumont's extinct theory of parallel mountain-ranges, which is certainly given more space than students in this last quarter of the century should ask for it. The author's familiarity with the geology of this country has not been such as to prompt many quotations from our surveys, nor to change the triassic coloring of the copper-bearing rocks of Lake Superior on the reduced copy of Marcou's geological map of the world, which serves as a frontispiece; so that, as a book for class reference in our higher schools and colleges, this work will hardly gain the reputation of Geikie's text-book: but, if the excellent fashion of placing different books in the hands of every member of a class could be introduced, this one would certainly be one of the most popular.

W. M. D.

PORTER'S MECHANICS AND FAITH.

This work is one of those attempts, so common in our day, to 'reconcile science and religion.' The main thesis of the author, which he endeavors through many chapters to prove, is this; that all truth, physical and spiritual, is made known to us by 'revelation,' and could never become known to us by any other means. Thus, he says that in mechanical science, "man, in his conscious ignorance, and with a sense of entire dependence, makes his appeal immediately to the Infinite Source of truth; that the methods of experiment and observation are the divinely appointed way in which this appeal is made and the revelation of physical truth is received" (p. 32). Having established this thesis, to his own satisfaction, he goes on to infer, that, since all other truth is given by revelation, we should naturally expect that religious truth, the most important of all, would be given in the same way. Thus he thinks to establish the doctrine of revelation in the theological sense.

Now, in all this there is great confusion of thought, resulting from the use of the word 'revelation' in two quite different senses. The 'revelation' which the author speaks of in physical science is nothing but the presentation of objects to our senses, and this is not a revelation of truth at all. Truth is not a property of objects, but of thoughts; and all our thoughts, whether true or false, are the product of our own mental activity. It is absurd, therefore, to say that scientific truth is revealed to us from an external source. On the other hand, the sacred books of religion are held to contain religious truth itself in the form of propositions, and we have nothing to do but to receive and assimilate it. At best, therefore, there is nothing more than a poetic analogy between the two cases, and nothing whatever to base an argument on.

Mr. Porter's main doctrine being thus defective, it is unnecessary to criticise his book in detail; but we would call attention to the chapter on 'The revelation of God,' as an example of the author's method. He expressly says that God cannot be known by the intellect, but only by love—with much more to the same effect. It is not by such methods as these that science and religion can be harmonized.

Mechanics and faith: a study of spiritual truth in nature. By Charles Talbot Porter. New York, *Putnam*, 1886. 12°.

SCIENCE.

FRIDAY, AUGUST 6, 1886.

COMMENT AND CRITICISM.

A RECENT NUMBER of the Philadelphia *American* has an article on 'Unrecognized proprietorships,' pointing out the difficulties encountered in 'rewarding men of the most beneficent inventiveness,' and recounting with many illustrations how seldom the originator of a new device reaps a fortune, while those who come after and make new adaptations of the original artifice become prosperous. Wyatt invented roller-spinning, and Hargreaves invented the spinning-jenny; but Arkwright appropriated both, and was the only 'successful' man of the three. On reading further, it is with surprise that we find 'Myer,' whose 'weather-charts have saved thousands of dollars,' classed, not with the successful Arkwrights, but with the neglected Wyatts and Hargreaves, where he is notoriously out of place. It is difficult to say in whose mind the idea of daily weather-charts first took practical shape; but the idea was fully carried out in Europe several years before its introduction here, if we except the charts with which Professor Henry used to entertain visitors to the Smithsonian in 1859 or 1860, and which might have early grown into a systematic service had it not been for the interruptions of 1861. Besides this, Professor Cleveland Abbe had, with the assistance of local enterprise, established an actual, continuous, and successful weather-service in Cincinnati a year before weather-prediction was undertaken by the government. It was essentially this Cincinnati service that General Myer, with his imperious executive ability and the support of the government treasury, appropriated and expanded into a national service; taking not only its methods, but its director, who has ever since been, even though anonymously, the leading scientific member of the weather-bureau. The *American's* article is an example of the very neglect that it laments.

A SON OF CHARLES GOODYEAR, the well-known inventor, has lately felt it to be his duty to make public some particulars in respect to the origin of the india-rubber patents, which, if not hitherto unknown, have been generally forgotten by those who participate in the great advantages which have followed the wonderful expansion of india-rubber manufactures. He wishes particularly to controvert the idea that his father's discovery was accidental; and for this purpose he publishes his father's account of the various steps which were taken by him as far back as 1838 to ascertain what modifications could be made in 'the material,' as he was accustomed to call the gum-elastic, in order to adapt its peculiar properties to the greater service of mankind. The inventor's own narrative was printed in 1849, in a very few impressions, upon thin sheets of a tissue made of cotton, and shows conclusively by what prolonged, intelligent, painstaking endeavors he reached the processes which are known as 'vulcanization.' Few persons are aware of the great changes which were introduced by these discoveries, or of the constant increase in india-rubber manufactures. In 1870 the imports of the crude material were five million pounds; in 1885 they were twenty-five millions.

The narrative from which we draw these particulars also calls attention to the fact that Goodyear at an early day foresaw most of the innumerable applications which were destined to follow the promulgation of his process. There is a circular of his, which was issued in 1844, announcing the invention or discovery of 'a metallic gum-elastic composition,' enumerating its properties and its possible uses, and inviting 'the most searching investigation and the most severe trial.' In the light of all that has followed, the prophetic sagacity of the inventor is as noteworthy as his inventive power. It is a pity that a life arduously devoted to the advancement of an idea which was fertile in utilities should have been so much depressed at one stage by penury, at another by extreme ill health, and again by vexatious and almost interminable litigations. The final decision of the U. S. supreme court, confirming Goodyear's claims, was given four years after the patent had expired, and eight years after his death.

DR. M. A. VEEDER of Lyons, N.Y., has sent a letter to the Rochester *Democrat and chronicle*

(July 21) on 'The significance of coincident weather-conditions,' in which he points out that the recent tornadoes in Kansas City and Madrid were nearly simultaneous, that the late 'sirocco' in Dakota accompanied intense heat in southern Europe, and that many other examples of corresponding weather may be found in widely separated localities. From this basis he concludes, without any sufficient examination of the dissimilar weather that so generally prevails in widely separated localities, that "the common cause which originates wide-spread atmospheric conditions of exceptional character . . . can be none other than variations in the condition of the sun." This can hardly mean that the appearance of a spot on the sun at once brings forth tornadoes on the earth: tornadoes are known to arise under much more local conditions; and the coincidence of their occurrence in Kansas and Spain is most trivial when it is recollected that the large disturbances in which the tornadoes spring up probably came from remote beginnings, unequally distant in time and place from these points of action. The coincidence is especially trivial in view of the great amount of non-coincidence it has to balance. Yet if this be not the meaning, the suggestion is simply a vague truism, of no value from its very antiquity and indefiniteness. No one will deny that the sun is at the bottom of all our weather-changes; but who will explain the full control that it exerts, and follow the process from beginning to end?

Theories of this kind have a remarkable resemblance. They pass at once from near effect to a remote cause, impatiently bridging over with wide-spanning assertions a whole world of process that lies between. They fail to see behind the immediate facts, and discover the long train of events leading up to them. They represent the theory of special creations on the inorganic side of nature. They always include a convenient corollary of about this form: "the disturbing influence due to changes in the condition of the sun may be modified to some extent by local conditions, so that it will not always manifest itself in the same way in every part of the earth." What with an entire lack of definition of the sun's disturbing influence, a complete assortment of 'local conditions' on the earth, and a glorious variety in our weather, coincidences may be found without limit. Finally, there is the unfailing presumption of novelty. "Studied in this way, meteorology becomes a science. The mere collection of miscellaneous facts without reference to underlying causes gives no insight, and reaches no conclusion;" but the new theory "may serve at least to direct our inquiries, and may open up new and unexpected fields of research" — just as if the ideas of his letter had not been written over and over again, until their truth and error are almost as old as the beautiful hills around Dr. Veeder's home!

The poisoning of 143 persons in Michigan, followed by a similar accident in Charleston, Ill., by which fifty persons were made sick, both attacks being attributed to ice-cream, has incited chemists throughout the country to examine critically the ingredients employed, in order to discover if possible which one is accountable for the poisonous effects. As has already been stated in *Science*, Professor Vaughan of Michigan charges it upon tyrotoxicon, a new poison which he has discovered, and which he believes to be produced during the decomposition of milk. Professor Bartley of the L. I. college hospital has investigated a number of cases, and gives as his opinion that the deleterious effects produced in these cases of poisoning by ice-cream is due to the gelatine which is now largely employed by manufacturers of ice-cream to give body to their product. If this gelatine is of poor quality it readily undergoes decomposition. Dr. P. A. Morrow, in the *Medical record*, July 24, 1886, refers the poisonous effects to the flavoring extract, and finds that in all the reported cases vanilla has been used for this purpose. He has found a number of references to similar poisoning-cases in French and German literature, which toxic phenomena have been spoken of as 'vanillism.' In Europe for years the vanilla used in flavoring ices and pastries has been recognized as in some cases poisonous. Orfila more than thirty years ago recorded such cases. Whether these poisonous effects are due to some principle in the vanilla bean itself, or to cardol, which is an oil used as a coating to prevent the deterioration of the bean, or to the too early gathering of the pods, is still a matter of dispute. It is to be hoped that the cause of the frequently occurring poisonings may be soon determined on, that ice-cream may not cease to be a part of the bountiful feasts provided at church picnics.

THE AMERICAN NEUROLOGICAL ASSOCIATION.

The twelfth annual meeting of the neurologists of America took place at the Howland house, Long Branch, N. J., on July 21, 22, and 23. The membership of this body is limited in number, and is intended to include eminent specialists on nervous diseases and workers in allied branches of science. From fifteen to twenty members attended the sessions, which is about the usual annual attendance.

Dr. Burt G. Wilder, professor of comparative anatomy at Cornell university, called the meeting to order and delivered the address of the retiring president. The address was devoted to the description of an embryonic fissure not hitherto noticed.

Dr. Wilder then introduced Dr. Charles K. Mills, the president-elect, of the medical department of the University of Pennsylvania. The address of the president was a plea for the extension of the activity of the association so as to enroll all the active neurologists of the country, and the distinct adoption of a broad psychological point of view, so that papers on scientific topics closely related to the interests of the practising neurologists might be then presented. The president also favored the proposition that the association should meet biennially as a section of the proposed congress of American physicians and surgeons.

The scientific portion of the address consisted in the presentation of a number of human brains abnormal in some way or other. The brains of a delusional monomaniac who perished at the fire at the insane department of the Philadelphia almshouse; of Taylor who was executed for the killing of his jailor, and who had committed other murders; of an adult idiot, one of three brothers similarly affected; of a negro; and what is very rare, of a Chinaman — were exhibited, and notes upon the brains of three other murderers, one of whom was afterwards afflicted with paralytic insanity, were read. In the paper to be published by Dr. Mills, he will treat in detail the peculiarities of the individual brains; in his address he confined himself more to a general presentation of their characteristics. The brains were all of a low type and showed similar affinities. The brain of the Chinaman was characterized by a shortening and obliquity of the orbital surface corresponding to the peculiar set of the eyes in that race, and by the extension of the first temporal convolution well up into the parietal lobe.

The presentation aroused great interest and much discussion. There was a general agreement that the brains had strong sutural, foetal, and low race-type characteristics.

Dr. L. C. Gray of Brooklyn gave an account of a case of lesion of both temporal lobes without word-deafness (sensory aphasia), but with a remarkable loss of memory. The patient seemed to have lost all retention of impressions whatever. For example, he was once hammering on the door. The doctor asked him to stop, as he was annoying others; he understood the request and complied with it after asking the reason for his stopping. The doctor had hardly left the room when the hammering began anew. He was again asked to stop; again asked the same question; had no recollection of the previous request and again promised to stop, but again forgot. His letters show the same state of mind; while otherwise rational, sudden breaks will occur in the writing, and then will follow the words, "I don't know when I wrote the above, whether yesterday, an hour, or a minute ago," or words to that effect. In short, his time-sense and retentiveness had almost completely vanished. The patient, whose age was forty-three, had an attack of convulsions, remained comatose for thirty-six hours, and then died. At the autopsy the skull and dura were found normal, and with slight exceptions, the only lesions were found in the temporal lobes in the parts supplied by the sylvian artery (septomeningitis). Dr. Gray laid special stress on the point that both lobes were affected, and thought that our views regarding the seat of the language-centre needed modification.

Dr. Leonard Weber of New York discussed some affections of the nervous system associated with tuberculosis. Attention was especially directed to the fact, illustrated by cases, that the nervous symptoms often appeared long before the usual symptoms of approaching tuberculosis could be detected. These nervous symptoms were often depressive in their nature, with a loss of interest in one's occupation, with little or no tendency to periodicity, and generally a well-developed suspicion of the doings of one's fellow-men. The cases generally showed hereditary taint, and were confined to women. An important part of the treatment consisted in restoring a healthier moral tone.

Dr. Phillip Zeuner of Cincinnati presented in person a case of auctioneer's cramp. The patient was first made aware of his trouble by a difficulty in crying his sales. He found himself unable to keep up the continual repetition of the same words, without causing a spasm on the left side of the mouth which eventually made the action impossible. He soon found that he could relieve the difficulty by lifting with a pencil one corner of his mouth. For a time the difficulty was confined to his professional duties, but gradually it extended, though less noticeably, to his ordinary conversation. The pronunciation of sounds not involving the lips, as *a* and *s*, was not interfered with. The case was regarded as one of the professional neuroses, arising from the too constant use of very specialized and delicate muscles, of which writer's cramp is the best-known type. In addition to the usual features of such a cramp, there were present subjective symptoms of a depressive, melancholic nature. In the minds of some of the members the case was strongly suggestive of a facial hemiparesis.

Dr. Wilder exhibited a frog from which the cerebral lobes had been removed on the 9th of last December, and which was in good healthy condition. In fact, Dr. Wilder could not see why such a frog should not live on indefinitely; he was freed from all wear and tear on his nervous system, was liberally fed, and was, in short, a living automaton. The frog behaved quite like those in the experiments of Professor Golz of Strassburg: and was presented only to show how long such an animal could be kept alive. Dr. Wilder used the occasion to record a few observations which might be new, and to suggest some further inquiries. Spontaneous movements were noticed every few hours. At times the frog was observed to wink with one eye only. A curious observation was that of the simultaneous performance of opposite reflexes. When a minnow was forced down the frog's mouth, it was swallowed by the reflex irritation of the head of the oesophagus, and at the same time the other end of the minnow was still twitching in the mouth and hanging out; the frog would attempt to remove the minnow with his leg, and swallow at the same time. Dr. Wilder asked whether such frogs sleep, whether they were capable of sensory education, whether they could breed, and so on.

Dr. Wharton Sinkler of Philadelphia described the treatment of a case of facial spasm in which, after various attempts at relief, the nerve was stretched, with the result of doing away with the spasm but leaving a paralysis after the operation. Similar cases were also referred to.

Dr. Wilder exhibited the head of a murderer cut in the median plane and showing the position of the brain in the skull, as well as other points. The preparation, which was unusually successful, was exhibited in order to describe the method of preparing it. After washing out the blood-vessels with a five per cent solution of chlorohydrate, a continuous injection of alcohol at first 65 per cent strong and gradually rising to a 94 per cent solution was kept up for a week. The injection was done under a high pressure, and the alcohol cooled to a temperature of about 10° C. by passage through an ice chest. The head was then imbedded in plaster of Paris and firmly fixed so that the saw would pass directly through the median plane.

Dr. Lloyd read a paper on moral insanity, in which he held the view that the name was a misnomer, that the physician had only to deal with disorders of the functions of the cerebral mass, and that moral insanity was only a form of intellectual insanity. The paper also criticised the psychologists who neglect physiological considerations, and cautioned physicians from falling into the mistakes of metaphysicians by creating abstract entities and treating them as real things. The paper aroused considerable discussion.

Among the papers presented were the following: Dr. Sarah J. McNutt of New York read a note on the case of an infant with multiple tumors of the cerebrum. Dr. G. Betton Massey exhibited diagrams designed to show by the graphic method the significance of Ohm's law; and also read a paper on the 'Cause of electrotonus and of the normal formula of polar reactions.' Dr. Wilder presented some notes on the brain, the first of which related to a new fissural integer which he would call the 'parocipital.' The next was devoted to the demonstration of an ental ridge corresponding with the occipital fissure; while the third referred to the appearance of a horizontal section through the foetal brain in man. Dr. C. L. Dana of New York considered some cases of pseudo-tabes from arsenical poisoning. Dr. Fisher presented some remarks on epilepsy, in which he inclined to the view that the disease was organic rather than functional. Dr. Sachs described a case of right hemiphlegia with aphasia in a child of two and a half years. Dr. V. P. Gibney of New York recorded a case of pseudo-hypertrophic paralysis, in which the microscopic examination of the spinal cord revealed changes in the anterior horns consisting in a diminution and loss of processes of the cells, especially in the dorsal and lumbar regions. The importance of the observation consists in the fact that such changes have been looked for in many cases, but none could be found. The propositions were demonstrated by Dr. Amidon.

Papers by Dr. Gibney and Dr. Dercum were announced but not read. A photograph of a microcephalic girl was received from Dr. Forel of Switzerland and ordered to be reproduced and published. A letter from the late Dr. Gudden was also read.

It was decided to meet at Washington in June of next year. Dr. Gray of Brooklyn was elected president, and Dr. Hammond of New York secretary, for the coming meeting. The meeting at

Long Branch was considered a very successful one, both for the character of the papers read and the interesting discussion which they aroused.

COREA BY NATIVE ARTISTS.

The testimony of recent explorers in Corea is to the effect that we have there a human exemplification of the survival of whole genera of industries and customs, while in surrounding regions these have been swept away or transformed. Half-a-dozen charming books on Corea, notably those of Griffis and Lowell, have lately portrayed portions of the inner life of a land hitherto closed to our gaze. No small curiosity has been manifested to ascertain how far these gentlemen have told the truth, whether they have faithfully interpreted what they narrate, and whether they are dealing with normal life or with monstrosities.

Ensign Bernadou, U. S. N., has just sent to the national museum a small but wisely chosen collection of art products to illustrate social and industrial life in Corea. Among his specimens is a series of old screens painted in oil on silk, and depicting the paying of tribute by surrounding nations to the emperor of China. An outer court is filled with attendants, beasts of burden, palanquins, and gifts in endless variety from every part of eastern Asia. Coreans, of course, hold a prominent place. A long procession of ambassadors from these various countries marches through massive gateways, along narrow courts, and over elevated bridges to the throne. There sit the reigning sovereign and his family, guarded by soldiers and attended by nobles. In front of the throne kneel the tribute-bearers with their gifts. The faces, costumes, and postures are accurately drawn, but the perspective is thoroughly Chinese in the method of taking advantage of the whole space.

This work of art introduces us to the high life of Corea; but Ensign Bernadou has also had the good fortune to obtain nearly a hundred old water-color sketches by native artists, portraying industrial life and natural scenery. Eight of these paintings are presented in the accompanying plates. They are rather studies in real life than finished paintings, the latter usually partaking of the grotesqueness characteristic of both Chinese and Japanese.

Corean women washing clothes (fig. 1). — Women are not seen abroad, says Mr. Lowell, excepting servants at the wells, and washerwomen. In Corea, garments are taken apart to be washed, both the cleansing and the subsequent mangling being effected by means of clubs. When the garment is restored, the seams are pressed close with a very narrow smoothing-iron.

House-builders at work (fig. 2). — Mr. Lowell also describes minutely the work of the joiner and the tiler. Hod-carriers are unknown, and unnecessary, because the attendant can easily throw his tiles to the workman while the balls of mud are passed up in netting. The 'chalk line' is blackened with ink. Plane, saw, square, and adze are of the most primitive type. The presence of 'the all-seeing eye' also seems necessary.

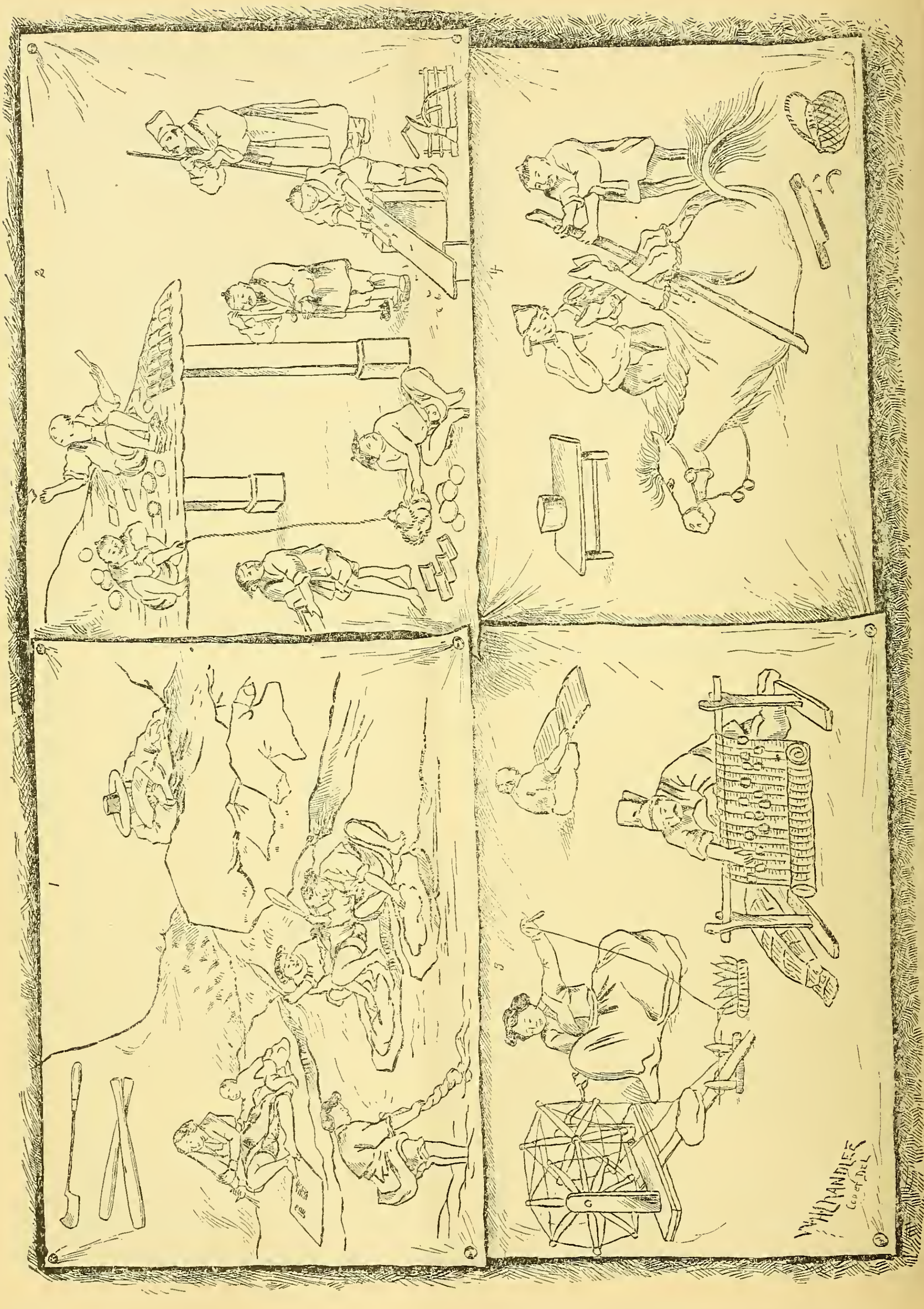
Spinning and weaving (fig. 3). — The textile practices of Corea exhibit the most primitive types of Chinese weaving. The loom for matting is very rude, although the work is excellent. The warp is held in place by a stone tied to the end of each thread. Half of these rest on one side, and half on the other side, of the upper beam. After the insertion of a weft straw, each of these stones is shifted to the opposite side.

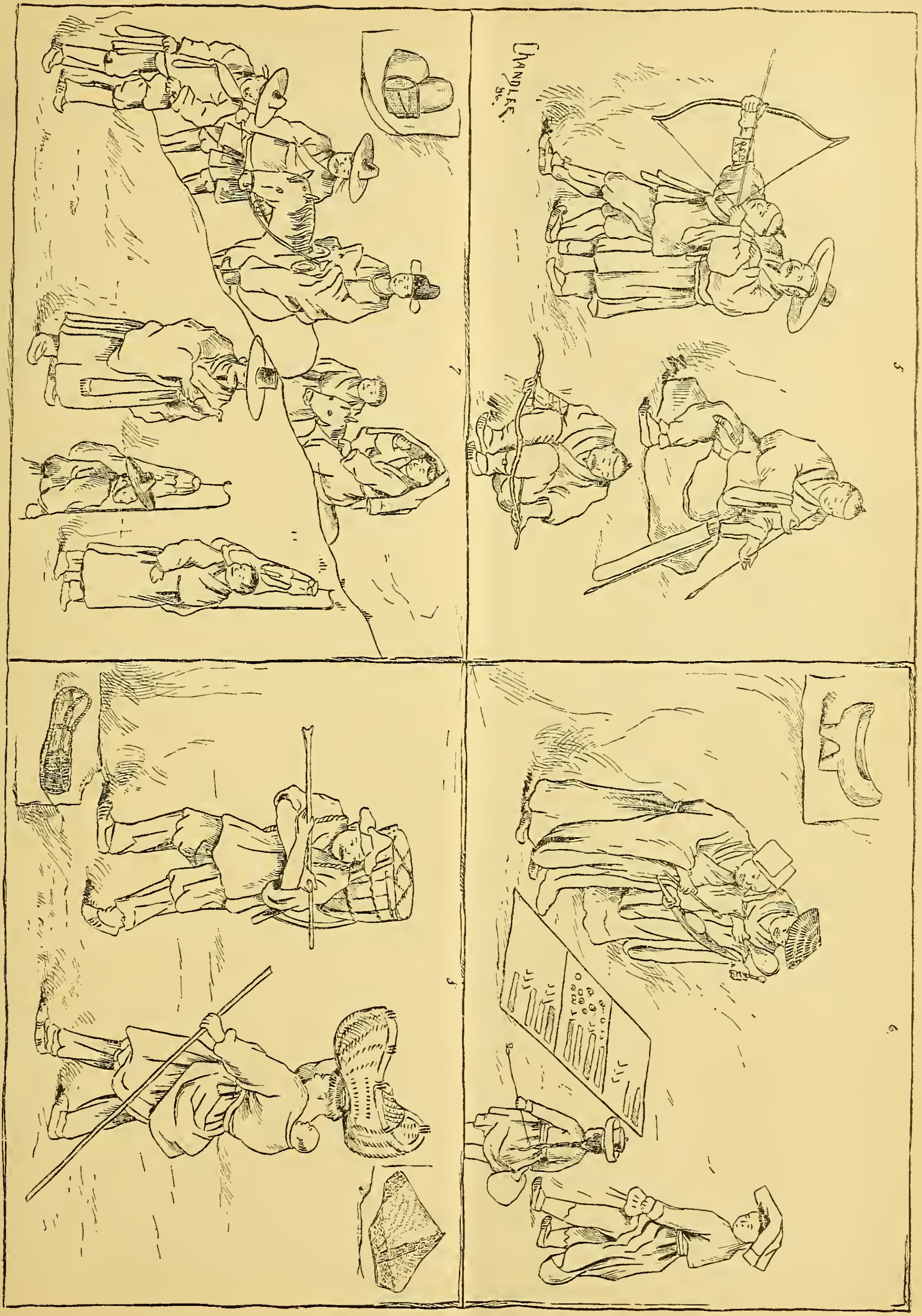
Shoeing a refractory horse (fig. 4). — The blacksmiths and other metal-workers of Corea are quite clever. Some of their silver and copper inlaying done on jewelry boxes and furniture contrasts favorably with similar work by their neighbors. The bellows consists of a square box, in which a plunger of wood packed with paper passes up and down.

A lesson in archery (fig. 5). — Archery is still a favorite amusement among the Coreans, and their soldiers are obliged to compete in yearly practice for prizes. Men of straw are set up in boats as marks. Great care is bestowed both on bows and arrows, and the junior members of the corps are carefully instructed in the precedents of practice.

Bonzes selling charms (fig. 6). — Mr. Lowell characterizes Corea as a land devoid of religion, Confucianism swaying the upper classes, and old superstitions the lower. Sorcerers and fortune-tellers sell their charms to men and women, often parading them in public, and announcing their presence with rude music. Mr. Griffis's 'man of straw' plays an important part, even now being sold and kicked to pieces as a scape-goat for the man's former self. In the drawing of the sorcerer is exhibited the quaint custom among Corean women of wearing on the top of the head a garment which they may draw over the face on the appearance of a man.

A wedding procession (fig. 7.) — In the wedding procession we see the lantern-men preceding; the bearer of a wild duck or goose or a model, symbol of domestic felicity; the happy bridegroom seated on a horse led by a man and attended by another; last of all, the bride, attended by a young boy. Her garment, ready to cover her





face on meeting a man, is characteristic, as well as the court dress and robe of the groom.

Pedlers on the road (fig. 8). — Pedlers are common throughout Corea. In our sketch are represented the methods of carrying loads and children, and the costume, hat, and shoes of the lower classes.

Each one of the paintings is as graphic and instructive as those presented. It is very difficult to impress upon the mind of ordinary travellers that it is just the information conveyed in such pictures that the anthropologists need. To write the life-history of our practical arts, it is absolutely necessary to understand the minutiae of industry in every stage. O. T. MASON.

BIRD-DESTRUCTION.

IN December, 1885, the American ornithologists' union committee on bird - protection began its work in behalf of the birds. After one or two conferences the committee became convinced that nothing would tend more to check the lamentable wholesale slaughter of our birds for millinery and other purposes than the proper enlightenment of the public respecting the extent of the annual sacrifice of bird-life, its causes, and its effects; that the almost universal use of birds for decorative purposes was due to thoughtlessness, and to ignorance of its baneful results; that in order to stem the tide of destruction it was simply necessary to make known the facts in the case, and thus create an intelligent public sentiment in favor of the birds. Accordingly the committee prepared a series of articles on the subject, which was published as a sixteen-page supplement to *Science*, in the issue of Feb. 26, 1886. This supplement was subsequently republished in pamphlet form as 'Bulletin No. 1' of the committee, and sent broadcast throughout the country.

The result far exceeded the most sanguine hopes of the committee: the press of the country took up the subject vigorously, there being scarcely a newspaper, magazine, or journal of any sort, technical, literary, educational, religious, or scientific, that did not publish copious extracts from the *Science* supplement, usually with editorial comment highly favorable to the movement thus started. This was often followed by letters from correspondents in further support of the cause, while not a few of the leading newspapers became earnest champions of the birds. At the same time various societies of natural history, in Canada as well as in the United States, appointed committees on the subject of bird-protection, which presented reports to their respective societies, embodying further evidence regarding the extent of the destruction of birds for millinery and other reprehensible purposes, frequently accompanied by resolutions indorsing most fully the conclusions and recommendations of the American ornithologists' union committee, and urging the most energetic measures possible to check the destruction of bird-life.

The Audubon society was speedily organized in New York City, under the auspices of the *Forest and stream* newspaper, for the express purpose of co-operating with the American ornithologists' union committee in its work of protecting the birds. Branches of this society have sprung up in various and widely distant parts of the country, till the membership already exceeds ten thousand. Anti-bird wearing leagues and juvenile 'bands of mercy' were formed in many towns and cities throughout the land, having the same objects in view, the members of which respectively pledge themselves not to use birds for decorative purposes, and not only not to destroy birds or their nests or eggs, but to exercise all their influence in checking their needless destruction.

Until recently the only discordant notes heard from any quarter were the subdued mutterings of a few reprehensible taxidermists, caterers of the milliners, whose pockets were affected by the movement in favor of the birds. Many of the dealers in birds for decorative purposes, particularly for hat ornamentation, expressed themselves as heartily in sympathy with the movement, as have the better class of taxidermists,— those legitimately entitled to the name, who are often men of scientific tastes, and too high-principled to lend themselves to the indiscriminate slaughter of birds simply for purposes of gain.

It was left, therefore, for a single ornithologist of some supposed standing as a man of sense and culture to make the first and thus far the only public protest against the movement, which he is pleased to term 'sentimental bosh.' Whatever his object, — whether a freak of the moment, an attempt to see what could be said on 'the other side,' a strike for notoriety, or the result of personal pique, — his statements were of a sufficiently sensational character to be eagerly seized upon by newspaper editors ignorant of or indifferent to the facts in the case, or unscrupulous in regard to what they put in their papers, provided it is 'interesting' or 'startling;' and the 'address' of the 'learned doctor' has consequently received more or less attention; and extracts from it, or editorials based upon it, have been published in two of the New York dailies, and possibly elsewhere, in addition to the paper in which it originally appeared.

The person who has thus attained unenviable notoriety is Dr. J. W. Langdon of Cincinnati, and his 'address' originated in the following manner: Some time since, the Cincinnati society of natural history appointed a committee of three of its ornithological members "to investigate and report on the destruction of native birds." This committee duly made its report, in the form of a series of papers, prepared by the different members of the committee, in which were summarized most of the facts and statements given in the *Science* supplement on bird-protection, with, in addition, much original matter of like character. This report was followed by a paper by Dr. Langdon, in which he ridiculed the idea that there had been any perceptible decrease of song-birds in consequence of their destruction for millinery purposes, or from any human influence whatever, while he furthermore claimed that it would be impossible for man to destroy enough small birds to make their absence appreciable. His conclusions were based, ostensibly at least, on an estimate of the bird population of America, and an assumed rate of natural increase, — both mere guesses, and the latter and his conclusions therefrom palpably absurd. Like some of our astute congressmen, he took the precaution to 'revise' his paper before it was printed, removing many of its grossest absurdities; leaving, however, enough to disgust intelligent ornithologists throughout the country, yet presenting so plausible an aspect as to be misleading to the general reader, unable to detect the false premises, misstatements, and misrepresentations of which it is mainly composed. The better part of the paper was later given to the readers of a New York daily newspaper; and its main points are summarized in a recent number of *Science* (viii. No. 178), and therefore need not be dwelt upon here.

To answer Dr. Langdon's paper in detail is not the purpose of this article. While it would be easy to refute its many absurd conclusions, and expose its misrepresentations, it would take much space to do so. For ornithologists no refutation is necessary; and it would not be entitled to serious consideration were it not so perniciously misleading to those who know little of the subject. It has, however, been already ably answered by the Cincinnati committee, at a meeting of the Cincinnati society of natural history held June 16, at which the consideration of Dr. Langdon's paper was made the special subject of the evening.

As a sufficient answer in the present connection, I subjoin the final report of the committee of the Cincinnati society on the destruction of native birds, adopted by the society at its meeting held July 6, premising merely that it was adopted with only one dissenting vote, and that Dr. Langdon's.

Your committee report as follows in the matter submitted to them, and state that they have fully investigated the subject of the destruction of our native birds, and several papers have been prepared and read at three meetings of the society. They find: —

First, That native birds of many species have greatly decreased in numbers over large areas of the country. This is particularly true of those water and game birds about which it is comparatively easy to obtain statistics.

Second, That the chief cause of such decrease, in addition to climatic changes, natural enemies, clearing up the country, etc., are, —

(*a*) The direct destruction of birds for their skins and feathers for decorative and millinery uses;

(*b*) The trapping of birds for cage purposes;

(*c*) The destruction of eggs and nests by men and boys;

(*d*) And the introduction of the European sparrows, which occupy the nesting-places of many native species.

Three of these causes are preventable, and the evils resulting can be greatly lessened:

First, If no birds be used for decoration.

Second, If none of the song-birds and insectivorous species be used for food.

Third, If the laws protecting certain species be backed by a much stronger public opinion, and more rigidly enforced.

Fourth, If thoughtless men and boys could be shown the great economic value of birds, and taught the desirability of protecting them and their eggs.

Your committee find that a wide-spread discussion of the bird question shows more interest in our feathered friends than they had hoped for; and they trust that Cuvier clubs, Audubon societies, and other clubs of like aims, will continue to flourish on all sides until public sentiment is entirely opposed to the destruction of our native birds.

R. H. Warder
Chas. Dury
Wm. Hubbell Fisher } *Committee.*

J. A. Allen.

GEOGRAPHICAL NOTES.

Yucatan. — The indefatigable Charnay, who has just closed another season of exploration in Yucatan, reports that he had been engaged only about six months. His object was to get moulds of the bas-reliefs on the walls of the ancient ruins. These sculptures proved to be much rarer than is generally supposed. Arrived at Izamal, he excavated the north side of the pyramid, which he hoped to find entire, but it proved to have been destroyed so that only about eight square metres of carving remained, which were not the less interesting on that account. However, in uncovering the base of the pyramid ancient mural paintings were revealed. A sort of chronic insurrection between the Indians of Maya stock and the Spanish-Americans has been going on for many years, and will probably end only with the extermination of one or the other party. In thirty years it is said 300,000 people have fallen victims to this conflict. A visite to Koba was prevented by a new incursion of the Mayas, and in taking a new direction Charnay came upon an old town, quite unknown, called Ek Balam, or the city of the black tiger. He was obliged to get away very soon, but now that the place is known it can be revisited. On an island about eight leagues north of Campeche he found a Maya burial ground which has never been investigated by a man of science. He lived here about fifteen days, the Indians gradually abandoning the camp for fear of the dead men's retaliation, owing to the death of one of their number. He then returned to Ek Balam, where he remained eighteen days. He is now busy on his report, which will be ready in a few months.

Greenland. — The information derived from the Danish newspapers in regard to Lieutenant Ryder's expedition to Greenland is enlarged and corrected on the authority of that officer. The party should have left Copenhagen on May 9, and did not expect to return before the autumn of 1887. The commission, besides Messrs. Ryder and Bloch, will comprise the geologist Ussing. The object of the exploration to be made is the little-known coast between Melville Bay and Upernivik, which has never been scientifically surveyed. It is hoped that suitable charts can be prepared when the commission has finished its researches, which will include soundings as well as geographical and geological surveys.

A newly discovered lake on the Spanish frontier. — Schrader has for some years been engaged upon surveys among the higher Pyrenees, and recently presented the third leaf of his proposed six-leaved chart of the central Pyrenees to the Paris geographical society. On this occasion he called attention to several points of interest. This third leaf represents the Aran valley on the north slope. but which being Spanish territory has not been included in the map of the French general staff. Part of it has been represented as draining into the Mediterranean. while it really is tributary to the Garonne. In the second place, Schrader's triangulations, made with difficulty amid the fogs and wind-storms of the higher peaks, showed a gap unfilled between two chains of peaks which, approached from opposite sides, he had supposed to form a single range. The explorations of Dr. Jaubernat of the Alpine club, of Toulouse. a zealous botanist and photographer, showed that this gap was filled by a lake, the largest on the whole northern slope of the Pyrenees. No one else had ever seen it. So it appears that it is only since the summer of 1883, when Jaubernat took his photographs, that any one has known of the existence of the largest lake on the Spanish frontier. M. Schrader adds that on the south and south-east of the Aran valley, several ranges are to be found, nearly ten thousand feet in height, which as yet have no place on any geographical map. It would seem that explorers may still find congenial work, even in Europe.

LONDON LETTER.

It is probably known to many readers of *Science* that a trial has lately taken place in London, the result of which, if not reversed by appeal, will seriously affect the future of electric lighting in this country, so far as incandescence lamps are concerned. Nobody but Messrs. Edison and Swan may now use the carbonaceous 'filament.' The use of such filaments is decided to be an infringement of the patent granted to Mr. T. A. Edison (Nov. 10, 1879; No. 4576), for the use of a 'light-giving body of carbon wire or sheets.' It has just been pointed out by Mr. Mattieu Williams, who himself assisted in the experiments more than forty years ago, that the real inventor of the process for obtaining light by the incandescence of a strip or wire of carbon was a young American, Mr. Starr, whose patent for it (taken out by Mr. King) was enrolled on May 4, 1846. At the end of a barometer-tube a bulb was blown, into which a platinum wire was fused, and to one end of this a stick of gas-retort carbon was fastened, the other wire being carried through the mercury. — the whole tube being 33 inches long. Mr. Starr tried platinum, and platino-irridium alloys, in wires and sheets, carbonized threads, cane, etc., before he hit upon gas-retort carbon. The lamp was repeatedly exhibited in action, at the town hall, and the Midland institute in Birmingham, by Mr. Williams. The carbon stick was 0.1 inch in diameter and 0.5 inch long; and the platinum wire had the same sectional area as the rod. The light was eminently and brilliantly successful: but funds were exhausted, and none concerned in it were adepts in getting up companies. Moreover, Mr. Starr was engaged in improving the magneto-electric machine then in use for electroplating, etc., by Messrs. Elkington of Birmingham; hence the matter was not followed up.

A very ingenious primary battery has just been brought into public notice by Messrs. Woodhouse & Rawson. the invention of M. René Upward. An outer cell, sealed at the top, holds fragments of carbon, slightly moistened with water; an inner porous cell contains zinc immersed in water. Chlorine gas is passed through the outer cells, each of which is of course provided with an inlet and outlet pipe, and a vacuum of about 0.5 inch water is maintained in the whole series of outer cells. The electromotive force per cell is 2.4 volts. The battery is entirely free from 'local action' and 'polarization,' and has been specially designed for small electric-light installations. For this purpose, it is well to connect it with some form (preferably that known as E. P. S.) of storage battery or accumulator. The chlorine is disengaged very simply from hydrochloric acid and manganese, and a necessary part of the apparatus is a small gas-holder, conveniently constructed of drain-pipes covered with pitch. All the gas apparatus is worked on the displacement principle, chlorine being nearly 2½ times as heavy as air. The apparatus necessary to establish a small installation of 15 to 18 ten-candle power lamps costs about $250. The commonest sheet zinc may be used, and the corrosive action is very slow, and remarkably regular.

At a recent conference at the Colonial exhibition, a paper was read by Mr. Sievwright on Colonial telegraphs, in which warm tributes were paid to the early labors, 1°, of Dr. (now Sir Wm.) O'Shaughnessy in India, who in 1839 and following years carried out experiments on the transmission of telegraphic signals by 'galvanism;' and 2°, of Mr. T. R. Crampton, the engineer who in 1851 laid the first submarine cable across the English Channel, and whose pluck and energy found, in addition, nearly the whole of the money necessary for the undertaking. Mr. Crampton was present, and made an interesting speech in the discussion which followed, in the course of which, also, the need of a submarine cable from the American to the Australian continent was alluded to.

The newly organized gunpowder factory at Chilworth was recently inspected by a party of scientific men, where, under Herr Hiedamann's direction, the new brown or 'cocoa' powder is being produced. Wood charcoal is replaced by another form, and the proportions of sulphur and nitre have been so changed that but little smoke is produced. Except in a gun-chamber, the firing of the powder is very slow, and a new departure in the history of artillery has taken place.

Dr. C. R. Drysdale, senior physician of the Metropolitan free hospital, is one of the most recent distinguished converts to Pasteurism. Having visited Paris, and investigated 740 cases treated in the Rue Vauquelin, in which there was no doubt of the madness of the dog, he gives the death-rate as 0.75 per cent, while under other treatments, the death-rate is 16 per cent. Hence he considers that the value of M. Pasteur's treatment is 25 times as great as that of all the other treatments.

The use of petroleum as fuel was the subject of a paper by Colonel Stewart at the United service institution recently, and a warm discussion followed. The Russians have now applied liquid fuel in various ways to 200 steamers, 700 or 800 locomotives, and probably 1,000 stationary engines. In England the use of liquid fuel is still only in an experimental stage, whereas in Russia the labors of Urquhart, Lentz, and other sound practical engineers, have made it as familiar as constant practice can make anything. A suggestion was made that English ship-owners should send one of their staff to Baku to examine the various systems in use. Two pioneer steamers are now being fitted out on this principle in West Hartlepool, one of which, the Glückauf, is to be engaged in carrying oil from the United States. She is of steel, to carry 3,000 tons dead weight, fitted with triple-expansion engines, with cylinders of 22, 35, and 58 inches diameter. Two single-ended steel boilers, with two furnaces in each, are expected to develop 1,000 horse-power. W.

London, July 13.

NOTES AND NEWS.

The local committee of the American association announces that the arrangements for a successful meeting are fairly completed. A misstatement was made in the first circular regarding telegraph dispatches. The Western union telegraph company has consented to accept for free transmission over its lines only the *official* telegrams of the association, and will charge one-half of the regular rates to members who have their messages stamped by the local secretary. The American express company, the United States express company, and the National express company will ship packages over their own lines free of charge to Buffalo providing, such packages, 1°, contain specimens, etc., to be used during the meeting; 2°, do not exceed twenty-five pounds in weight; 3°, are shipped at owner's risk and are addressed to the American association, care of the local secretary at the High school in Buffalo. The following programme has been arranged by the local committee: Thursday, afternoon, excursion down the Niagara River to Grand Island; evening, the Botanical club of Buffalo will receive the Botanical club of the association, at the residence of Hon. David F. Day; the Entomological club of Buffalo will receive the Entomological club of the association at the rooms of the Society of natural sciences. Friday, afternoon, Mrs. Bronson C. Rumsey will receive the association at a lawn party at her residence on Delaware Avenue from 4 to 6 o'clock; evening, illustrated lecture by Prof. C. A. Ashburner, on 'the Geology of oil and gas.' Two excursions will be given to the members of the association on Saturday, one to Niagara Falls, the other to Chautauqua Lake. Monday, afternoon, excursion of the Botanical club of the association to Point Abino in company of the Botanical club of Buffalo; and excursion of the Entomological club of the association to Ebenezer in company of the home club; evening, receptions at different places. As another large convention is held in Buffalo during the same week, it will add greatly to the comfort of the members to have the necessary rooms engaged prior to their arrival, and notices to that effect should be sent as soon as possible to the local secretary.

— The Pilot chart for August, just issued by the Hydrographic office, contains information appropriate to the season: The tracks of tropical huricanes on their curved course into the temperate zone drawn for eleven examples recorded in previous years. It is also announced that the charts for the months of August, September, and October will contain brief accounts of the form and motions of the tropical cyclones that characterize this season, and the signs of their approach; of the principles on which the rules for their avoidance are based; and of points that need additional information. The first of these papers is printed on the current chart. The slow progress made by a wreck east of the Gulf Stream off Charleston is of interest; as is also the curious direct and retrograde course of the bark Rowland Hill in mid-ocean. The following tells a sad story: "Captain Maddox of the British steamer Norseman reports passing close to a raft and a heavy stick of timber, on July 13, in latitude 42° 49′ north, longitude 66° 0′ west. The raft, about twenty feet square, was strongly built of heavy square timbers, stoutly lashed and wedged, and had evidently been used by a shipwrecked crew."

— The U. S. coast survey has recently issued a chart of the approaches to New York showing remarkable features of much interest to navigators. Among them is a mud gorge which appears to have been formerly an extension or continuation of the bed of the Hudson. It extends from Sandy Hook out to the ocean basin, through a sea-bed of sand. The earlier surveys showed a number of mud holes off the entrance to New York harbor, and these, from their depth and the peculiar characteristics of the bottom, have long served in some degree as guides to the mariner. The recent re-survey of this locality with improved facilities has developed the fact that instead of detached holes there is a continuous gully. Ensigns Henry E. Parmenter and Walter O. Hulme have been ordered to the Palinurus at Stamford, Conn. Ensigns I. K. Seymour, C. M. Fahs, and H. P. Jones have all been ordered to the Endeavor to work on the re-survey of New York harbor. Naval Cadet R. Welles and Ensign A. W. Dodd, the latter having been detached from the Gedney, have been ordered to the Arago at her new station on the Long Island coast. Ensign C. S. Williams has been assigned to the Eagre for duty in Long Island sound. Lieut. Commander Brownson, chief hydrographic inspector, will inspect next week the work and vessels engaged in the survey of Long Island Sound. Lieut. F. H. Crosley, commanding the steamer Gedney, has been granted two weeks' leave of absence; Ensign J. S. Watters will be in charge of the work. Lieut. J. E. Pillsbury, in command of the coast survey steamer Blake, has been conducting an interesting series of experiments in the Gulf of Mexico, measuring by the aid of an instrument of his own invention, the depth and velocity of sub-ocean currents. Lieut. E. D. Taussig of the coast survey, who has been conducting work off Cape Mendocino, California, has been detached and ordered home to await orders. The coast survey operations of the steamer Hassler in that vicinity have been attended with considerable difficulty not to say danger, on account of the high seas in that locality. Lieut. Commander W. N. Brownson, U. S. N., hydrographic inspector, of the U. S. coast survey, leaves Washington this week to inspect the work of the survey on Long Island Sound.

— The Senate has passed the bill for the relief of the party composing the Greely Arctic expedition. It appropriates $703.75 in lieu of commutations for fuel and quarters and extra duty pay to each of the nineteen persons composing the party. It also provides that if any of the nineteen persons shall have died prior to July 1, 1884, the allowance is to be computed to date of death and the money paid to their families.

— The history of the past two years seems about to be re-enacted in Italy. Cholera has appeared at Latiano. Francavilla, Venice, and Ferrara. Fiume in Austria is also infected.

— In the suit brought by the Society for the prevention of cruelty to animals in Jersey City against Dr. Beriah A. Watson to recover penalties for cruelty to dogs in experimental surgery, Justice Lane gave judgment against the doctor. The case will be appealed.

— Prof. William A. Rogers of the Harvard college observatory has been chosen to fill the chair of physics at Colby university, Waterville, Me.

— The U. S. S. Dispatch was ordered to sea recently to find and sink four wrecks that have been derelict for a long time and now reported to be somewhere in the bight of sea between Cape Barnegat and Fire Island light.

— Dr. Rufus Haymond, a well-known student of vertebrate zoölogy, and one of the pioneer naturalists of the Ohio valley, died at Brookville, Ind., July 29, at the age of 81 years. He was a native of Virginia, and came to Indiana in 1826.

— Mr. B. W. Evermann, late of Indiana university, has been elected to the chair of natural sciences at the State normal school, Terre Haute, Ind.

— Mr. George H. Boehmer of the Smithsonian institution leaves Washington during the present month on a European mission, as agent for the library of congress and the Smithsonian, in perfecting a more systematic and satisfactory method for the international exchange of public documents published by each country.

— Mr. Nathanel H. R. Dawson of Selma, Alabama, has been nominated by the President for the position of commissioner of education.

— Rev. Charles Henry Appleton Dall, father of Dr. Wm. H. Dall, the conchologist, died at Darjiling, India, on July 18. He had been for more than thirty years in the missionary service.

— Spirits of turpentine will remove unpleasant odors from the hands when all other deodorants fail.

LETTERS TO THE EDITOR.

⁂Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

Feline telepathy.

In the issue of your admirable journal for July 31, 1885, the then editor, my esteemed friend Prof. S. H. Scudder, a distinguished histologist of special eminence in entomology, does me the honor to notice my censorship of the American society for psychical research, and passes the compliment of calling me 'the well-known ghost-smeller,' perhaps with some 'occult' reference to my psychical researches.

Neither affirming nor denying this hard impeachment, I beg to cite Professor Scudder himself in connection with the interesting and instructive psychic researches now in progress concerning telepathy. I submit that the eminent entomologist is in his own person a demonstration of telepathy; and no false delicacy should make him shrink from offering himself as a good subject for telepathic experimentation on the part of the members of the American society for psychical research.

No one more than myself, among Professor Scudder's friends, sincerely deplores the painful affection of the respiratory passages from which he suffers when brought within a certain radius of a cat. It may be some mental consolation, if no alleviation of the difficulty of breathing, for the professor to reflect that his case is an interesting and valuable one for the purposes of psychic research, since it is able thus to offer an important contribution to the science of telepathy.

If I am correctly informed, Professor Scudder does not require to see the cat, or hear the cat, or smell the cat, or taste the cat, or touch the cat, in order to become painfully alive to the proximity of the animal, in the way above said. None of his physical senses is concerned in the psychic cognition of the cat and its painful bodily result. This is telepathy, namely, thought-transfer without any known or recognized physical or mechanical means of communication. Professor Scudder is evidently telepathic with cats, as a psychist would express it. What subtile connection there is between the anthropoid and the aeluroid organisms in this case, resulting in such violent antipathy and respiratory derangement on the one hand and such complacent sympathy or entire apathy on the other, is hard to say; though it may be suggested that asthmatic breathing resembles purring in some audible respects. Whether any real mind-reading is here involved is doubtful, because it is impossible to say what cats think of Professor Scudder; though what this amiable gentleman thinks of cats, while under the shock of the feline telepathic impact, and also subsequently, is well known to the large circle of his friends.

When I was appointed by the Theosophical society its official censor of the American society for psychical research — a delicate and difficult office, which I reluctantly accepted about a year ago in the interests of psychic science — it became incumbent upon me to explain to the psychical society any fact in psychic science which they might succeed in establishing.

I cannot admit that the said society has established this case of telepathy, considering that I have been obliged to do so for them. But since one of their members has been the unwitting means of demonstrating feline telepathy, I pass the credit of the discovery over to the psychical society, with the compliments of the Theosophical society, and offer my explanation of the matter. It is the same 'Explanation of telepathy' which was printed in the New York *Nation* of Jan. 15, 1885, after Professor Scudder, with tender regard for my reputation as a scientist, had declined to publish it in *Science*, of which he was then editor.

All animals, plants, and minerals disengage from their bodies a substance variously called 'biogen,' 'od,' 'akasa,' etc., this aura or ultra-sensible emanation having certain modes of motion which are the direct means of 'phenomenalizing' or making apparent to the natural senses those effects known as 'mesmeric,' 'magnetic,' 'nervauric,' 'telepathic,' 'spiritistic,' etc. Professor Scudder happens to be so constituted, in relation to cats, that the feline biogen, impinging upon the Scudderian, immediately makes him think of cats, transfers his thought from all other objects of interest to cats, fixes his mind upon cats, excites a violent 'psychic storm,' or emotional disturbance, and results in the painful physical derangement above noted.

It would interest any student of psychics to ascertain whether the eminent entomologist who furnishes this case does not suffer in much the same way from various other animals, as horses and cows. I venture to surmise that such will be found to be the case.

Any other explanation than I have given does not occur to me as probable. A physicist or biologist, however, might base an opinion contrary to mine, on the ground of common zoölogical ancestry, heredity, atavism, and so forth, according to the general principles of evolution.

Not even a 'well known ghost-smeller' should retort by calling Professor Scudder a hitherto unknown 'cat-smeller,' because that would not be polite, and because the learned professor does not smell cats, in point of fact, when he enters into telepathic relations with these zoölogical organisms. And then, too, his apparent inability to become cognizant of unembodied human intelligences by means of telepathy may be more a matter of necessity than of choice. Should he ever succeed in establishing telepathic relations with a ghost, let us trust he will find such method of communication less painful to his respiratory apparatus, and more conducive to his peace of mind.

ELLIOTT COUES, F. T. S.,
Censor A. S. P. R.

Washington, D.C.

Barometer exposure.

In President LeConte's last letter (*Science*, vol. viii. p. 80) he suggests that the effects of the wind on the barometer should be farther experimented on; since "it is evident, that, according to the conditions of exposure, the influence of the wind must tend sometimes to increase, and at other times to diminish, the pressure within the building in which the barometer is placed." Mr. Gilbert's and Mr. Todd's experiments (*Science*, vol. vii. p. 571, and vol. viii. p. 58) certainly indicate that the pressure is higher on the windward than on the leeward side of objects; and I have frequently found at Blue Hill observatory, that, if a window or door be opened on the side against which a strong wind is blowing, there will be a rise of the barometer in the building, and a fall again when the window is closed.

This does not prove, however, that the effect of the wind on an in-door barometer is as likely to make it read too high as too low. Both deduction from theory and induction from all of the facts so far gathered, I think, indicate, that, under all ordinary conditions, the effect of the wind must be to make an in-door barometer read too low. The experiments of physicists clearly demonstrate that air, in moving by at right angles to an aperture, lowers the pressure within; hence, while wind would tend to increase the pressure on the windward side of a building, on every other side and at the top of the building the tendency must be to reduce the pressure; and the total resultant must be a decided lowering of the pressure within the building during a strong wind. These points were only omitted from my first letter because I was desirous of being brief.

The effect of wind in lowering the pressure is probably strongly felt on board of ships, where the bottom and sides are tight, and the wind blows directly across the apertures at the top. This, perhaps, in part accounts for the very low readings sometimes reported in severe storms.

In his 19th paper (*Amer. journ. sc.*, Dec., 1883), Loomis makes a careful comparison between the observed gradients in severe storms and those computed by Ferrel's formula. The storms were those occurring on the Atlantic Ocean and in the United States; and comparisons were made on that side of the storms where the winds were strongest and gradients steepest. He found that the observed gradients were always larger than the computed gradients, and the latter had to be increased by a a suitable constant to equal the former. In these cases, might not the observed gradients have been only apparent, and partly due to erroneous readings of the barometer produced by a greater wind velocity near the centre of the storm?

H. HELM CLAYTON.

Blue Hill meteor. obser., July 26.

The swindling naturalist caught.

The geological swindler described in *Science*, p. 308, No. 165 (April 2, 1886), has finally been entrapped and captured here, and is now in jail at Kankakee, Illinois, for the sale of books which he borrowed from a gentleman in that town.

He passed here as 'Captain Lindley' of the U. S. army, detailed as 'instructor in geology' at West Point. I need not say that there is no such name in the Army register nor on the roster of instructors at the military academy.

As he will undoubtedly be sentenced for at least a term in jail, it is much to be desired that those who have heretofore been swindled by him may communicate promptly with the sheriff of Kankakee county. If he is not vigorously prosecuted, it will soon become necessary for the naturalist to carry a passport in travelling through this region.

S. A. FORBES.

Champaign, Ill., July 28.

A brilliant aurora.

At 9 P.M. on July 27, an arch of an aurora was noticed here through the clouds in the north-east. At 10.45 P.M. the sky was clear and a brilliant auroral arch stretched entirely across the northern sky with a height above the horizon of 15° or 20° and a width of about 5°. Beneath it the sky was very dark; but from its top stretched upward to within about 30° of the zenith the most brilliant streamers, which danced and flickered, and during the ten minutes preceding 11 P.M. showed beautiful colors at their base. At 11.10 P.M. the arch had become dimmer, and the streamers had developed into patches of light which stretched up still nearer the zenith. At this time waves or pulses of light shot upward from the north in rapid succession and moved with great rapidity. These continued, but the auroral arch gradually died away, and at 11.20 P.M. only patches of white light were visible, which covered about three-fourths of the northern sky. At 11.27 P.M. a large patch of white light in the north-east began visibly to move upward toward the zenith, and the patches on all sides began to extend in the same direction; so that by 11.30 P.M. the whole northern half of the sky was covered with patches of pulsating light. At 11.32 P.M. the patches extended eight or ten degrees beyond the zenith, and the magnetic zenith became apparent by the arrangement of the patches around it. After 11.35 P.M. the aurora began to die down, and by midnight only a whitish glow was visible in the north. At 2 A.M. of the 28th the conditions remained much the same as at midnight.

A number of meteors were seen in the north-east while watching the aurora.

H. HELM CLAYTON.

Blue Hill meteor. observ., July 28.

SCIENCE.—SUPPLEMENT.

FRIDAY, AUGUST 6, 1886.

THE PHYSICAL BASIS OF HEREDITY.

Professor Huxley, in his well-known essay, has described protoplasm as the material substratum of all vital phenomena, and established the term 'physical basis of life.' Recent investigations lead to the hypothesis that there is a special and visible substance, which is the material substratum of hereditary transmission from parent to offspring, and may be called, if we choose to imitate Huxley, the physical basis of heredity. The name of the substance is chromatine, in reference to the special affinity for coloring-matters, which is the most striking characteristic of the substance.

Chromatine, also called nucleine by some writers, is found in the nuclei of cells of all kinds. It is only recently that it has been clearly recognized, and a great deal of additional investigation must be accomplished before we can hope to know much about it. It was impossible to ascertain much concerning it hitherto, because the methods of preserving tissues for microscopical examination have become perfected only within the last few years, so far that the minute details of cell organization could be studied. Nor was it until the recent introduction of oil immersion objectives by Dr. Zeiss, that we had command of lenses sufficiently perfect for the investigation of chromatine. For those who wish to inform themselves more fully concerning the occurrence and peculiarities of chromatine, I refer to Carnoy's 'Biologie cellulaire,' which I venture to think the best general work yet published on the structure of cells.

For our present discussion a very brief statement will suffice. When cells, properly preserved, are stained with almost any of the dyes commonly used by histologists for the coloration of cell nuclei, the higher powers of the microscope reveal the fact that the nucleus contains three visibly different matters, — 1°, the network of slightly colored threads; 2°, some dots or threads very deeply stained; 3°, the hyaline, or granular substance, in which the other parts are embedded. This basal substance, enchylema, is probably more or less nearly fluid during life, and is equivalent to the *kernsaft* of those German writers, who apply that term in its proper and restricted sense: unfortunately it is employed with a variety of meanings. The network resembles the protoplasm network of the body of the cells, and is probably the intra-nuclear extension of the protoplasm. The deeply dyed parts are the chromatine; and the presence thereof appears, so far as our present knowledge goes, the essential and distinctive characteristic of a nucleus.

During the division of cells, in the great majority of cases, very remarkable changes occur in the arrangement of the chromatine, leading to the development of those striking appearances known as karyokinetic figures, or, as Flemming would like to have them called, mitoses. It is difficult to refrain from styling the latter term new-fangled; for the systematic duplication of terms with which Professor Flemming has unnecessarily burdened science of late can only be condemned. It is curious to encounter such pedantry in so industrious and sensible a histologist, because to overvalue terminology is the mark of mental poverty. As the figures in question are described in the more recent text-books of anatomy and histology very fully, we need allude only to the conclusion that the nucleus appears to lead the process of division, and the chromatine to lead the division of the nucleus. Nussbaum (*Arch. f. mikros. anat.*, xxvi. 504) points out, however, that in some cases the protoplasm apparently leads, alterations in it preceding nuclear changes. He refers especially to observations on Infusoria by Everts (*Zeitschr. wiss. zool.*, xxiii. 601) and Jickeli (*Zool. anz.*, 1884, p. 491). But to interpret such observations, we must not forget that the nucleus and protoplasm are interdependent, neither being able to maintain its existence without the other, at least in any instance where they are normally united. The fact that the visible alteration of the protoplasm in a certain rare case comes before that of the nucleus shows that the protoplasm probably has an active *rôle* in cell-division; but since even then its arrangement depends on the position of the nucleus, the evidence of the superiority of nuclear control is, I think, not affected.

On the other hand, there are many observations which may be interpreted as proofs that the nuclei have a regulating power over the cells, especially as regards their division and organization. A few of these may be instanced. 1°. After a cell is formed, its nucleus enlarges first, and the cell body follows it in growth. 2°. Kölliker, in his paper[1] on heredity (p. 29 ff.), discusses the relation of nuclei to growth very fully and ably. The great extent of his learning has enabled him to present the manifold aspects of the question more thoroughly than any other writer. His argumentation seems to me so satisfactory that it does not require the weight of his great authority to establish the conclusion that without nuclei there is no growth. Of this, the most faith-compelling evidence is offered by the important experiments of Nussbaum and Gruber,[2] who found that when unicellular animals are artificially divided, the fragments containing nuclei continue to grow, while pieces without nuclei die off. 3°. The large unicellular Thallophytes, such as Caulerpa and Codium, become multinuclear before they attain their adult size. Further illustrations are given by Kölliker (*l. c.*, pp. 19–20). 4°. Perhaps the most striking demonstration of the importance of the nucleus is afforded by the experimental alteration of the plane of division of the ovum. Pflüger[3] showed that the plane of the first division of the ovum is altered by tilting the ovum before the division begins, and keeping it in the same position during division; normally the plane passes through the white pole, but when the ovum is fastened in an oblique position, the plane is not in the axis of the ovum but in the line of gravity. Born[4] has continued these remarkable experiments, and discovered that the nucleus changes its position when the ovum is kept tilted, and that the site of the nucleus determines the plane of division of the ovum.

Still more pertinent to the theme of this article are the phenomena of the impregnation of the ovum.[5] In 1872 Bütschli[6] discovered that two nuclei are present in the fertilized ovum of Rhabditis dolichura, a nematod worm, and that the two nuclei unite, becoming the first nucleus of the embryo. Oscar Hertwig[7] proved three years later that the two nuclei, or as they are better called, pronuclei, are derived, one from the nucleus of the ovum, the other probably from the fertilizing male element, the spermatozoon. His observations, which were made at that time on echinoderms, led him to the theory that "impregnation depends upon the fusion of two sexually differentiated nuclei." Both Hertwig himself and many others, notably Fol Selenka, Flemming, Platner, and Strassburger, have confirmed this conclusion, so that there is a very strong presumption in favor of Hertwig's theory being a true law for all cases of fertilization. Strassburger was for some time[8] an opponent of the exclusive significance of the nuclei, holding the opinion that "there also occurs a copulation between the other equivalent parts of the spermatozoon and ovum," thus making the participation of cell protoplasm essential. But lately[9] he has acceded to Hertwig's opinion, and has expressed himself in a recent publication[10] with great distinctness in favor of the nuclei alone being essential to impregnation. Strassburger observed in some cryptogams the protoplasm of the male element to be so much reduced that hardly more than the nucleus remained, and found that in certain phanerogams only the nucleus of the pollen grain reaches the ovum.

The next point to be brought forward is that the spermatozoon, which forms one of the pronuclei, is in many animals developed exclusively from the nucleus. The formation of the spermatozoon has been much investigated, and yet very little thoroughly satisfactory work has been published in result. Although the great majority of the articles report more or less that is valuable, yet they also contain, too often, much that is crude, inaccurate, or even out and out false; so that it is a difficult task to unsnarl the truth from the mesh of error in which it is ravelled. Kölliker,[11] as long ago as 1841, advanced the hypothesis that the spermatozoa of all animals have the significance of nuclei. This is not quite correct, since the seminal corpuscles of nematods have the value of cells, as do probably also those of the higher crustacea, and possibly of other animals. It still remains true that in the majority of cases the spermatozoa are modified nuclei, and nuclei only. As regards the higher animals, the obser-

[1] 'Die bedeutung der zellenkerne für die vorgänge der vererbung,' in *Zeitschr. f. wiss. zool.*, xlii. pp. 1–46.

[2] *Science*, vol. vi. p. 4. See also Nussbaum's later paper in the *Archiv für mikroskop. anat.*, xxvi. p. 485. Nussbaum also cites Fr. Schmitz's experiments on the artificial division of plants. Schmitz's paper I have not seen: it was published in 1879, in the *Festschrift der naturforschenden gesellschaft zu Halle.*

[3] *Pflüger's Archiv für die gesammte physiol.*, xxxii. pp. 1–80.

[4] *Breslauer arztlich. zeitschr.*, 22 März. 1884. I have not seen the original. There is an abstract in Hofmann und Schwalbe's *Jahresbericht* for 1884, p. 444.

[5] For a synopsis of recent investigations, the reader is referred to the article 'Impregnation' by the author in Wood's 'Handbook.'

[6] 'Beiträge zur kenntniss der freilebenden nematoden,' in *Nova acta*, xxxvi. 1773.

[7] 'Beiträge zur kenntniss der bildung, befruchtung und theilung des thierischen eies,' in *Morphol. jahrbuch*, i.

[8] *Ueber befruchtung und zelltheilung*, 1878, pp. 75–77.

[9] *Ueber den bau und das wachsthum der zellhäute*, 1882, pp. 250–252.

[10] *Neue untersuchungen über den befruchtungs-vorgang bei den phanerogamen als grundlage für eine theorie der zeugung.* Jena, 1884 (see p. 77).

[11] *Beiträge zur kenntniss der geschlechtsverhältnisse und der samenflüssigkeit wirbelloser thiere, nebst einem versuch*, etc., Berlin, 1841.

vations of Flemming[12] and of several other recent authors seem to me conclusive.[13] The footnote communicates more fully the further significant fact, that the male element is developed chiefly from the chromatine of the nucleus. The facts stated prove that a body consisting mainly of chromatine from the nucleus of a sperm cell can impregnate an ovum.

Oskar Hertwig was the first[14] to point out the bearing of this induction upon the problem of heredity. It is obvious, since qualities may be inherited from the father, that the nucleus alone can furnish the means of transmission from parent to offspring. And, since it can accomplish this on the paternal side, it is probable that it can do as much on the mother's side, an assumption against which no evidence has been brought forward: hence the hypothesis that *the nucleus is the organ of hereditary transmission.* Further, since the chromatine is the characteristic of the nucleus, and since spermatozoa in some cases consist almost exclusively of chromatine, it is probable that *chromatine is the essential factor in the function of heredity.* The leading defenders of this double hypothesis are Hertwig, Strassburger, and Kölliker, all biologists as able as they are distinguished. Careful study of their writings must, I think, lead a candid mind to accept their argumentation; though of course one does not forget that hypotheses are not demonstrations.

Hertwig's paper[14] is to be recommended as the best single essay, the one to be read by those who desire to grasp the essential points of the discussion of heredity, and yet have not the leisure to go through all that has been published. Hertwig writes admirably: his matter is well arranged, his language direct, and his thinking clear and forcible. In brief, his papers have many of the qualities which we expect in a model of scientific writing. Some of his later ones exhibit less careful preparation.

Johannes Frenzel[15] has published what may be characterized as a lengthy, and on the whole half-hearted, criticism of the hypothesis of Hertwig. The objections he brings forward are in large part those which necessarily occur of themselves to every competent judge of the problem. An older investigator would have perceived this, and accordingly dealt with the discussion with much greater brevity. Frenzel's first objection is, that it is not certain that the nuclei of the male elements are not still accompanied by some protoplasm when they fuse with the ovum. Unfortunately our author has overlooked that the best investigations show the mammalian spermatozoon to be derived solely from the nucleus. Frenzel's second objection is that there are cells without nuclei. Careless and incomplete observations have frequently led to the assertion that there are such cells, but the error has been again and again refuted. On pp. 97–98 Frenzel cites Bobretzky and Korotneff as authorities, but these authors have not made sure of the absence of the nuclei. On the contrary, their investigations on the insect eggs, in which cells without nuclei are supposed to occur, are so obviously insufficient that it is astonishing to find stress laid upon them. For my own part, I feel little hesitation in asserting that except, perhaps, among the very lowest organisms, *there are no cells without nuclei.* As regards the lowest organisms, there is uncertainty. Nothing to be called a nucleus is known in bacteria, for instance. We cannot, indeed, state at present that the continuance of life is impossible without a nucleus. On the other hand, our knowledge of the minute fungi and supposed monera is so imperfect, that it would be foolish to accept the dogma that these organisms have no nuclei. It is conceivable that in the lowest forms of life the material basis of heredity is a diffused substance, which in the progress of evolution has gathered together to result in the genesis of nuclei. Therefore, whether the lowest bionts are nucleate or not, they do not offer, so far as at present known, any valid objection to Hertwig's theory that the nucleus is the organ of heredity. There is nothing else in Frenzel's article requiring notice in this brief review. It will not, I think, repay those not engaged in the special study of the subject to familiarize themselves with the essay in question, for I am able to commend it only with reserve.

The last few years have not only brought us

[12] *Archiv für mikrosk. anat.*, xviii. p. 249.

[13] The following authorities covering the period of the last eighteen months have dealt with the development of the spermatozoon in mammalia: Brown, *Quart. journ. micros. sc.*, xxv. 343; Wiedersperg, *Arch. f. mikrosk. anat.*, xxv. 113; Platner, *Ibid.*, xxv. 564; Biondi, *Ibid.*, xxv. 594; Platner, *Ibid.*, xxvi. 343; La Vallette St. George, *Ibid.*, xxvi. and xxv. 581. Others might be cited. I have given a synopsis of these researches in the *Boston medical and surgical journal*, cxiv. 460. Nussbaum, even in his latest paper, adheres to his belief that the spermatozoa are always cellular, and not exclusively nuclear. Unfortunately he does not state upon what grounds the results of so many investigators are to be set aside. The authors cited show that the chromatine gathers together within the nucleus, and that it forms the head of the spermatozoon, while a large part of the nucleus breaks down: hence the spermatozoon arises chifly from the chromatine of the nucleus of the cell (spermatoblast).

[14] 'Das problem der befruchtung und der isotropie des eies, eine theorie der vererbung,' in *Jena zeitschr. naturwissensch.*, xviii.

[15] 'Das idioplasma und die kernsubstanz,' in *Archiv für mikros. anat.*, xxvii. 1886, pp. 73–128. Frenzel's position is best shown by a paragraph on p. 89 which summarizes his view.

fresh insight into the morphological basis, but also into the physiological function of heredity.

A few words are necessary about pangenesis. The hypothesis, as originally advanced by Darwin, was the suggestion of a masterly mind, and as a succinct and comprehensive expression of the facts of heredity, commands admiration. But the real worth and real significance of the hypothesis have not been grasped by those who have tried to better it: its value was not in explaining, but in expressing, heredity in hypothetical terms, which were at once suggestive and comprehensible. Haeckel, whose judgment has too often to be deplored, accepted pangenesis in the mistaken way, and made an attempt to improve upon it as an explanation, in a pamphlet [16] which no competent critic any longer assigns serious value to. Indeed, were some one to assert that the alliterative euphony of its title, 'Die perigenesis der plastidule,' was its cleverest part, a physiologist might feel unable to prove the assertion erroneous. According to Darwin's hypothesis, every part of the body throws off particles, or gemmules, and some of these from each portion of the body enter the sexual elements, each of which, therefore, contains contributions from every part of the parent. The gemmules, by their multiplication in the embryo, reproduce their own kind, and so rebuild on the former pattern. Haeckel's perigenesis is, when separated from his rhetoric, the substitution of rhythmical vibrations for the different kinds of gemmules. It need hardly be said that not a tittle of evidence for this notion is shown, and that, as elaborated by its author, it violates the elementary laws alike of biology and physics. In these respects it recalls the delightful theory of Dr. Cohen,[17] who, having noticed a certain resemblance of the ovum to a ganglion cell of the spinal cord, and of the spermatozoon to the unipolar cells of the sympathetic ganglia, gravely concludes, "The influence of the spermatozoon, the male hereditary influence, extends above all to the cerebro-spinal system, while the action of the ovulum, Goethe's 'ewig weibliches,' shows itself above all upon the organs subordinate to the sympathetic nervous system" (pp. 30–31). In physics, also, Cohen even surpasses Haeckel: he attributes (p. 19) the entrance of the spermatozoon into the ovum to reaction between the positive electricity of the one and the negative of the other.

Brooks's [18] modification of the theory of pangenesis well deserves consideration, although the subsequent progress of biology does not lead me to think it felicitous; but we can now recognize it as a step towards Nussbaum's valuable theory, and also towards Weismann's conception that sexual reproduction has for its object the maintenance of variability. Brooks's theory is advocated in his book on 'Heredity' (Baltimore, 1879): he states it succinctly [18] as follows: —

"This paper proposes a modification of Darwin's hypothesis of the same name (pangenesis), removing most of its difficulties, but retaining all that is valuable. According to the hypothesis in its modified form, characteristics which are constitutional and already hereditary are transmitted by the female organism by means of the ovum; while new variations are transmitted by gemmules, which are thrown off by the varying physiological units of the body, gathered up by the testicle, and transmitted to the next generation by impregnation."

If this theory was tenable, there should be — to mention a single objection — little variation in individuals produced by parthenogenesis; and they ought always to be females, whereas they are sometimes males. There remains, not a new theory of pangenesis, but the valuable suggestion that the maternal influence causes less variability than the paternal. I am, however, strongly disinclined to anticipate the confirmation of this suggestion, especially because the males are not more variable than the females, as we should expect. I have some extensive statistics, which show that in mammals, at least, there are no essential differences between the sexes in variability. Even if Brooks's thesis should be established, it would prove only that the inheritance from the mother is stronger than from the father, and there would lack reasons for his abstruse hypothesis.

The first important step towards the substitution of a new theory, *vice* pangenesis, was taken by Dr. Moritz Nussbaum, whose memoirs [19] on the differentiation of sex deserve great attention. Every one who feels interest in the general problems of biology, and is able to follow a technical paper, will find Nussbaum's memoirs profitable reading.

[16] The pamphlet was published at Berlin in 1876. For some, considering its character, very gentle criticisms, see Ray Lankester in *Nature*, July 13, 1876, xiv. 235–238. Elsberg has also written on the subject in the Proc. Amer. assoc. adv. sc., xxv. 178, and cites there earlier writings of his own. The perusal of his article has not enabled me to recognize any thing novel except the substitution of the term 'plastidule,' for 'gemmule' used by Darwin, and speculations as to composition of plastidules, as if he was groping after the conception of the micella of Nägeli, with which he was apparently unacquainted.

[17] *Das gesetz der befruchtung und vererbung*, etc., Nördlingen, 1875.

[18] Proc. Amer. assoc. sc., Buffalo, 1876, p. 177. abstract of a paper read before the section of natural history.

[19] 'Zur differenzirung des geschlechtes im thierreich.,' in *Arch. für mikrosk. anat.*, xviii. (1880) pp. 1–113; and 'Ueber die veränderung der geschlechtsprodukte bis zur eifurchung, in *Ibid.*, xxiii. 155.

Professor Weismann[20] has adopted Nussbaum's conception, and defended it with considerable energy, adding also several important modifications. Nussbaum pointed out that there is noteworthy evidence in the development of various animals, tending to show that the germinal cells from which the sexual products are derived are separated off from the other cells of the embryo very early, and undergo little alteration. Hence he concluded that some of the original germ substance is directly abstracted from the ovum, and preserved without essential alteration to become, by giving rise to the sexual elements, the germ substance of another generation. Weismann insists upon the corollary, that the whole nature of the animal or plant depends upon its germinal substance, and that the reason why the offspring is like the parent is that in each biont some of the germinal matter is preserved unchanged. He calls this view the theory of the continuity of germ plasma. He follows Nussbaum also in emphasizing the fact that this theory is inconsistent with the theory of pangenesis and with the theory of the transmission of parental characteristics which are acquired through external causes. On these two points Weismann's second and third papers mentioned in the footnote[20] are the most important. I fully coincide with him as regards pangenesis, but am less inclined to do the same as regards acquired characteristics. It is upon the latter theme that Virchow has opposed him. I am compelled to say, however, that the distinguished pathologist has failed to understand Weismann's position correctly, and that most of his criticisms I cannot deem valid.

According to the theory of Nussbaum and Weismann, the cells in the embryo separate into two kinds, — 1°, the germ cells, which are converted into the sexual elements; and, 2°, the somatic cells, which constitute the body of the organism. The germ cells descend directly from the impregnated ovum, and undergo little alteration, so that they have (in suspension) the power to produce a whole organism. It is difficult to agree to this remarkable speculation: on the contrary, we must side with Kölliker (*l. c.*, pp. 44–46), who says that a sharp division between germ cells and somatic cells cannot be maintained. The feeling that there is a flaw in Weismann's argumentation cannot be escaped. While we recognize the ability, the great ability, of his essays, and cannot read them without our minds appropriating much from them, we remain sensible of the mysticism which zigzags across his pages, now and then blurring his expressions, and making his thought indefinite. After reading his article on the 'Continuity of the germ plasma,' there lingers an uncomfortable sense of mental haze. I have already indicated elsewhere[21] a more comprehensive theory, which is irreconcilable, so far as I can perceive, with the continuity theory. My views I hope to defend on another and more appropriate occasion. Nor is a discussion of Nussbaum's theory essential in this article. We turn, therefore, to the next point demanding attention.

Nägeli, the celebrated botanist, published in 1884 a large work containing a series of views reached at the culmination of a remarkable career of scientific research. The volume[22] has been less studied than one would wish: it comprises over eight hundred pages, and is decidedly abstruse. Nägeli is led to the theory that there are in every living cell two substances, — one, which he calls *idioplasma*, in distinction to the other, which he names the nutritive plasma. It is the idioplasma alone which carries on the function of hereditary transmission. We have here the definite conception, that the character of a special constituent of living matter regulates the organization of it. In other words, Nägeli assumes the formative force to reside in a specific material substratum, which reproduces and perpetuates itself, occurs throughout the organism, and supplies fragments of itself to the genital products. The argument in support of this theory is very able, and one can but join in the praise which Kölliker and others have bestowed upon it so cordially. The theory itself supplies us for the first time with a tangible notion from which to work ahead. A clew is given as to the physiological process of heredity.

Putting together all that has been said, the conclusion is evident. Nägeli's hypothetical idioplasma is probably identical with the nuclear chromatine of morphologists.

[20] Weismann's first paper was read before the University of Freiburg as a Prorectorats Rede, and was published in pamphlet form at Jena in 1883, with the title 'Ueber die vererbung.' A second paper was read before the German Naturforscherversammlung in 1885, and appeared in the Tageblatt of that association: it was subsequently amplified and republished with the title, 'Die continuität des keimplasmas,' etc. (Jena, 1885). A third paper, 'Ueber die bedeutung der geschlechtlichen fortpflanzung für die selectionstheorie.' was likewise addressed to the Naturforscherversammlung, and published at Jena (1886). A notice of this last by Kollmann was given in the *Biolog. centralbl.*, v. pp. 673 and 705. At the same meeting of the Naturforscher, Virchow also delivered an address (since published in *Virchow's archiv*, ciii. pp. 1, 205, 413, and in shorter form in the *Biolog. centralbl.*, vi. pp. 97, 129, and 161), in which he attacked Weismann's thesis. To Kollmann and Virchow, Weismann has replied (*Biolog. centralbl.*, vi. p. 33).

[21] Minot, — 'Organization and death,' in Proc. Amer. assoc adv. sc., Ann Arbor, 1885.

[22] Mechanisch-physiologische theorie der abstammungslehre, Munich, 1884 (available abstracts are given in the *Biolog. centralbl.*, iv. pp. 488 and 517).

It is my conviction that the hypothesis of pangenesis, both in its original form and in all its subsequent modifications, has been definitely set aside. In its place we have the theory that the nature of the germ, i.e., of the impregnated ovum of each species, is the same over and over, not because there is in each case a similar collocation of gemmules or plastidules, but because the chromatine perpetuates itself, so that the same kind of chromatine is found in the one generation as in the generations preceding it and following it. *The child is like the parents, because its organization is regulated by not merely similar, but by some of the same, chromatine as that of the parents.* Perhaps, instead of chromatine we ought to say, in order to avoid an unjustifiable explicitness, nuclear substance.

When it is recalled that heredity is one of the fundamental phenomena of life, and that hitherto we have seen no hopeful way leading to its comprehension, we can understand the delight with which biologists welcome the new theory and its rich promises. CHARLES SEDGWICK MINOT.

ROSMINI'S PSYCHOLOGY.

THIS is the sixth volume of the translation which Rosmini's English disciples have undertaken to make of his principal writings, — a labor of devotion surely, not only by reason of the mere pains involved, but in view of the probable thanklessness of the English-reading public for whose sake they are all taken. When one thinks of the mere quantity of labor which Rosmini accomplished in his not long life, one cannot refuse to him the title of being one of the very small number of intellectual giants of the world. He is of the race of the Aristotles, the St. Thomases, the Leibnitzes, the Kants, and the Hegels. The mere cogitative energy of him, too, is fully equal to theirs. Every page he writes is filled with thinking as hard, subtle, and original as theirs; and his style is as clear and flowing as theirs is usually the reverse. His learning is prodigious too. In short, he is a miracle of intellectual force, compared with whom a mere reviewer's mind is as a midge against an elephant. But Rosmini is a *dead* giant, and the reviewer can have it his own way with him, because *he* is alive, and writes for readers taught by all their Lockian and Protestant education to treat the kind of thing that Rosmini represents — thoroughgoing, concatenated, and systematic ontologizing and theologizing by the conceptions of principle and term, substance and essence and act — as 'scholastic jargon,' and so to close their ears. Scholastic jargon, too, it seems to this reviewer; only he has a bad conscience about saying it so shortly, and therewith turning Rosmini over to the disdain of many of our native philistines who at bottom are spiritually unfit to loosen his shoe. The last word has not yet been said about scholasticism. We are all scholastics without knowing it, so sure as we talk of things and acts and essence and force. But we don't elaborate our scholasticism, because Locke taught us that to do so led to no practical use. The only practical gain which accrues to a scholastic from his elaboration of what we all believe, is what Rosmini calls "the experience in himself of a kind of jubilation and felicity, which is so peculiar as to be unlike any other feeling and to bear testimony to its infinite source." This is the rapture of all intellectual order and harmony; but our race would willingly part with it, if only thereby it could buy a new way of peeling potatoes, or of teaching children how to read. We renounce one thing, scholasticism another. It is not that the distinctions made by Rosmini and other scholastics are false. On the contrary, they seem for the most part true. They are one way of seeing and naming the facts of life. But they are sterile: we can deduce from them no immediate practical receipts. To peel potatoes, we must look at other aspects of the world than substantiality and accidentality and the distinction between immanent and transient acts. Many are the aspects of every bit of reality, and all are equally true. But each carries us a different way. By a succession of accidents modern critics and men of science have stumbled on the aspects which lead to the ways of foreseeing and handling particular material events. Together, these aspects form the armament of the scientific and positivistic view of life, a hodge-podge of which we moderns are very proud, but of which, great as the practical fruits are, the speculative dignity leaves much to be desired. Maybe some disciple of Rosmini may show a path down from his categories to the practical details of life. It were sad that such strenuous and in many ways such exquisite thinking as his should be among the mere superfluities of human history. W. J.

Psychology. By ANTONIO ROSMINI SERBATI. Vol. ii. London, *Kegan Paul, Trench & Co.*, 1885. 8°.

CLERKE'S HISTORY OF ASTRONOMY.

THIS is in some respects a remarkable book, and takes its place at once in importance beside Grant's 'History of physical astronomy,' which it in a measure supplements. No clearer indication

A popular history of astronomy during the nineteenth century. By AGNES M. CLERKE. Edinburgh, *Black*, 1885. 8°.

of the wonderful advance of the 'new astronomy' during the third of a century since Professor Grant wrote, and of the need of a historian for it, can be furnished than the fact that what was then called physical astronomy is now termed theoretical, mathematical, or gravitational; while to-day by physical astronomy is generally understood the investigation of the intimate relations between astronomy, physics, and chemistry as studied in the sun, stars, comets, planets, our own atmosphere, and laboratories.

Miss Clerke has been peculiarly happy in the *rôle* of historian. Terse and highly original in style, her work will hold the attention of every educated reader for its literary merit alone, while the copious footnote references to the original sources of information make it a mine of wealth to the student and astronomer. The work is so excellent, and also so rapid is the progress of astronomical discovery, that new editions will rapidly follow; and for the purpose of making them as valuable and accurate as possible, we trust we shall not be considered hypercritical in calling attention to a few points, either where further comment or criticism would seem desirable, or where we think an error of judgment or interpretation, or some slight slip of reference or quotation, has been made. Anything but a first-class work we should not consider thus worthy of attention.

On page viii., for 'Illinois' read 'Madison, Wisconsin.'

In the closing description of the total disappearance of Biela's comet, on pp. 127 and 128, it would seem desirable, for the benefit of the reader ignorant of the facts, to refer him to the description further on, pp. 377 – 380, of subsequent encounters with it in the form of meteor showers, the latter now to be supplemented by the shower of last November, since the book was written.

To the non-astronomical reader, and even to the amateur spectroscopist who only knows of the spectrum as given by an image of the sun covering the whole slit or by some form of integrating spectroscope, the reference on p. 254 to Lockyer's long and short lines will be unintelligible without such a description of his apparatus as will explain that his long or short lines indicated the existence of incandescent shells of vapor at greater or less distances round his electric spark terminals, whose image was thrown on the slit by a lens.

In the enumeration of phenomena observed during different transits of Mercury, pp, 290 and 291, reference should be made to the one most extensively observed of all, that of 1878, May 5 and 6, as described and discussed in the *Washington observations* for 1876, part ii., app. ii.

Probably the paragraphs on pp. 304 and 305 regarding Mr. Croll's theories of secular changes in climate would be somewhat modified since the rather merciless criticism these theories have received at the hands of Woeikof, from the standpoint of a scientific meteorologist. (See *Amer. journ. of science* for March, 1886.) We can hardly see a justification for the opinion, p. 315, that Professor Langley's researches lend countenance to the idea that the temperature of the full moon's surface is anything like 500° F. It is difficult to keep up with Professor Langley nowadays, but, so far as we understand his results, they almost certainly point to a temperature below 100° F., and very probably below the freezing point of water.

Upon reading the letters of Bakhuyzen and Proctor in *Nature*, xxxiii. pp. 153 and 245, the author will see that the period or rotation of Mars deduced by the former must be incomparably more accurate than Proctor's, and in a new edition Bakhuyzen's later value should be given.

In spite of the apparent partial confirmation from several sources, we still remain somewhat skeptical regarding Schiaparelli's canals upon Mars (pp. 324 and 325), especially the duplicate parallel ones. We shall look with interest for the attack upon Mars with the Lick 36-inch refractor when set up on Mt. Hamilton.

On p. 329, line 3, for 'Vesta' read 'Pallas.'

As to the idea that the distribution of the asteroids has been largely influenced by commensurability of period with that of Jupiter (p. 329), or that gaps in the rings of Saturn have anything to do with the distances of its satellites, we regard the theory as entirely unproven as yet, and would refer to an article on the subject by Professor Hall in the *Sidereal messenger* for September, 1885, also copied in the October number of the *Observatory*.

We question the advisability of referring to a meteor shower as 'star-drift' (p. 371, line 5), when this term has already crystallized into the definite meaning of community of proper motion among neighboring stars or systems of stars (p. 438).

The subject of photometry is not adequately treated in the volume. This really deserves a whole chapter, but does not even occur in the index, while the paragraph on p. 435 does no justice whatever to the subject. Several of Professor Pickering's results are incidentally referred to in various parts of the book, but some description of his wonderfully ingenious photometers and methods which have revolutionized the whole subject and given rise to so much discussion is certainly to be expected in a book of this high character. One of the most important of his works, the series of photometric observations of the eclipses of Jupiter's satellites, which has now been going on for eight years at the Harvard college observatory, is not mentioned at all. We should like to say a few words here upon the importance of this particular series of observations, which has as yet not received due justice in print, but space forbids. By the way, the phenomenon of the eclipses of these satellites and their important relation to the velocity of light and the dimensions of the solar system is not referred to at all.

We regret that the pages concerning the relative value of large versus small telescopes (443 and 445) appear in so good a book, and we do not think they would have been so written had the author been a practiced observer. We have not space here to join in this wide discussion, but we would commend the author and our readers to the able summary of the case in the letter of Professor Young (*Observatory*, February, 1886,) as embodying the true gist of the whole matter. Incidentally, the curious misunderstanding of Professor Hall's letter (*Observatory*, May, 1885,) is worth noticing. How any one who has ever used a telescope can read this letter without seeing quiet sarcasm in every line, we fail to see. But our transatlantic neighbors in a body seem to have taken it as written in sober earnest, and the sermons preached from it have been highly amusing, even going so far as to suggest a possible permanent set or distortion in the lenses of the Washington 26-inch since its first manufacture. We advise Professor Hall to preface any future communications of this sort with 'The following is sarcastic,' or other equivalent explanation.

In the various discussions of reflectors *versus* refractors, we have looked in vain for a clear statement of the different effect, upon definition, of flexure of the mirror or objective. If gravity bends a lens so that one side is more convex, the other becomes more concave, and the effect upon definition is a quantity of another order entirely from that due to flexure of either side alone ; while the bending of the surface of a mirror appears with its full effect upon the definition ; so that a mirror which forms any part of a telescope and changes its position with reference to gravity must be almost infinitely more rigid than a lens in the same situation in order to perform equally well. This should be borne in mind in such discussions (p. 450).

Miss Clerke has not touched upon the subject of Mr. Denning's so-called 'fixed radiants' of meteor streams and the startling suggestions as to the peopling of interstellar space to which the claim has given rise. In the present uncertainty about the reality of the phenomena, perhaps it is just as well. With to-day's doubtful methods of mapping the tracks of meteors, our opinion is that we must wait till some Argus-eyed camera, whose overlapping lenses and plates (mounted on a hemispherical surface driven by equatorial clockwork) are sensitive enough to record the paths of all the fairly bright meteors, shall decide, by the doctrine of probabilities, as to the real existence of nine-tenths of the so-called 'radiants' of to-day.

Did space permit, pages might be written in praise of the excellent features of the book. But, where so much is good, we consider our limited space better employed in pointing out a part of the minor faults, in order that subsequent editions may be as perfect as possible. Hence, in so much as we may have seemed hypercritical, by so much we trust that the author will consider it a compliment to the general excellence and importance of her work. H. M. PAUL.

Washington, July 24.

IT is not a little curious, says the *Lancet*, that the diseases arising from the wrong use of tea should be met with in greater frequency in countries foreign to its growth. The diseases due to this cause are well known to doctors, but the public seem to be strangely indifferent to the teachings of their medical advisers in these matters. Recently in France M. Eloy has reminded medical men how vast is the number of diseases owing an allegiance to the dominion of Queen Tea. America and England are the two countries that are afflicted most with the maladies arising from its excessive consumption. Individuals may suffer in a variety of ways. It is customary to speak of acute, subacute, and chronic 'theism,' — a form that has no connection with theological matters. The predominance of nervous symptoms is a characteristic of theism. General excitation of the functions of the nervous system may be observed, or the weakness may be noted more especially in the brain as distinguished from the spinal cord. Perversion of the sense of hearing is not at all an uncommon symptom, patients hearing voices that have no real or objective existence. The irritability that overtakes women so frequently may sometimes be clearly traced to an excessive indulgence in afternoon tea. No doubt the tannin which tea that has been standing contains does a great amount of mischief ; but theism belongs, rather, to that class of diseases in which morphinism, caffeism, and vanillism are found. The habit of tea-drinking is one that grows on its victims like the similar ones of opium or alcohol. Taken in strict moderation, and with due precautions in the mode of preparation, tea is, like alcohol, a valuable stimulant ; in its abuse there is also certain analogy.

SCIENCE.

FRIDAY, AUGUST 13, 1886.

COMMENT AND CRITICISM.

Considerable interest has of late been taken in the study of the etiology of pneumonia. Some believe it to be due, in the majority of cases, to microbes, and base this opinion upon the discovery of four varieties of micro-organisms in lungs affected with the disease; others find a marked relation between its prevalence and the increased amount of ozone in the air, either just at the time or immediately preceding. Dr. Seibert has made a study of 768 cases of primary pneumonia, which were reported to him by the members of the New York medical society, and which occurred in their practice during twelve months. These cases were distributed as follows: January, 71; February, 140; March, 103; April, 73; May, 55; June, 37; July, 26; August, 25; September, 43; October, 62; November, 65; December, 78. The results of Dr. Seibert's investigations are, 1°, that the varying prevalence of pneumonia may be explained by changes in temperature, humidity, and velocity of the winds; and, 2°, that, whenever there exists a low or falling temperature with excessive and increasing humidity and high winds, pneumonia prevails to its greatest extent. If two of these conditions exist without the third, the disease will be markedly prevalent, but not so much so as in the preceding instance. Catarrhal troubles are also favored by the same conditions.

There has recently been published a biography of Se-Quo-Yah, styled the American Cadmus. Born in 1770, of a Cherokee mother whose European husband had deserted her, he grew up as the pride of his people, both in games and war. One day (so the story goes) a white captive produced a letter, and everybody wondered at the 'talking leaf.' Se-Quo-Yah (which translates suspiciously into 'he guessed it') pondered over the mystery, and with the use of an English spelling-book which had fallen into his hands (but which of course he could not read), invented a written alphabet for his people, making the English characters, with modifications and additions of his own, stand for the eighty-two syllables of which the Cherokee language is composed. He analyzed the spoken speech, and had each distinct syllable represented by a sign. His tribe at first considered him as weak-minded, but eventually recognized the utility of his invention. Five years after the invention he had a school with many scholars, and a printing press was publishing a Cherokee paper, part of which was printed in the Se-Quo-Yah alphabet. This invention is referred to as the means of civilizing the Cherokee nation. The story is unfortunately not sufficiently clear to enable one to appreciate just how much of the idea was original with Se-Quo-Yah, or to claim for him the honor of doing by a flash of genius what in other races had been slowly worked out before history began.

It is a prevalent popular impression that some special providence surrounds the physician with protective agencies, and that, although daily exposed to disease in its most malignant forms, he escapes when others are attacked. Dr. Ogle of England finds that while the lawyers die at the rate of 20, the clergy at the rate of 16, the doctors' mortality is 25 per 1,000. In a million adults other than physicians, 16 died of scarlet-fever, 14 of diphtheria, and 238 of typhoid-fever; while, of an equal number of physicians, 59 succumbed to scarlet-fever, 59 to diphtheria, and 311 to typhoid-fever. Small-pox, on the other hand, claims more victims among the laity than in the medical profession; due, doubtless, to the fact that physicians have sufficient confidence in the protective influence of vaccination to keep themselves insusceptible to the attacks of small-pox.

Dr. Lincoln, in the 'Report of the Massachusetts state board of health for 1884,' says that a child who enters a public school has become a fractional part of a machine. He has been well understood by persons who have watched him from birth, and who are deeply interested in him. He is now transferred to the care of strangers, who meet with him only five hours in the day, and whose interest in him is restricted by the fact that he forms but a portion — say, from one and one-tenth to two and one-half per cent — of the total group of children that is intrusted to the care of the teacher. He is held by the teacher, and then passed on to another again as a fraction, and not as an integer. Does he not lose much, as well as gain, by this system? As regards his health, he loses that defence which the sympathy of the community always extends to that individual who is suffering conspicuously. Taken generally, all children in school are suffering from discomfort. Average this discomfort among ten thousand, and it may not be very great for each one; but a class of fifty children is not made up of fifty averages.

THE AMERICAN ASSOCIATION AS A MISSIONARY BODY.

Two years ago we published some statistics concerning the membership of the American association which were somewhat curious. The figures then given dealt simply with the geographical distribution of the members; and they showed, among other things, that one-third of the association came from the states of New York and Massachusetts. If the north-eastern states, that is, New England and the Atlantic states to the Virginia line, had been counted, it would have been found that these included fully three-fifths of the association.

It could also be shown that during the last ten years, when only four of the ten meetings have been held in the north-eastern states, the average attendance of members from this section has been 53 per cent of the whole attendance, increased to 76 per cent when the meetings have been held within its own territory. It has even been larger than the territorial representation in two instances, as at the St. Louis meeting of 1878, when it was larger than the representation of all the states west of the Mississippi; and at the Montreal meeting of 1882, when it was five times as large as the entire Canadian membership present. At the other extra-territorial meetings, where its proportion of the total attendance has varied from 24 per cent to 37 per cent, it has easily held the second place, though falling below the local representation of large areas. Indeed, the representation of no other section, excepting of the northern states lying east of the Mississippi and west of the Atlantic states, ever has more than a passing importance, viz., when the meeting is held in that section. Thus Canada's representation has never been more than 3 per cent of the whole in any meetings of the last ten years, excepting in 1882, when it was held in Montreal and the percentage rose to 14 per cent; the next year however it fell to 2 per cent, and, omitting 1882, the average has been less than 2 per cent. In this same period the states west of the Mississippi have averaged a little more than 4 per cent, and have never reached 6 per cent, excepting when the meeting was held at St. Louis in 1878, when it rose to 31 per cent, and at Minneapolis in 1883, when it was 15 per cent. The southern states have done better than this, for at the Nashville meeting in 1877 their average was 57 per cent of the whole, and though at no other time (even at St. Louis) have they exceeded 12 per cent, their general average, apart from the Nashville meeting, has been over 6 per cent.

It is, however, a matter of practical importance, in deciding where a meeting shall be held, to know how large a general attendance of members to expect, and here the statistics show some further significant facts. The general proportion of members in attendance to total membership during the past ten years has been 30½ per cent, but the proportion has varied enormously, as may be seen by the following serial figures, from 1876 down: Buffalo 25 per cent; Nashville 17 per cent; St. Louis 14 per cent; Saratoga 25 per cent; Boston 63 per cent; Cincinnati 27 per cent; Montreal 48; Minneapolis 20 per cent; Philadelphia 49 per cent; Ann Arbor 17 per cent. While it should not be forgotten that it is one part of the association's work to look upon the meetings as in some sort a missionary enterprise, neither should it be overlooked, when it is asked to hold an undue proportion of its meetings away from the centres where it gains its main financial and moral support, that such assemblies are held *in partibus infidelium*.

It might be sagacious to institute an inquiry as to the length of time for which new members, gathered in from the district immediately surrounding a place of meeting, are held. That membership changes largely from year to year is a well known fact; that it is largely recruited from the places where the meetings are held is sufficiently obvious to any constant attendant. But what shall we say when we discover that Buffalo, which a month hence can point to itself with pride as the only city which has harbored the association for a third time; that Buffalo, situated in the region which these statistics have shown is most favorable for science, where two or three local societies for the cultivation of the natural sciences have sprung up, where scientific periodicals have found a home and a patronage; that Buffalo, renowned for its hospitality to science, literature, and art, where ten short years ago the association was enlarged by nearly one hundred and fifty members, twenty-five of them its own citizens,—

has at present only seven members on the association's rolls, three of them the sole survivors of the twenty-five. Was it for missionary service that Buffalo called the association to its open doors? Does Buffalo look upon itself as *in partibus infidelium?*

THE TRANSCASPIAN RAILWAY.

The Transcaspian railway was opened for traffic on the 14th of July as far as Merv. The operations must already be far advanced on the Merv-Bokhara-Samarcand branches, for the names of railway stations, the distances, and other details over the whole length of the railway, from the Caspian to the Turkestan frontier, are already known. The following are fresh particulars of this important central Asian strategical railway:

There are altogether 63 stations from Michailovsk, on the bay of that name on the Caspian, right through the deserts and oases of the Transcaspian, across the Amu Darya and Bokhara to Samarcand. These do not include the new branch of 25 versts, made from Michailovsk along the Caspian coast to Ousun Ada, in order to have deep water for the connecting sea service, and to avoid the reshipment formerly necessary between Krasnovodsk and Michailovsk. The distances between these stations vary from 15 to 33 versts, being in most cases from 22 to 25 versts.

The whole distance of the line when completed as far as Samarcand will be 1,335 versts. The distances in Central Asia have become so exaggerated in most minds that few persons would imagine that they might travel by this new railway right through the Transcaspian Steppes, over the Oxus, and from one side of Bokhara to the other, coming out at Samarcand, in something like a day and a half, or less.

The first, or western, portion of the railway runs through a desert, crossing now and then an oasis, then traverses the cultivated territory of Bokhara, and ends at Samarcand in Russian Turkestan. The desert stretches along the line 148 versts between the sea-coast and Kazandjik, and 69 versts from the latter station to Kizil Arvat. The Akhal Tekee oasis extends as far as Gheours, 237 versts. The furthest point south, Doujak, is distant from the sea 581 versts, from Askabad 159 versts, Merv 167 versts, and Samarcand 754 versts. The railway traverses 300 versts of Bokharan territory. Were the line made from Merv over Burdalisk and Korti, instead of Charjui, 100 versts would be saved, and the distance between Michailovsk and Samarcand would be only 1,200 versts, or 800 miles, instead of 890 miles; but the Bokharan government, for some reason or other, did not consider that this shorter route would so well serve the interests of their country.

The principal stations are those of Askabad and Samarcand. Besides post and telegraph offices, lodging houses have been already partly built at several stations for travellers, though nothing in the way of luxury will be provided, as may be imagined. According to the time-table, the trains will run 20 versts an hour. In the event of war, the number of trains departing may be increased to 12 per day.

The railway at present is only a single line. Although many of the stations are situated in waterless deserts, they are all furnished with water in one way or another. At Michailovsk there is Nöbel's machinery for converting the sea water into fresh water, and at several stations large cisterns are to be regularly supplied, either through pipe lines or by water trains. Artesian wells have also been dug, and good water has been found between Michailovsk and Molla Kary, and at other points. Not far from Bala Isshem, the railway also has its own petroleum sources, connected by a branch line.

THE RECENT ERUPTION IN NEW ZEALAND.

A steamer which recently arrived at San Francisco from Australia brings further details of the great volcanic disturbances in New Zealand. Heavy earthquakes were still felt in the Tarawera and Sulphur Springs districts, and severe shocks continued in the Rotoli district. A relief party that was sent out reported that Lake Tarawera had fallen considerably. The oil bath at Whakarewarewa was throwing up stones and mud to the height of twenty feet, and the great boiling lagoon of Papatangi would suddenly rise as much as two feet, and then as quickly fall. A similar phenomenon was observed at the Kuirrau caldron, which would rise two feet in half an hour, and then as quickly return to its normal level. Mr. Dinsey, the telegraph officer in charge of the Rotonea station, near where the eruptions and earthquakes were heaviest, reported on June 25 that volcano No. 1 was dead, and that Nos. 2 and 3 were steaming. No. 4 was still throwing up mud. Lake Rotomahana was comparatively quiet, with only one geyser in the centre playing. The Pink Terrace geysers were still blowing up clouds of steam, but were less active than they had been. The immense crevasse created between Tarawera and White Terrace continued to steam, and the cone on top of Tarawera Mountain was throwing out volumes of black smoke and steam. The New Zealand *Herald* says: "On Galatea Plains the volcanic showers of mud at times took very eccentric courses, overleaping one section of land and then striking another further on, in the same line. Dr. Hector, who is making a scientific examination of the volcanic districts, said he expected that the volcanic cone which was thrown up in Lake Rotomahana during the disturbances had already on July 1 attained a height of six hundred feet, and was daily adding to its stature. He has named it Mount Hazard, after the gentleman of that name who lost his life on the first night of the great eruption. A chemical examination of the volcanic ashes shows that they are mostly composed of fine basaltic soil. Every human being has abandoned the entire portion of country situated within the limits of the vôlcanic system. Photographers were busily engaged taking views of the region."

GAS SUPPLY.

NUMBERS two and three of the publications of the American economic association are covered by a monograph, entitled "The relation of the modern municipality to the gas supply," prepared by Edmund J. James, Ph.D. The pamphlet contains a thoroughgoing investigation of the various systems of gas supply, and for that reason should commend itself to all interested in municipal administration and economic phenomena. The author, as is well known to readers of *Science*, is disposed to widen the sphere of state activity, basing his reasoning on philosophic conceptions. The present discussion, however, is not limited to a scholastic treatment, but assumes an intensely practical form. It is viewed from two standpoints: that of the individual, who is interested in obtaining a good quality of gas at a low price; and that of the municipality, which is interested in acquiring a revenue by legitimate economic methods. On both these points, Dr. James supplies abundant data. He shows how many European, and especially English, cities have been able to save large sums for the taxpayers by managing gas trusts on a business basis; while on the other hand, "the general opinion in England seems to be that the gas furnished by the public companies is better than that made by private companies." The experience of city upon city is adduced to support the belief that a transfer of ownership from private parties to municipal authorities would be of immense benefit. In the United States, there are at least three city corporations, Philadelphia, Richmond, and Wheeling, which undertake the manufacture and sale of gas. In each of these the results, upon the whole, have been favorable. The monograph is enriched by statistical information which makes it exceedingly serviceable; and the thoroughness of the work augurs well for the series of publications which the Economic association has undertaken.

LONDON LETTER.

SEVERAL weeks ago, attention was drawn in this correspondence to a remarkable outbreak of scarlatina in a London district, in which the hypothesis that the disease had spread from the milk drawn from one particular farm, seemed to be suggested and supported by the facts of the case. The proof, then wanting, that the disease of the animals could really produce scarlatina in man, has now been supplied by the investigations of Dr. Klein (conducted mainly at the 'Brown institution'), whose report has just been issued by the local government board. Four calves were inoculated with the matter from sores on the udders of the diseased cows, and similar sores were produced in them. Dr. Klein states that this disease, thus artificially produced in the calf, 'bears a close resemblance to human scarlatina,' and he specially quotes the appearances found in the kidney of the animal as indicative of the scarlatina attack. It is remarkable, however, that the milk of the affected cows is harmless, and does not contain, *per se*, the germs of the disease, but that it is contaminated after it has passed from the udder of the cow. Dr. Klein says that the fingers of the milker must of necessity bring down into the milk diseased particles from the ulcerations on the teats of the animal, and he points out that in the milk 'the disease germs find a good medium in which to multiply.'

As the last important act of his present official existence, Mr. Mundella, the president of the board of trade, has just announced that a 'Fishery department' is to be forthwith created, with an assistant secretary of state at its head. Mr. Berrington, who is to be the chief inspector, will be recognized as the right man in the right place, since he has already won his spurs as the successor in that post of Professor Huxley. The new department promises to be strong in practical knowledge.

The latest large engineering scheme which has been broached is that for a tunnel between Scotland and Ireland, at two points (Port Patrick and Donaghadee) where the distance from land to land does not exceed twenty miles. A shaft is to be sunk at once to test the strata. The cost of the tunnel has been estimated by competent authorities at $25,000,000, and that of the land approaches on either side, $5,000,000 more. The distance from Moville, in Lough Foyle (where the Allan line steamers now call), to London will be four hundred and fifty miles, or eleven hours' rail. No American lines would land mails and passengers at Queenstown, when they could be delivered by the new route much earlier in Scotland, Lancashire, and London.

It is on many accounts to be regretted that the necessary capital for the Manchester ship-canal has not been subscribed within the time-limit allowed by the act of parliament authorizing its construction. Another opportunity will be afforded next year. It is to be 35 miles long, and a contract for its construction had been taken for $28,750,000. The depth is to be 26 feet, and the bottom width 120 feet. There will therefore be ample room for the largest ocean steamers to pass each other, and such delays as on the Suez canal cannot take place. The 60 feet difference of level between the two ends will be surmounted by four sets of locks. It is estimated that the labor of 20,000 men will be required for four years to complete it.

Science will be represented in the new house of commons by Sir John Lubbock, Sir Henry Roscoe, Mr. Nevil Story Maskelyne, and Sir Lyon Playfair, who, now that he is released from the cares of office by the resignation of the Gladstone ministry, is intending to make his usual autumnal visit to the United States with Lady Playfair.

The following telegram from Paris on electrical transmission of force, appeared in the *Times* of July 26 : —

"During the last ten years M. Marcel Deprez has been engaged in experiments connected with the transmission of force by means of electricity. The Rothschilds some time since provided him with an unlimited credit to prosecute his researches at Creil, under the inspection of a commission of thirty-eight men of science. On Friday the commission met to hear a report on the results at present obtained, drawn up at their request by M. Maurice Lévy. This report was unanimously approved. It appears from it that we can now, with only one generator and only one receptor, transport to a distance of about 35 miles a force capable of being used for industrial purposes of 52-horse power, with a yield of 45 per cent, without exceeding a current of 10 ampères. When the amount of force absorbed by the apparatus used to facilitate the recent experiment, but not required in the applications to industrial purposes, is added, the yield will be nearly 50 per cent.

"The commission certifies that the machines now work regularly and continuously. The maximum electro-motive force is 6,290 volts. Before the construction of the Marcel Deprez apparatus the maximum force did not exceed 2,000 volts. The report states that this high tension does not give rise to any danger, and that no accident has occurred during the past six months. The commission is of opinion that the transmitting wire may be left uncovered on poles, provided it be placed beyond the reach of the hand. It estimates at nearly £5,000 the probable cost of the transmission of 50-horse power round a circular line of about 70 miles. This price would, however, be much diminished if the machines were frequently constructed.

"The commission, in the name of science and industry, warmly congratulated M. Deprez on the admirable results which he had obtained, and expressed thanks to the Rothschilds for the generous aid extended to the undertaking."

In connection with this, attention may well be drawn to an admirable little book on this whole subject of the electrical transmission and distribution of power, just published, from the pen of Mr. Gisbert Kapp, in Whitaker's 'specialist' series. It contains a clear and concise summary of principles, and a detailed account of what has actually been accomplished.

The forest fires which have been desolating an important section of Algeria seem at last to have burnt out. During the Roman occupation, Tunis probably contained twenty millions of people; now the most favorable estimates do not place the population at more than one million and a half. At one time the regions at present so barren were wealthy with crops, as shown, for example, by the frequent ruins of Roman oil mills. In those days the country was covered with luxuriant forests. In Bruce's day, one hundred and twenty years ago, allusion is made to forests where now not a single tree is visible. Yet the soil is still there, only waiting to be stirred into life by rain. Every country off which timber has been cut or burnt without discretion is feeling more or less the same inconvenience. Let the United States and Canada take warning!

The institute of naval architects is now holding its summer session at Liverpool, under the presidency of the Earl of Ravensworth. Chief-engineer Parker, surveyor to Lloyds, read a paper on the progress and development of marine engineering, in which he illustrated by tables and diagrams the improvements effected during the past few years. Mr. William John, the manager of the Barrow ship-building company, then read a paper upon 'The construction of Atlantic passenger steamers,' in which he pointed out that none of the English transatlantic liners had yet been fitted with the latest modern improvements for economy of fuel or quick combustion, such as triple-expansion engines or forced draught, which some of the heaviest subsidized French and German transatlantic steamers possessed. He argued strongly in favor of twin-screw propulsion, on which point the discussion that followed mainly turned. The views of the author were strongly supported by Mr. H. White, chief constructor to the navy, who stated that in 1878, on the basis of admiralty data, he had said every thing in favor of twin screws that Mr. John had stated in his paper. W.

London, July 31.

NOTES AND NEWS.

It may interest our readers to see the following table of percentages on which some comments are offered in another part of the paper. These percentages represent the proportion of members from the region designated to the total membership registered (exclusive of Europeans) at the meetings of the American association for the advancement of science during the last ten years.

	Canada.	North-eastern states.				Other northern states. East of Missis-sippi.		Other northern states. West of Missis-sippi.		Southern states.
	Montreal, 1882.	Buffalo, 1876.	Saratoga, 1879.	Boston, 1880.	Ph'delphia, 1884.	Cincinnati, 1881.	Ann Arbor, 1885.	St. Louis, 1878.	Min'apolis, 1883.	Nashville, 1877.
Canada........	14	3	3	2	3	1	2	1	2	0
N.-east. states.	65	68	80	84	73	29	37	35	33	24
Other north'n states. East of Mis.riv.	14	19	8	7	12	54	49	19	47	13
Other north'n states. West of Mis.riv.	3	4	3	4	5	5	5	31	15	5
South'n states.	3	5	5	3	8	10	7	12	4	57
Total att'd'ce exl. Europeans	918	199	258	979	978	542	364	132	328	166

— At the Buffalo meeting of the American association it is proposed to devote especial attention to the study and discussion of the interesting phenomena of the Niagara Falls and the gorge below. On Friday, August 20, one or more preliminary papers of an expository and suggestive nature will be given, intended to prepare the way for a short field-study of the falls and the gorge, which will occupy Saturday. Monday forenoon will be devoted to the discussion of the gorge and the problems to which it gives rise. A new survey of the falls has been arranged for, so that a considerable addition to the data for the computation of the rate of recession will be at command, and it is expected that new observations in other important lines bearing upon the chronology of the gorge will be presented, and will throw fresh light upon the history of the formation and recession of the falls and upon the utility or untrustworthiness of the gorge as a geological meassure of time.

— Among the few local scientific societies of the United States, the Wyoming (Penn.) historical and geological society is especially to be commended for its activity. The second volume of its Proceedings, just published, contains, among other historical papers, several of interest on the local geology of the Wyoming valley. It would seem that the scope of the society might very profitably be widened so as to include other fields of scientific research in natural history.

— The 'Third annual report of the Wisconsin experiment station' deals with a variety of subjects, chiefly the results of experiments on crops, feeding, the composition of food-stuffs, fertilizers, etc., by Professors Henry and Armsby, together with more strictly botanical papers by Professors Trelease and Seymour.

—The 'Report of the life-saving service for 1885' presents not a few facts of interest deserving attention. One can only rightly appreciate the great importance that this branch of the public service has attained by the examination of the results as given for the past year in this report. The entire number of stations in operation was 203, of which 157 are on the Atlantic coast, 38 on the lakes, and seven on the Pacific coast, with one on the Ohio River at Louisville, Ky. The entire expense for the support of these stations during the year was less than $800,000, — not one-fourth as much as the value of the actual property saved. According to the report, there were 256 disasters to documented vessels during the year within the field of station operations. There were on board these vessels 2,206 persons, of whom 2,196 were saved, and only 10 lost. The estimated value of the vessels was $3,519,550, and that of their cargoes, $1,084,905, making the total value of property involved $4,604,455. Of this amount, $3,352,-760 was saved, and $1,251,695 lost. The number of disasters involving the total loss of the vessels was 56. Besides the foregoing, there were 115 disasters to smaller crafts, from which 231 persons were saved, with the loss of only one life. The total loss of life was the smallest ever reached by the service, except in the year 1880, when but nine persons were lost. During the fourteen years' existence of the present service the total value of property saved has amounted to over $35,000,000, and there have been over 25,000 persons saved, with only 457 lost out of all those endangered. These figures seem almost incredible, and speak volumes for the efficiency of the service, reflecting the greatest credit, not only upon the superintendents and directors, but upon the keepers and crews of all the stations as well.

— Mr. W. M. Davis has recently given in the *American meteorological journal* an account of the derivation of the term 'trade-wind.' The original meaning of the word 'trade' has been so far replaced by an acquired meaning, that a popular error has arisen as to the derivation of the common term, 'trade-wind.' Webster's dictionary says the trade-wind is "so called because of great advantage to navigators, and hence to trade." Worcester's dictionary explains it as "so called because favorable to commerce." But looking further back, the following extract from Skeat's etymological dictionary is instructive: "Trade-wind, a wind blowing in a constant direction, formed from the phrase, 'to blow trade,' to blow always in the same course." A step further discovers that trade is "properly that path which we 'tread.' . . . It once meant, literally, a 'path.' . . . The M. E. [Middle English] words are 'tred' and 'trod,' both in the sense of foot-mark. All from the A. S. [Anglo-Saxon] 'tredan,' to tread." The following extracts show the early use of the term, two or three centuries ago, by the navigators of that time: Hakluyt wrote, "The wind blowing trade, without an inch of sail, we spooned before the sea" ('Voyages,' iii. 849, published in 1600). Dampier said, "Trade-winds are such as do blow constantly from one point or quarter of the compass. There are divers sorts of these winds; some blowing from east to west, some from south to north, others from west to east, etc. Some are constant in one quarter all the year; some blow one-half the year one way, and the other six months quite contrary; and others blow six months one way, and then shifting only eight or ten points, continue six months more, and then return again to their former stations, as all these shifting trade-winds do" (Discourse of the trade-winds, in his 'Voyages and descriptions,' London, 1705, vol. ii. part iii. pp. 1, 2).

— The 'Fourth annual report of the U. S. entomological commission,' after much seemingly unnecessary delay on the part of the public printer, has recently appeared, and forms a worthy addition to the preceding volumes. It deals chiefly with the cotton-worm, with a chapter on the boll-worm — two of the most injurious insect pests that the south, at least, has to combat. The subjects are treated fully, and a large share of attention is devoted to the consideration of insecticides and insecticide apparatus, fully justified by the importance of the subject. The losses of crops in some places in the south during different years from the depredations of the cotton-worm or larva of the cotton-moth (Aletia), are very heavy, the total estimated loss for a single year of severe depredation throughout the southern states being as high as thirty million dollars, while the average annual loss for the fourteen years following the war is placed at fifteen million dollars. The chief objects of such entomological investigations are, of course, the discovery or improvement of remedies and of their methods of application, the results of which, both positive and negative, in this case indicate that arsenical compounds and pyrethrum, both first suggested by Dr. Riley, are the most efficacious. The boll-worm (Heliothis), on account of its wide distribution both north and south, and the almost indifference in the choice of its food-plants (or food-habits, for it is omnivorous, carnivorous, and cannabalistic), is but little less injurious a pest. The northern agriculturist, or even the northern housewife, is only too familiar with it for its injuries to growing corn in the ear. Their depredations are within the boll or pod of the cotton, and often render whole fields valueless. Aside from the more practical nature of the work accomplished, chiefly by or under the direction of Professor Riley, the report contains considerable matter of more strictly scientific interest on the habits, etc., of different insects, including a chapter on the anatomy of Aletia by Dr. Minot and Mr. Burgess.

— The Prince of Monaco sailed from the military port of Lorient July 14, in company with Professor Ponchet, to pursue a series of observations on the Gulf Stream. He carried with him five hundred floats, so constructed as to be affected by naught save the currents, to be placed in the water near the twentieth degree of west longitude, between the latitude of Cape Finisterre and that of the south of England. In addition, he has fitted out with the necessary appliances for deep-sea and surface zoölogical collecting, which will be pursued during the voyage.

— A marked improvement in the criminality of Spain has been apparent during the last few decades. In 1843, with a population of twelve million, there were 17,683 crimes against the person, and 10,425 against property; while in 1884, with a population of seventeen million, the numbers had decreased to 9,187 and 9,599 respectively. These figures are, however, yet very high in comparison with those of France. Thus, during 1883 there were 1,457 homicides or assassinations in Spain against only seven hundred in France, with more than double the population. Infanticides, however, are proportionally less common. It is a noteworthy fact that the professional criminal is not nearly so common in Spain as in France.

— The Entomological society of Washington, founded but two years ago, has given an evidence of its activity by the publication of the first part of its first volume of proceedings. There can hardly be any place in the United States so favorably located as Washington for an active entomological society, and the list of well-known entomologists enrolled as members is an assurance that much can, and we believe will be, accomplished by the society.

— Statistics from a German periodical give a very unfavorable showing of the crowded condition of Berlin. Of the forty thousand houses contained in the city, one half have from twenty to thirty tenements each, while in another thousand or more there are a still greater number of tenements. Among these apartment or tenements there are seventy-five thousand consisting of a single room, inhabited by two hundred and seventy thousand people, or an average of about four to each room. The apartments divided into two rooms also number about seventy-five thousand, occupied by three hundred and sixty thousand persons. The houses in the poorer quarter are five or six stories high, and built so close to each other that there is insufficient light and air. Filth and repulsive odors are the inevitable result. The promiscuous crowding into single rooms of adults and young of both sexes, naturally results in debased morals, and the city is renowned for the extravagant number of juvenile criminals who prowl around the streets. The death-rate of Berlin is one of the highest among the large cities of Europe.

— The *Neurological review* (Chicago, *Rand, McNally & Co.*) is the title of a new monthly to be devoted to original articles, as well as a review of the recent literature in this field of medical and psychological science. The largely increased number of periodicals devoted to these and allied subjects of late, is a strong evidence of the greatly increased activity in researches pertaining to the mental and nervous functions in America as well as in Europe. The present review appears to be well edited by Dr. J. S. Jewell.

— 'Lanolin' is the name given to a substance which is being extensively recommended as a basis for ointments. It possesses properties which are not found in any other variety of fat. In 1868 Hartman and Schultze found that the fatty acids of sheep's wool were in combination with cholesterine. Such a fat will take up one hundred per cent of water, and will not readily decompose. Ordinarily the neutral glycerine fats and vaseline have been used as the bases of ointments. Fatty ointments by their decomposition form irritating substances, and thus tend to injure the skin. Vaseline is not readily absorbed. Lanolin appears to be free from both these objections, and will doubtless come into general use.

— Dr. Wooster Beach, in the *Medical record* for July 24, discusses the proper mode of infliction of the death penalty. He states that the autopsies of those who have been hung show that in not over five per cent is either dislocation, fracture, or any injury to the spinal cord observed. He thinks that any of the following methods could, with advantage, be substituted for hanging. The condemned man should be firmly secured, and a vital part should be struck by a ball from a rifle which had previously been sighted and secured fast; or electricity might be employed. The recent improvements in the apparatus for generating electricity make this method of causing death much surer than it formerly would have been. Dr. W. A. Hammond thinks that the usual apparatus of traps and weights should be dispensed with, and that the body of the criminal should be drawn up slowly by a rope around his neck. Death would be speedy, certain, and painless. Dr. N. E. Brill criticised, some months ago, the present methods of hanging, and as a result a committee of the Society of medical jurisprudence of New York drew up a bill and submitted it to the legislature, in which the condemned was permitted to select the method by which his life should be taken. This bill failed of passage. In Germany decapitation is done with the sword, in France with the guillotine, and in Spain by the garotte. Poisoning by carbonic-acid gas, chloroform, and hydrocyanic acid has also been suggested as substitutes for hanging.

— A study of ten thousand physicians' prescriptions has recently been made by the editor of the *Chemist and druggist*. Spirits of chloroform, glycerine, and sirup of orange-peel, are the most frequently prescribed; then come bromide of potash, wine of ipecac, sulphate of quinine, bicarbonate of soda, liquor ammoniae acetatis, bicarbonate of potash, and sweet spirits of nitre.

— The commercial exportations of France during the year 1884, we learn from the *Revue scientifique*, amounted in total value to $843,400,000, an increase of only about $65,000 over that of 1869. The largest exportations during this time were in the years 1873, 1875, and 1882, when they were more than $100,000,000 greater. Of the exportation in 1884, about $200,000,000 went to England, $83,000,000 to the United States, $103,000,000 to Belgium, $75,000,000 to Germany,

$61,000,000 to Switzerland, etc. The exportation to the United States has increased $105,000,000 since 1869, though in 1872 it was somewhat greater, and in 1882 reached a total value of $107,000,000.

— Professor Forbes publishes in the 'Bulletin of the Illinois state laboratory of natural history,' vol. ii. pp. 257 – 321, an account of the continuation of the interesting studies on the contagious diseases of insects begun by him in 1883. In this account he describes at length a common and highly destructive disease of the European cabbage-worm (Pieris rapae). This disease he believes to be caused by a spherical micrococcus, of which he gives two excellent microphotographs. More complete and conclusive studies were made of a disease of the silkworm, which was apparently that known as jaundice. Of especial interest is the fact that he was able to produce this disease in cabbage-worms by moistening their food with culture-fluids containing the bacteria of this disease derived from silkworms. These experiments seem to us to be of the highest importance. If this or some other bacterium could be used against the cotton-worm, how much more effectual it might be than the poisons which are now used! These are liable to be washed away by the first rain, and will not multiply themselves. Professor Forbes also reports at length on a disease attacking two species of datana in his breeding-cages. This disease he is positive is the well-known *flacherie* of the silkworm.

— One of the most interesting special reports issued in connection with the last census is part i. of the report on 'Social statistics of cities,' by Col. George E. Waring, jun., the sanitary expert, which is now going through the press, and will be ready to be issued Sept. 1. The subject-matter of this volume is confined to the statistics of certain cities in New England and the middle states; and the second part, which is still to appear, will be devoted to the cities in the southern and western states. The method pursued is to give a historical sketch of the town, which is followed by a description of the climate, the drainage, the financial condition, the gas supply, interments, manufactures, parks, reformatories and healing institutions, police, places of amusement, population, public buildings, streets, water-works, and, in fact, complete statistics of the social life in the places described. In many instances, maps are given showing the system of sewerage, the location of places of amusement, parks, libraries, and museums. The sketches of the cities of Boston, New York, and Philadelphia are very elaborate, especially in relation to the subject of sanitary drainage. The second volume will contain a sketch of New Orleans, furnished by Mr. George W. Cable, the novelist. The report complete will contain about 2000 pages.

—The Ophthalmological society of Heidelberg has awarded Professor Helmholtz a gold Graefe medal and the sum of fifty dollars yearly, as the greatest benefiter of science.

— The Commissioner of agriculture has prepared a circular containing rules and regulations for co-operation between the department of agriculture and the authorities of the several states and territories, for the suppression and extirpation of contagious pleuro-pneumonia of cattle. It will be remembered that congress appropriated $100,000, at its last session, to be employed in such manner as the commissioner may think best, to prevent the spread of pleuro-pneumonia.

— The following changes have been made in the personnel of the coast survey since our last issue: Assistants Boyd, Bradford, and Ellicott have been instructed to organize a party to perform field-work on the coast of Maine, and to survey the topography of the north-eastern corner of the state. The steamer Bache, Lieutenant Hawley commanding, is doing the hydrographic work; Messrs. Vinall, Hodgkins, Van Orden, and Gray have taken the field on the re-survey of Long Island Sound; Mr. E. L. Taney, with a topographical party, is at work on the Kill von Kull; Captain C. O. Boutelle is organizing the parties for furnishing points for state surveys. The appropriations for this purpose this year being so limited, only four parties can be put in the field. The constitution of a permanent tide station on Sandy Hook has begun, and will be finished in about two months. It is hoped when this gauge is finished that an uninterrupted series, both winter and summer, extending over a period of 19 years, will be obtained.

— The number of deaths from yellow-fever in Rio de Janeiro for the fifteen years preceding the last was 15,338. The fever first appeared in 1849, and has been continuous since, though much more severe at times. In 1850 the number of deaths of cases treated in the hospitals was twenty-six per cent, in 1870, seventeen per cent, and in 1883, thirty per cent.

— New discoveries of gold in West Australia, where it has hitherto not been known to exist, are causing considerable excitement in that part of the continent. The locality is in the north-western part, four hundred miles from King Sound, in a wild, desolated, and almost impassable region. The gold is found near the surface in alluvium.

— The 'Pacific coast tide tables' for 1887 have been received from the printer by the coast survey. It is a curious fact that these are the most perfect ever yet received, and close examination thus far reveals not a single error or misprint in the entire edition. The 'Atlantic coast tide tables' will be given to the public in about a week. Section xvi. of the topographical survey of the District of Columbia is in the hands of the photo-lithographer. This beautiful sheet covers the country in the vicinity of the picturesque village of Tenallytown, near which the summer house of President Cleveland is located. The chart of Puget Sound, the Gulf of Georgia, Straits of Fuca, etc., in one sheet, will probably be placed in the hands of agents within two weeks. This chart will supply a long felt want to the people of Washington Territory, covering, as it does, all the inland waters from Gray's Harbor, on the Pacific coast, to the Nanaimo coal fields, in British Columbia. Assistant Schott is well advanced with the computation of magnetic observations of the Greely party in the Arctic regions; the computations of Arctic tides from observations made by the same explorer are also well under way.

— The annual exportation of ivory from Africa has of late years been nearly four hundred thousand pounds, about two-thirds of which is obtained from the eastern part of the continent. These figures represent a sum of about four million dollars, and the death of sixty-five thousand elephants.

— The fiftieth anniversary of the founding of South Australia in December, 1836, will be celebrated by an international exposition to be opened on the twentieth of June next at Adelaide. The population of the colony now numbers three hundred and thirteen thousand, but at present it is decreasing rather than increasing.

— Computations from statistics show about one million as the number of blind persons throughout the world, which, estimating the population of the globe at 1,400,000,000, gives about one blind person to every fourteen hundred. In Austria there is one to every 1,785 inhabitants; in Sweden, one to every 1,418; in France one to every 1,191; in Prussia, one to every 1,111; in England, one to every 1,037, etc. The greatest proportion of blind persons is in Egypt, where, in Cairo, there is one among every twenty inhabitants. Australia shows the greatest variation; in New Zealand there is only one to every 3,550 inhabitants, while in Tasmania there is one to every 625. The nation possessing the greatest number of institutes for the blind is Germany with thirty-five; next comes England with sixteen; France with thirteen; Austria-Hungary with ten; Italy with nine; Belgium with six; while according to our authority, the *Deutsche rundschau für geographie und statistik*, America, Asia, and Africa together possess only six. There are two in Australia.

— There are twenty-one cities in the German empire containing each more than one hundred thousand inhabitants.

— The population of New South Wales, according to the census recently taken, is very nearly one million, which is of interest as showing the very rapid growth, forty per cent increase, during the last ten years.

— According to Dr. Tipton of Alabama, in the *Medical journal*, the negroes before the war in the south never had phthisis, but now it is the greatest scourge among them. He also says that the negro is rarely if ever near-sighted.

LETTERS TO THE EDITOR.

⁂Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

The source of the Mississippi.

IN June, 1884, the *New York Herald* announced that recent explorations had revealed the true source of the Mississippi River to be, not the lake discovered by Schoolcraft in 1832 and named by him Itasca, but a tributary lake to the south of it, discovered and first explored by a Capt. Willard Glazier in 1881.

In commenting upon this alleged discovery, *Science* says (May 15, 1885): "To this lake he (Glazier) gives his own name, that the fame of his achievement may be perpetuated. It is perhaps unfortunate that, as this whole region was sectionized by the general land office several years previously, lines having been run at every mile, a prior claim to this great discovery may arise."

This comment was thought to be sufficient to impress upon all the absurdity of a claim to have discovered, at this late day, a lake of any considerable size in the region referred to; but as one of our popular school geographies[1] has indorsed the genuineness of this discovery (?) by adopting 'Glazier Lake' as the source of the Mississippi, and as the makers of our school geographies have a bad habit of blindly following each other's lead, it will be well, perhaps, to examine a little more closely Mr. Glazier's claim to such recognition.

In 1806 Lieut. Zebulon Pike, and in 1820 Governor Lewis Cass, penetrated to Red Cedar or Cass Lake: but there is no record of definite explorations beyond this lake earlier than those of Henry R. Schoolcraft, who in 1832, under authority of the war department, led a well-equipped expedition through this region. In his brief official report, dated at Sault Ste. Marie, Sept. 1, 1832, Schoolcraft states that Lieutenant Allen accompanied him as topographer, and that he carefully collected material for maps and plans of the entire route. Upon his return to Detroit, Schoolcraft wrote, in 1833, a full narrative of the expedi-

[1] '*Barnes's complete geography*'. By JAMES MONTEITH. New York and Chicago, *A. S. Barnes & Co.* Copyright 1885.

tion, which was published by Harpers in 1834, and is accompanied by a map of the region, compiled by Lieutenant Allen. A reduced fac-simile of a portion of this map is here reproduced. From Lac

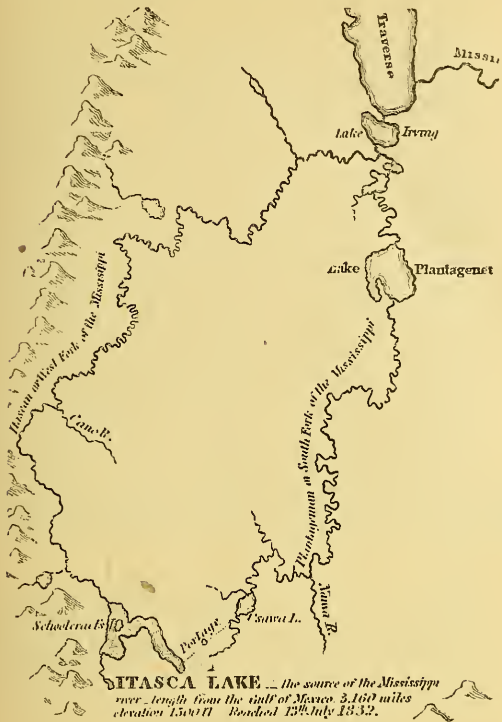


Fig. 1. — Schoolcraft's map. — 1832.

Travers (Bunidji Lake) the expedition ascended the Plantagenian Fork, 'carried' over a six-mile portage to Lake Owashkos (Elk), which Schoolcraft named *Itasca*, and descended the Itascan Fork, having spent three days in making the circuit.

That Schoolcraft knew of an inlet to Lake Itasca is evident from his map, on which an inlet leading from a smaller lake to the south is indicated, but in addition to this he says on p. 58 of his 'Narrative:' "The outlet of Itasca Lake is perhaps ten to twelve feet broad, with an apparent depth of twelve to eighteen inches. The discharge of water appears to be copious, *compared to its inlet*."

It may be asserted that Schoolcraft knew of an inlet only from visiting its mouth, but that he neglected to ascend and explore it, and that his knowledge of the existence of the small lake from which it leads was gathered from his Indian guide—or was entirely hypothetical. Although this is unlikely, owing to the object of the expedition and to the fact that the map does not show other and larger lakes which were not visited, still, as no mention of this small lake is made in the narrative, let this view of the case be conceded, and let us pass to the next explorer.

Four years later, in 1836, Mr. J. N. Nicollet visited and made an instrumental exploration of this region. The results of his explorations he incorporated in a report and map published by the U. S. bureau of topographical engineers, as 'Senate document No. 237, 26th congress, 2nd session, 1843.' A reduced fac-simile of a portion of this map is here reproduced.

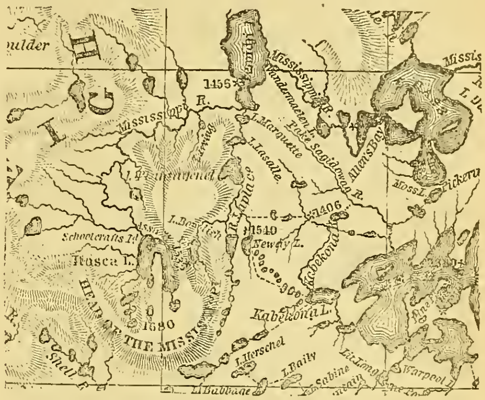


Fig. 2. — Nicollet's map. — 1843.

From his report we learn that Nicollet approached Itasca via Leech Lake and Kabekona lake and river; his route joining Schoolcraft's near the mouth of the Naiwa River — on the Plantagenian Fork, which Nicollet named La Place River. Arrived at Itasca, his report proceeds (pp. 57-59): "The Mississippi holds its own from its very origin; for it is not necessary to suppose . . . that Lake Itasca may be supplied with invisible sources. . . . There are five creeks that fall into it, formed by innumerable streamlets oozing from the clay beds at the bases of the hills . . . known here by the name of 'heights of land.' South of Lake Itasca, they (the heights of land) form a semicircular region with a boggy bottom, extending to the south-west a distance of several miles. . . . The waters supplied by the north flank of these heights of land . . . give origin to the five creeks of which I have spoken above. These are the waters which I consider to be the utmost sources of the Mississippi.

"Now, of the five creeks that empty into Itasca Lake, . . . one empties into the east bay of the lake, the four others into the west bay. I *visited the whole of them*; and among the latter there is one remarkable above the others, inasmuch as its course is longer, and its waters more abundant; so that, in obedience to the geographical rule 'that the sources of a river are those which are most distant from its mouth,' this creek is truly the infant Mississippi. . . . The day on which I explored this principal creek (August 29th, 1836) I judged that, at its entrance into Itasca Lake, its bed was from 15 to 20 feet wide, and the depth of water from 2 to 3 feet. . . . As a further description of these head-waters, I may add that they unite at a small distance from the hills wherein they originate, and form a small lake from which the Mississippi flows with a breadth of a foot and a half and a depth of one foot. At no great distance, however, this rivulet . . . supplies a second minor lake. . . . From this lake issues a rivulet . . . into the basin of a third lake somewhat larger than the two preceding. Having here acquired renewed vigor, and tried its consequence upon an additional length of two or three miles, it finally empties into Lake Itasca. . . . After having devoted three days to an exploration of the sources of the Mississippi, and spent portions of the nights in making astronomical observations, I took leave of Itasca Lake, to the examination of which the expedition that preceded me by four years had devoted but a short time. . . .

"The honor of having first explored the sources of the Mississippi and of introducing a knowledge of them into physical geography, belongs to Mr. Schoolcraft and Lieutenant Allen. I come only after these gentlemen; but I may be permitted to claim some merit for having completed what was wanting for a full geographical account of these sources. Moreover, I am, I believe, the first traveller who has carried with him astronomical instruments, and put them to profitable account along the whole course of the Mississippi from its mouth to its sources."

In the table on pp. 124 and 125 are to be found Nicollet's determination of the geodetic position and elevation of this region — among others Lake Itasca (Schoolcraft's Island) 47° 13′ 35″ north latitude, 95° 2′ west longitude, and 1,575 feet above the Gulf of Mexico — and the "utmost sources of the Mississippi, at the summit of the height of land, six miles south of Lake Itasca — elevation 1,680 feet above the Gulf."

Nicollet, therefore, fully explored, recorded, and mapped all the inlets to Lake Itasca, found that these inlets, or some of them, came from lakes or lakelets; and, recognizing that the source of a river is the one most distant from its mouth, considered none of the tributary lakelets he had explored as sufficiently important to even merit a name. In addition to this he distinctly states that "the honor of first exploring the sources of the Mississippi belongs to Messrs. Schoolcraft and Allen."

But it may be urged, that opinions may differ as to the relative importance of the Itascan lakes; that the smaller tributary lake, though discovered and explored in 1836, was not then named; and as it is nearer than Lake Itasca to the ultimate head spring of the Mississippi, it was fair game for the traveller who should reach it and affix a name to it. This,

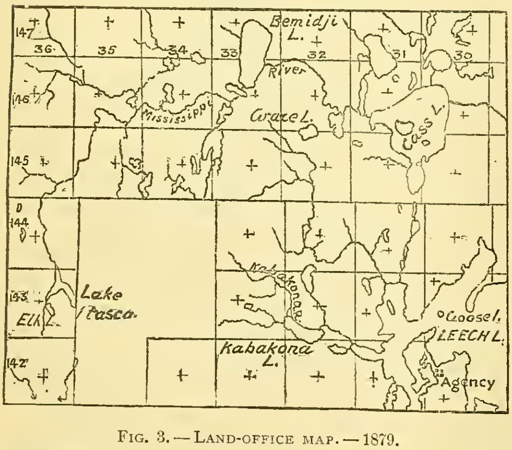


FIG. 3. — LAND-OFFICE MAP. — 1879.

though again an extreme view, may be again conceded.

I am unable to give the exact date at which the township including the immediate vicinage of Lake Itasca was surveyed and subdivided into one-mile sections; but it is marked, by the little cross, as having been so subdivided, on the land office map of Minnesota, issued in 1879 — or two years before Mr. Glazier's trip. A tracing from this map is reproduced here, and on it is shown not only a small lake south of and tributary to Lake Itasca, but a name, 'Elk Lake,' is affixed to this lake. Probably the surveyors in sectionizing this region, remembering the old Indian name, 'Owoshkos,' of the lake which Schoolcraft called Itasca, thought to preserve it by affixing its English equivalent to the small tributary lake to the south. A further inspection of the land-office map proves the integrity of its makers. East of Lake Itasca is an area not crossed by township lines; it had not been surveyed by the land-office at the time this map was made, and consequently all topographical features, streams, and lakes, were omitted. Thus only part of the east, or Plantagenian, branch of the Mississippi is shown, though the existence and course of the river was well known: and on other government maps, as, for instance, the post route maps for 1876 — the whole course of this branch is indicated. And now, having seen that the small lake south of and tributary to Lake Itasca was mapped by Schoolcraft in 1832; fully explored and mapped by Nicollet in 1836; and surveyed, mapped, and named by the land office prior to 1879 — what remains to justify Mr. Glazier's claim to discovery in 1881?

His own detailed account of his trip entitled the 'Recent discovery of the true source of the Mississippi, By Captain Willard Glazier,' was published in vol. 1 of the *American meteorological journal* (Detroit, 1884), and was illustrated by a map of the region 'drawn from delineations by his Indian guide.' A

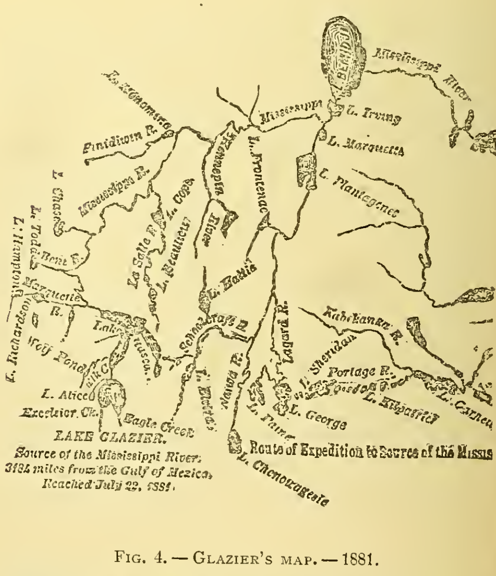


FIG. 4. — GLAZIER'S MAP. — 1881.

portion of this map is here reproduced for comparison with the others.

Certain passages of Glazier's account reveal a striking similarity in observation, incident, and phraseology when placed in parallel columns and compared with passages from Schoolcraft's 'Narrative' (editions of 1834 and 1855):

Schoolcraft, 1832.	*Glazier*, 1881.
Naiwa River.	Naiwa River.
(p. 238.) "On questioning Ozawindeb (the guide) of the Naiwa River, he informed me that . . . it originated in a lake . . . infested with the copperhead snake; hence the name."	(p. 258.) "Che-no-wa-ge-sic explained that Naiwa was a stream . . . having its origin in a lake . . . infested with snakes, to which its name has refereuce."
Assawa Lake	Assawa Lake (Elvira).
(p. 239.) "We were just twenty minutes in passing through it. . . . our course . . . was directly south. Ozawindeb entered an inlet, but had not ascended it far when he rested on his paddles and exclaimed 'Oomahmekunnah,' here is the path, or portage. . . . The water was tepid. After wading about fifty yards the footing became more firm, and we soon began to ascend a slight elevation . . . where vestiges of the bones of birds and old camp poles indicated the prior encampment of Indians. The next morning a dense fog prevailed....It was five o'clock before we could proceed."	(p. 259.) "We were twenty minutes in passing through the lake. On reaching its southern end we entered one of the brooks. . . . Che-no-wa-ge-sic soon pushed his canoe into the rushes and exclaimed 'Oma-mikunna,' here is the portage. We stepped into rather warm pond water ... After wading about a hundred yards or more the soil became firm, and we began to ascend a slight elevation ... Remains of former fires, the bones of birds, and scattered camp poles proved it to be a spot which had previously been occupied by the Indians. . . . A dense fog . . . prevented our getting upon the trail until seven o'clock in the morning."
Lake Itasca	Lake Glazier (!)
(p. 241.) "Soon out went him on the trail, and got the first glimpse of the glittering nymph we had been pursuing."	(p. 265.) "In their eagerness to get a first glimpse of the glittering nymph we had been pursuing."

Glazier states (p. 327) that Lake Glazier is in latitude 47° 13′ 25″ north; is 1,578 feet above sea level; and distant from the sea 3,184 miles. Schoolcraft states in his first edition (1834, p. 58) that Lake Itasca is 3,160 miles from the sea, and in his revised edition (1855, pp. 243 and 245) he inserts Nicollet's determinations of its latitude, 47° 13′ 35″ North, and its elevation, 1,575 feet. With the exception of the figures, Glazier's language is word for word that of Schoolcraft.

On p. 328 of Glazier's account is found an *addendum* entitled 'Meteorological observations at the head-waters of the Mississippi,' consisting of a record of daily temperature from July 17 to Aug. 2 (July 17 is the date at which Glazier says, p. 252, he started from Leech Lake). Now reference to p. 423 of Schoolcraft's 'Narrative' (edition of 1855) reveals the fact that this meteorological table is an exact copy, word for word and figure for figure, of observations taken between the days named, in the year 1820, by Schoolcraft in the vicinity of Cass Lake!

This liberal use of the statistical information gathered by others; i.e., a subtraction of ten seconds from Nicollet's observation of the latitude, and an addition of three feet to his barometrical determination of the elevation of Lake Itasca; and the exact copy of Schoolcraft's meteorological observations at Cass Lake, — afford strong evidence, in the absence of any direct statement to the contrary, that Mr. Glazier took no scientific instruments with him, such as thermometer, barometer, and sextant or solar-compass, and that he simply made a guess at the latitude and elevation of the lake with which he desires to associate his name. That his guess was a grossly inaccurate one is curiously proved by his own account. He says (p. 262): "Itasca is . . . between five and six miles in length, and from one-fourth to three-fourths of a mile in width. It has three arms, — one to the south-east, three miles long; one extending south-west from the island; and one reaching northwards to the outlet, two and one-half miles."

Now Nicollet's determination of the latitude of Itasca is of *the island* in the lake (Schoolcraft's Island), and is 47° 13′ 35″; while Glazier says (p. 327) that Glazier Lake (exact locality not noted) is in latitude 47° 13′ 25″, or just ten seconds of arc south of Schoolcraft's Island. The degree of latitude between 46° 30′ and 47° 30′ is 69.079 miles long (Coast survey report, 1884). As ten seconds is $\frac{1}{360}$th part of this distance, or 1,013$\frac{1}{4}$ feet, the position of Glazier Lake, as given by Mr. Glazier, is actually *within* Lake Itasca.

Russell Hinman.

Copper River, Alaska, glacial action.

For the study of the action of water in its relation to geological changes, American students have always found an ample field at home; not so, however, with respect to glacial action, for we find our most exhaustive treatise on this subject (Shaler's) confined almost exclusively to the Alps glaciers. Let specialists in the future seek fields in our own province, where the system is probably more extensive than in any other country south of the arctic circle. I refer to that portion of the territory from Chilcat inlet up to Cook's inlet, and in especial to that portion drained by the Copper River.

How far glacial action has been concerned in tho determination of the topography will long be a subject for study.

My observations were such as to cause a belief in an ice sheet that one time extended from the Alaskan Mountains to the coast; as to how much farther from the north it came I have nothing to say. It may at first be considered at variance with the theory of contemporary upheaval of this part of the territory with the ranges of the western part of the United States. If the glacial period be considered long subsequent to the upheaval, there need be no difficulty in reconciling the above. It was the ice sea, which, by its steady motion to the south, has largely assisted in giving the country its present configuration.

From Yakutat Bay to the mouth of Copper River is an unbroken face of ice extending a distance of fifty miles. How far this reaches to the interior through the gorges of the coast is unknown, though it may be safe to consider the distance equal to that of the glaciers of Copper River from its mouth. These latter may be considered an extension of the ice fronting the coast, — including the above-mentioned fifty miles, — which has been cut through by the river. There is every reason to believe that Miles's and Child's glaciers were formerly one and the same, — an opinion that is in some way strengthened by the traditions of the natives. The most southerly point of the former on the left is one mile or less from the most northerly point of the latter on the right bank; while in the river bed between are well-worn bowlders eight to twelve feet in diameter.

Furthermore, on the left bank below Miles's glacier, and opposite Child's, is an enormous glacial drift now covered with vegetation. Where this is joined to Miles's it is impossible to distinguish the drift from the glacier.

The flow of these is now from east to west for those on the left bank, and from west to east for those on the right bank; yet this is not the general course the masses had when much larger than at present. They are at present but a residuum of the once extensive ice fields now discharging along the paths of least resistance. Had not the climate here been moist and in other respects favorable for glacier making, the present site would have been occupied by only drift or moraine. Farther north, above the Chittyná on the east bank of the Copper, are for many miles terraces large and small. The smaller ones are so regularly formed as to leave the impression that they were the fronts of old fortifications.

In Blake's 'Stickeen River,' he makes mention of the scarcity of well-defined terraces, while Dall also failed to observe any in the vicinity of Sitka and the Alaska Peninsula.

I can only account for the remarkable width of the bed of the Copper by the supposition that it was excavated by the power of gigantic ice masses assisted by the eroding effects of the torrent waters from them. The volume of water in proportion to the width of bed is less than in any river within my knowledge, yet the banks, as a rule, are high and rather steep. The sources of the Copper and its principal tributary, the Chittyná, are glaciers, though small in comparison with those above mentioned.

By an examination of the map it will be seen that the Alaskan Mountains form an arc convex to the northward; hence the lines of least resistance of ice masses in moving from these mountains to the southward, tended to intersect in the present Copper valley. The result was the enormous power producing the remarkable excavations cited above.

I earnestly hope that glacial action in this district will receive early attention at the hands of competent men. A simple inspection of the maps of Alaska, however deficient in detail they are, by a student of nature will show that this locality was the scene of most powerful action, the traces of which are correspondingly clearly preserved.

North of the Alaskan Mountains I failed to observe any of these remarkable glacial phenomena, though from reports of miners they may be found in the White River region.

HENRY T. ALLEN.

Fort Walla Walla, Washington Ter., Aug. 1.

The significance of coincident weather-conditions.

In your criticism (Aug. 6) upon my article entitled, 'The significance of coincident weather-conditions,' you intimate that I have not given proper heed to 'dissimilar weather.' It did not seem to me necessary to dwell at length upon that phase of the subject in order to make my meaning plain. But inasmuch as there seems to be an entire misunderstanding, I will now say that any theory that demands, for instance, that a typhoon shall occur in New York state is manifestly absurd. The influence of oceans, and continents, and of mountain ranges, and the like, must be taken into the account. In certain latitudes storms have a well-defined character at certain seasons of the year. Thus, dissimilarity of weather conditions in different localities is readily accounted for. There are times, however, when great storms occur almost simultaneously in every quarter of the globe. My point is that such an event affords an opportunity to test the theory that there is a direct relation of some sort between disturbances on the sun and storms on the earth. If this relation does exist, the sun should be disturbed in proportion to the magnitude of these exceptional atmospheric movements on the earth. That this was the case during the storms in May, the records of the condition of the sun then made will show (see *Nature* for July 22, p. 278). Also consult any records accessible in regard to the terrestrial and solar conditions existing on March 31, 1886. It would manifestly be unsafe to generalize on the basis of one or two such cases. But when numerous instances of this sort have been recorded, it would seem quite proper to call attention to the matter, as constituting one item of information in regard to a great and complex subject about which confessedly but little is known. In the words of my article, "the truth of the theory that the condition of the sun modifies the weather on the earth can be tested by considering the case of great storms that prevail widely."

M. A. VEEDER.

Lyons, N. Y., Aug. 7.

Poisoning by ice-cream.

No chemist certainly would suppose that the same poison exists in all samples of ice-cream which have produced untoward symptoms in man. Mineral poisons, copper, lead, arsenic, and mercury, have all been found in ice cream. In some instances these have been used with criminal intent. In other cases their presence has been accidental. Likewise, that vanilla is sometimes the bearer, at least, of the poison, is well known to all chemists. Dr. Bartley's idea that the poisonous properties of the cream which he examined were due to putrid gelatine is certainly a rational theory. The poisonous principle might in this case arise from the decomposition of the gelatine; or with the gelatine there may be introduced into the milk a ferment, by the growth of which a poison is produced.

But in the cream which I examined, none of the above sources of the poisoning existed. There were no mineral poisons present. No gelatine of any kind had been used in making the cream. The vanilla used was shown to be not poisonous. This showing was made, not by a chemical analysis, which might not have been conclusive, but Mr. Novie and I drank of the vanilla extract which was used, and no ill results followed. Still, from this cream we isolated the same poison which I had before found in poisonous cheese (*Zeitschrift für physiologische chemie*, x, heft 2), and demonstrated its poisonous properties by experiments upon cats. Moreover, by adding a piece of the solid portion of the poisonous cream, about the size of a filbert, to some normal milk, and making cream with this milk, following the details of the maker of the Lawton cream, omitting, however, all flavoring, I obtained a highly poisonous cream. Does this not prove that the poison may be produced by fermentation in good milk? A detailed account of my experiments may be found in my report to the Michigan state board of health.

V. C. VAUGHAN.

Ann Arbor, August 9.

SCIENCE.—SUPPLEMENT.

FRIDAY, AUGUST 13, 1886.

MEDICINE IN THE UNITED STATES, AND ITS RELATIONS TO CO-OPERATIVE INVESTIGATION.[1]

I PROPOSE to call your attention briefly to some points relating to the present condition and future prospects of medicine in the United States, and to the direction in which you may reasonably hope and expect from that country in the future the most useful co-operation in the improvement of medical science and art. I believe that these must be matters of interest to you, and that I can perhaps make clear certain peculiarities which do not seem to be as generally understood on this side of the Atlantic as it is desirable that they should be to insure sound judgment upon some of the results observed.

In the first place, permit me to call your attention to the fact that it is hardly possible to make any statements with regard to medicine in, or the medical profession of, the United States as a whole, which shall be definite and at the same time distinctive; that is, which will not apply almost equally well to medicine and the medical profession in other countries. This is due to the fact that there are great differences in the organization of the profession in different parts of America, so that what is true of one state would not be true of another; what is required as to fitness or qualification to practise in one place is not required in another; and the country covers so many parallels of latitude and meridians of longitude, making the conditions of life so diverse, and producing such differences in the prevailing diseases, that a man who is fairly qualified to practise in one section may be poorly fitted to treat the endemic diseases of another.

Let us begin by considering some of the things that American physicians complain about; in other words, some of their supposed grievances. One of these is that the profession is overcrowded; that there are too many doctors, both *in esse* and *in posse*, and that this is due to too low a standard of education, and to the want of legal restrictions as to the qualifications which shall give a man the right to practise. Statistics gathered in 1883,[2] showed that in the United States and Canada there were 90,410 persons calling themselves physicians, being in the proportion of 1 to every 600 of population. In Canada alone, there were 3487 physicians, or 1 to 1112 of population. If we take the figures of our last census, of 1880, the proportion of physicians reported, is 1 to 589 of population, or 17 per 10,000. In England and Wales, by the census of 1881, the proportion of physicians is only 5.8 per 10,000, but these figures are not properly comparable with those of the United States, because they do not include unregistered persons. If the same classes were included that are counted in the United States report, I presume that the proportion would be about 9 per 10,000, or a little more than half that in the United States.

In the United State the proportion to the population of those who call themselves physicians varies greatly in different localities; thus, in Colorado there are 29.3, in Indiana 25.2, in Oregon 24.3, and in Arkansas 23.5 per 10,000; while in New Mexico there are only 6.6, in South Carolina 9.2 and in North Carolina 9.7 per 10,000.

It is not easy to give satisfactory reasons for these differences; we can only say that they do not depend to any great extent upon local legislation. The proportion of physicians is generally lowest in the southern states lying east of the Mississippi, and highest in those regions where immigration has recently been active. If we compare, by localities, the proportion of physicians to the population with that of clergymen and lawyers, we find some curious differences. It seems that the lawyers in the United States number 12.7, while in England and Wales they are 6.6 per 10,000, but that on the other hand the clergymen are 14.6 in England and 12.8 in the United States per 10,000 of population. In many instances it seems that where the lawyers are most numerous the supply of clergymen is smallest. I believe that a fair proportion of physicians to population is about 1 per 1000, which is not far from the actual proportion in England, while the true proportion of practising physicians in the United States is about 1 in 750. We must admit, then, that there is at all events no scarcity of physicians in the United States, and, as we have over 80 medical schools at work, besides a fair proportion of medical immigrants, there is no immediate danger of any interruption to the supply.

[1] Condensed from the annual address in medicine delivered before the British medical association, Wednesday, August 11, 1886, by JOHN S. BILLINGS, surgeon U. S. A.

[2] Illinois state board of health report, 1884.

Let us now consider the second head of the complaint, viz., that the standard of education is too low. There is ground for this, considered with reference to some localities, but not for others. I said a moment ago that a man might be fairly qualified for practice in one part of the country and yet find himself at a loss in another. This needs a little explanation, which I can, perhaps, give most easily in connection with a map of the United States (chart i.). This map, which was prepared for a very different purpose, indicates by different shades of color, the relative proportion of deaths reported as due to malarial disease to the total number of deaths in different parts of the country, for the census-year 1879–80. You will note how comparatively light the tint is in the north and north-east, and how dark the shades become in the south and in the valley of the Mississippi, thus indicating the great differences which exist as to the prevalence and deadly effects of the malarial poison in different sections of the country.

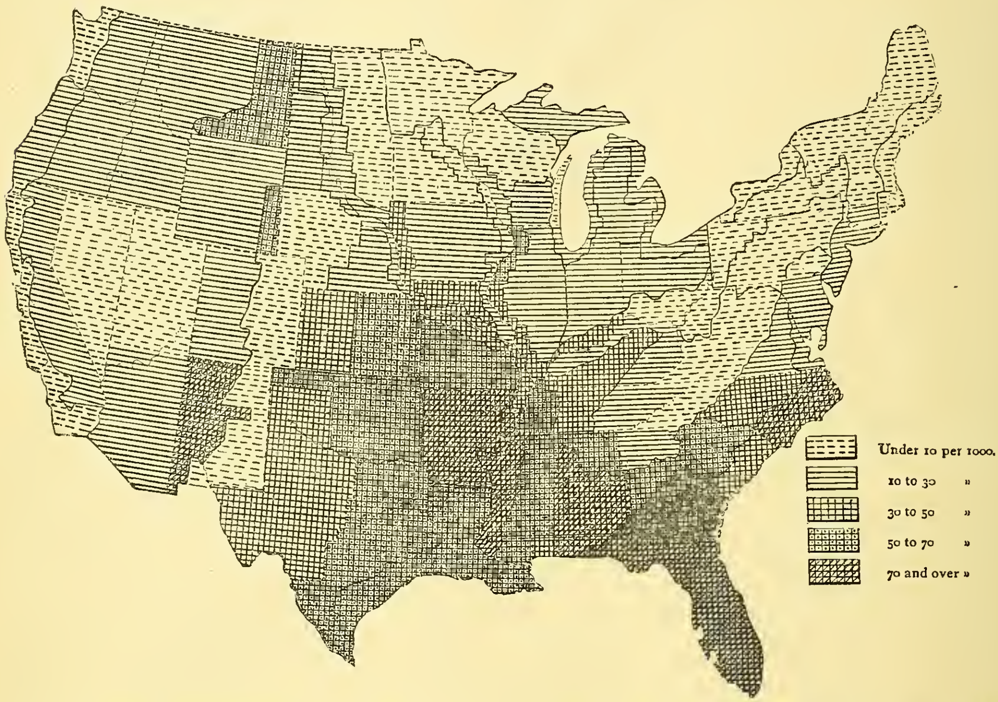


CHART I.—SHOWING THE DISTRIBUTION OF DEATHS FROM MALARIAL FEVER AS COMPARED WITH DEATHS FROM KNOWN CAUSES.

As compared with the north and east, much of this malarious region is a thinly settled country, an almost purely agricultural country, and not a rich country. I need hardly tell you that the physician who has received his chief clinical instruction in the office of his preceptor in Vermont or New Hampshire, supplemented by distant glimpses of a few cases in hospital in Boston or New York, will find himself at a loss at first in dealing with the emergencies of daily practice in Arkansas and Mississippi. He will be subjected to influences which at times are dangerous to one who is not acclimated, and which tend to produce depression of spirits, want of energy, and bad health. He will not have free and constant access to scientific companionship, nor be stimulated by the influence of learned societies, and he cannot avail himself of the ordinary sources of amusement, education, and rest, such as art galleries, the drama, libraries, and museums, etc., which are found in the large cities. Moreover, the pecuniary reward which the practitioner in many of these places can reasonably hope for is comparatively small.

Nor can the inducements for highly educated physicians to settle in thinly settled localities be made stronger by any form of penal or restrictive legislation. Any attempt to fix a standard of requirements or qualifications for practice which shall be the same for such rural districts and for the large cities and manufacturing towns, must result in the adoption of what competent judges would consider so low a standard as to be ridiculous and useless. The demands are widely different, and corresponding differences exist in the sources of supply, that is, in the medical schools.

There is a class of medical schools in the United States whose object is to give the minimum amount of instruction which will enable a man to commence the practice of medicine without much danger of making such serious and glaring blunders as will be readily detected by the public. There are other schools whose aim and object is to make fairly well trained practitioners; the general character of the instruction given in these being substantially the same as that given in your English hospital schools. The results of such a three-years' graded course of instruction in medicine as these schools furnish, depend upon the character of the material upon which they work; that is to say, upon the general preliminary education possessed by the student at the time of his matriculation. This is evidently too often defective, and only a few schools have thus far ventured to establish any standard of preliminary examination which at all approaches in its demands that which is required in England.

As a rule, the efforts which have been made to secure legislation upon medical matters in America have come from the profession itself and have been chiefly urged and recommended by physicians. The general public, and even the educated public, has shown very little interest in the matter. It dees not demand protection against ignorance, but entrusts the care of its health and the lives of those who are nearest and dearest to it to almost any one who announces himself as prepared to take charge of them. The number of those who profess to practise medicine in the United States and are not qualified to do so is undoubtedly large, though by no means so large as one might suppose after listening to the impassioned eloquence which is duly aired every year upon the subject. There are some advertising charlatans, and travelling quacks are occasionally to be met with, but they are rare.

But what evidence have we as to the results upon the health and life of the people? What shall we take as the measure of the difference of skill in physicians? The death-rate? If we compare the death-rate of the United States with those of other civilized countries, we find that it is as low as any with the exception of Sweden. Does a low death-rate mean better sanitary condition, or more skill among the doctors? For the last twenty years the death-rate has been diminishing in England; the average amount of life for each person here has been increased, but I observe that the sanitarians claim this as proof of the value and importance of their efforts, and that nothing is said about its being in any way due to increase in medical skill or to improvements in medical science. Evidently this test is not a convincing one. Almost the only matter in which figures seem to demonstrate the importance of superior medical education and skill is in the statistics of deaths due to childbirth and of the results of surgical operations.

The proportion of deaths from childbirth to the number of births is decidedly greater in the rural districts than in large cities, and among the colored than among the white population. Similar differences are found in England, and are undoubtedly due to the better treatment afforded in the cities by the surgeons and hospitals.

Now, seeing that really efficacious legislation with regard to medical education or to the practice of medicine must, like all efficacious legislation, be substantially in accord with public opinion, since it is impossible to continue to punish for any length of time that which public opinion does not condemn; and as the great mass of the people of the United States have not as yet had such evidence as they can understand, and which would thoroughly convince them that it is to their interest to suppress quackery, it follows that it is necessary to go slowly and to allow such evidence to accumulate.

To me it seems that the most important of the first steps to be taken in this direction is one which has already been taken in Great Britain — namely, the requirement that every death in the community shall be registered, and that in such registration satisfactory evidence shall be given as to the cause of death, sufficient at least to prove that such cause is what is known as a natural cause, that is, that it is not due to crime. When it is admitted that one of the duties of government is to provide for such registration, it follows, necessarily, that those persons whose certificates as to the cause of death are to be accepted must present evidence that they are properly qualified to make such certificates.

So far as the art of medicine is concerned, the demand has much, though by no means all, to do with regulating the quantity and quality of the supply; and there are few localities in the United States where the qualifications of the medical man are not fully up to the standard which the community is able to appreciate and is willing to pay for. The laws regulating the practice of medicine in the United States are all state laws. Of the various methods which have been tried in different states to insure by law that physicians shall be properly qualified, I will call your attention to two which are of special interest.

The first is that of Alabama, the principle of which is to organize the whole medical profession of the state, and use it as the means of regulating the qualifications of practitioners and of caring for the public health. The Medical society of the state of Alabama, with its branches, the county medical societies, thus forms a part of the machinery of the government; it appoints boards of medical examiners, selects state and county sanitary officials, supervises the registration of vital statistics, the administration of quarantine, etc., — in short, it is the state board of health, and the county branches are the county boards of health. This system has now been in operation nine years, and has gradually been consolidated and improved by educating local boards, and getting all physicians interested in it, until it is now working fairly well.

The second system to which I will call your attention, is that of the state of Illinois, which was commenced in 1877, or about the same time as that of Alabama.

In Illinois any one who presents a diploma, or license to practise, from a legally chartered medical institution in good standing, is entitled to practise, and the state board of health is to decide as to what shall constitute 'good standing.' The board of health also examines all persons who do not possess satisfactory diplomas, and who nevertheless wish to practise in this state.

One of the greatest practical difficulties in the way of providing any system of state examinations in medicine in the United States, is that public opinion will not support any law which can be supposed to condemn or in any way to injure homoeopathic and eclectic practitioners or their schools, and hence any proposed law relating to medicine, or to the organization of state boards of health, which does not recognize the existence of these sects, will in many states, at all events, meet with enough opposition to defeat it. In Illinois this difficulty was surmounted by the arrangement, that of the five physicians on the board, one should be homoeopathic and one eclectic. The Kansas law, passed last year, goes further in this direction, and provides that appointments must be so made that no school of medicine shall ever furnish a majority of the members of the board. Much to the surprise of many, the Illinois plan has worked very well — there has been no quarreling in the board — and the homoeopathic and eclectic members seem to have upheld quite as high a standard of qualification as their fellow members. The results of the work in Illinois have been very good. A large number of ignorant charlatans were forced to leave the state. The requirements of the board as to what shall constitute a medical college in good standing, have been raised, and it has thus caused improvement in the medical schools, not only of Illinois, but of other states. Moreover, the neighboring states have been stimulated to action, not only by the force of example, but because they received the men who had been driven out of Illinois, and found the accession an unpleasant one.

The relations of the general government to medical education are indirect, but they have of late years become of very considerable practical importance, and are now exerting much influence upon medical investigations and literature. This is effected by the museums and libraries which are now being formed under the auspices of the government at Washington, and also, to some extent, by certain special investigations undertaken by the government in the interests of preventive medicine. Of these various agencies one of the most important is the library which has been formed at Washington, under the auspices of the medical department of the army in connection with the Army medical museum.

As regards investigations into the causes of disease, undertaken at the expense of the general government, only a beginning has as yet been made; but it is sufficient to indicate future possibilities and probabilities. The main importance of the work of the National board of health, which was organized in 1879 under the stimulus of the great yellow-fever epidemic of the previous year, was due to investigations upon the causes of yellow-fever and diphtheria, the relations of soils and of water-supply to certain diseases, etc. Similar investigations have been undertaken by state boards of health, and especially by the state board of health of Massachusetts, and the fact that governmental health departments are tending to work in this direction is significant as to future co-operation from such sources.

In this connection should be mentioned the National museum of hygiene, which has been formed under the direction of the medical department of the United States navy, which is now one of the most instructive collections of the kind in the world, and has also connected with it an excellent library and a well-equipped laboratory.

Comparative and experimental pathology is also receiving attention from the government under the direction of the department of agriculture, which is doing some good work in the investigation of the diseases of our domestic animals.

As to the condition of medical science and art in America, it partakes of the general progress, for the press now makes all discoveries the common property of the civilized world. The marked feature of the present epoch is the recent advance in knowledge as to the relations between micro-organisms and certain diseases, and the strong stimulus which this has given to preventive medicine. Sanitation is becoming fashionable, and if we may believe some of its votaries, it is a very simple matter to prolong the average life-time to the scriptural, 'three score years and ten.' All that is necessary is that everything shall be clean, and every person virtuous. Having learned to distinguish those diseases which can be prevented much more easily and certainly than they can be cured, we may turn them over to the sanitarian, who has his own battles to fight with ignorance and prejudice. If he succeeds, and so far as he succeeds, he will change, in certain respects, the work of the practitioner.

I come now to the consideration of the second part of my subject, namely, the direction or manner in which we have reason to hope that medicine will be developed in the United States, and the kind of co-operation which you may reasonably expect to receive from the medical profession of that country.

In one sense medicine, as we have it to-day, is the result of co-operation; not of deliberate, centrally planned, and direct co-operation, but of natural selection from results produced by many men, often working at cross-purposes, and, therefore, wasting much energy, but nevertheless working, though blindly, to a common end. And it is safe to predict that in the future much of the best work will be done in the same way, by individual effort inspired by the love of science, by personal ambition, etc. But the results obtained in this way come slowly, and some things that we want can hardly be obtained by individual effort, even if we were willing to wait, hence we must look to organization for help.

In this broader view of co-operation it is interesting to consider those fields of labor to which comparatively few physicians can devote themselves, because of want of time and opportunity, but whose proper working is, nevertheless, of the greatest importance to the practitioner.

One of these is experimental laboratory work, and in this direction the prospect of valuable contributions from America is now exceedingly good. Some of the wisest of our most wealthy men have shown their appreciation of the responsibilities which riches entail on their possessors by seeking new channels through which to benefit their fellow-men. While the old and well-known methods of endowing hospitals and charitable institutions are not neglected, there is apparent an increasing tendency to endeavor to promote the advancement of knowledge, and especially of such knowledge as tends to the mitigation of suffering and the improvement of the race, to furnish means for the investigation of disease, to provide laboratories, and to endow medical schools, and thus place them beyond the reach of the temptations and difficulties which must always exist when such schools are dependent upon the fees of students, and are, therefore, practically commercial manufacturing establishments.

As illustrations of this tendency, I may mention the bequest of £1,400,000 by Johns Hopkins to endow, in the city of Baltimore, a university and a hospital of which the medical department is to be a special feature, to be provided with the best laboratory and other facilities for original investigation as well as for teaching; the gift of Mr. Carnegie to the Bellevue hospital medical school of New York in the shape of a well-equipped pathological laboratory; the presentation by Mr. Vanderbilt and members of his family, to the College of physicians of New York, of £200,000, to provide for that school new buildings and clinics having the best means of teaching and research, and the endowment by an unknown donor, of a laboratory for the University medical college of New York, with the sum of £20,000.

As the class of men who have wealth, leisure, and knowledge becomes greater, there comes an ever increasing demand, not only for the best medical skill, for the most expert practitioner, but also for exhaustive research in every direction which promises to furnish new means for the prevention or relief of suffering, and for warding off, as long as possible, the inevitable end; and hence there is little reason to doubt that the examples I have named will be followed by others in the near future. With such opportunities, and under such conditions and influences, the stimulus to the young and ambitious worker is strong; we have abundance of material of this kind upon which the process of natural selection can operate, and there is little reason to doubt that the result will be substantial and valuable contributions to physiology, pathology, and therapeutics.

There is another most important means of advancing medical and sanitary science which only a government can furnish, and in which field of work England now stands pre-eminent—I refer to vital statistics. In this field, the United States government has thus far done but little, yet enough to show the great interest and value of what we have a right to hope will be done in the future by combining the work of the several states. This is one of the fields in which international co-operation is most desirable; it alone can furnish data sufficiently complete and reliable for a scientific consideration of the relations of disease to geographical and race distinctions.

To illustrate the possibilities in this direction, I will call your attention to some peculiarities in the distribution of deaths from certain causes in different parts of the United States, and for this purpose I shall make use of the data from our last census, taken in 1880. We have no general and uniform system of registration of births and deaths. The larger cities, and about half-a-dozen states, have such a system, but for much the larger portion of the country the only means which we have for determining differences in amount or causes of mortality in different localities is through the census, which is taken once in ten years. The data thus obtained with regard to deaths are imperfect, because when these are collected only at the end of the year, about 30 per cent of the deaths are unrecorded; and they are inaccurate, because the reports of the causes of death are not furnished by persons competent to give reliable information with regard to them. Nevertheless, these data are the best that we have; and although for a large part of the country they do not give us the actual number of deaths from any cause or set of causes, they do furnish some interesting information with regard to the relative prevalence and importance of certain causes, and suggest questions and lines for future investigation, although they do not furnish definite and scientific answers.

Take, for instance, the map of the United States upon which, by varying shades of color, is shown the proportion of deaths reported as due to cancer, as compared with the reported deaths from all causes. (Chart ii.)

The mortality from cancer in the United States is proportionately greatest in the New England states, somewhat less so in New York and Pennsylvania, and it causes the least proportion of deaths in the Mississippi valley and the south generally. The proportion of deaths from cancer in the United States is somewhat greater than it is in England; but it is not possible to make any accurate comparisons in this respect. Now why are the shades on this map so dark in the northeast and so light in the south? In the first place, cancer is a disease the mortality from which steadily increases with advanced age, as you may see from this diagram. Hence, cancer causes a higher proportion of mortality in those localities which have the greatest proportion of population living at advanced ages, and in the United States these localities are the New England states, as you will see by this map. Another explanation of the peculiar shading of the cancer

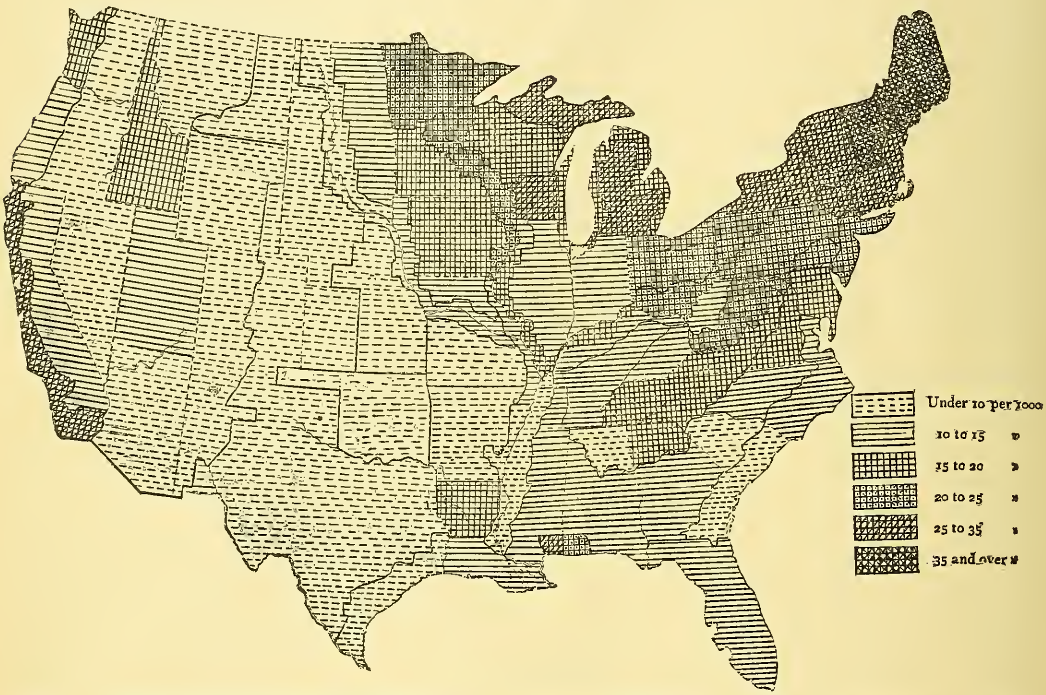


CHART II.—SHOWING THE DISTRIBUTION OF DEATHS FROM CANCER AS COMPARED WITH TOTAL DEATHS FORM KNOWN CAUSES.

map is found in the relations of race to the tendency to death from this disease. The proportion of annual deaths from cancer per hundred thousand living population was, in round numbers, twenty-eight for the whites, and thirteen for the colored. That is to say, cancer is more than twice as prevalent among whites as it is among colored in the same localities, for these figures apply only to the south. On the other hand, cancer appears to cause a greater proportion of deaths in persons of Irish and German parentage, than it does among the rest of the white population, the indications being that between the ages of fifteen and sixty-five, the Germans are especially liable to cancer; more so than the Irish, and decidedly more so than the average white population. Now when we remember that the greater part of the colored population is in the south, and the greater part of the Irish and German population is in the north, we have another reason for the differences in mortality caused by this disease in the two sections.

Scarlet fever is most fatal in the north, and, here again, the influence of race comes in, because in the negro race the mortality from this disease appears to be very low. This disease has always been much rarer in the south than in the north, and the contrast was much stronger in former years than it is at present; but this cannot be explained solely, or even to any great extent, by difference of temperature, because scarlet fever has often been epidemic in the tropics, and, on the other hand, in many localities in temperate climates it is among the rarest of diseases.

Diphtheria has been unusually prevalent in the northern portion of the United States for several years. During the census year it caused 2374 deaths out of every 100,000 deaths from all causes, while in England, for the year 1880, the deaths from diphtheria were 532 per 100,000 deaths from all causes; that is to say, the comparative mortality from this disease in England was less than one-fourth that of the United States for the same period. Diphtheria, again, is essentially a disease of the north, but especially of the north-west. It causes an excessive mortality in children of German parentage, sufficiently so to show that here again the influence of race comes into the problem, although, probably, only indirectly, that is to say, it is probable that it is the habits of a peculiar class of people which favors the propagation of the disease rather than any physical peculiarities in the structure of their bodies.

Consumption is a vague term, and, as used in

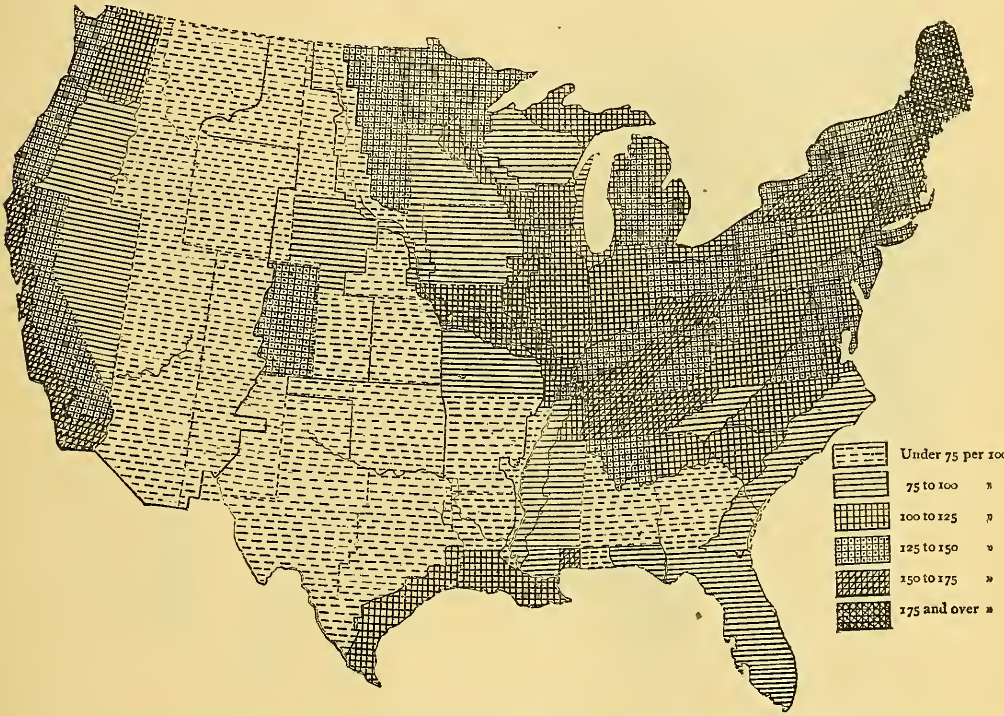


Chart III.—Showing the distribution of deaths from consumption as compared with deaths from known causes.

the census, no doubt includes many cases which were not true tubercular phthisis. It is reported as causing 12 per cent of all the deaths, or more than any other single cause. In England and Wales, in 1880, it caused a little over 9 per cent of all the deaths. Such wholesale ratios are, however, of little interest or value. There are very great differences in the liability to this disease in different parts of the United States, as the map (chart iii.) makes evident; and it is from a study of the causes of these differences in the data derived from large masses of people, combined with clinical histories and experimental laboratory work, that we have good reason to hope to obtain knowledge, not only of the causes of this disease, but of better methods of prevention and treatment than are now at our command. It causes a greater mortality among the Irish than in other white races, and, perhaps, a greater mortality among the colored than among the white.

Next to consumption, pneumonia is reported as causing the greatest number of deaths in the United States during the census-year, giving a ratio of 8.3 per cent of all deaths, as against 4.8 per cent in England and Wales in 1880. Here, again, the local distribution of deaths is interesting, and the contrast between the map of consumption and that of pneumonia (chart iv.) is very striking. Here, again, we find that race peculiarity is an important factor in the problem, the proportion of deaths from pneumonia among the colored being much greater than it is among the white.

While we must consider the difficulties in the way of the improvement of the science and art of medicine, difficulties due to ignorance, to indolence, to conflict of interests, and to the eternal fitness of things, the existence of such difficulties is not a matter to be bemoaned and lamented over. These obstacles are the spice of life, the incentives to action, the source of some of the greatest pleasures which it is given to man to experience. As each man has special opportunities and duties, if he can only recognize them, so it is with guilds, with professions, and with nations. I have tried to indicate to you some of these opportunities which are presenting themselves to my colleagues, your brothers, in the lands beyond the sea, and I hope that I shall not be considered rash, or vainglorious in saying that I believe they will so use those opportunities as to return compound interest for what they have received from the storehouse of our common inheritance.

JOHN S. BILLINGS.

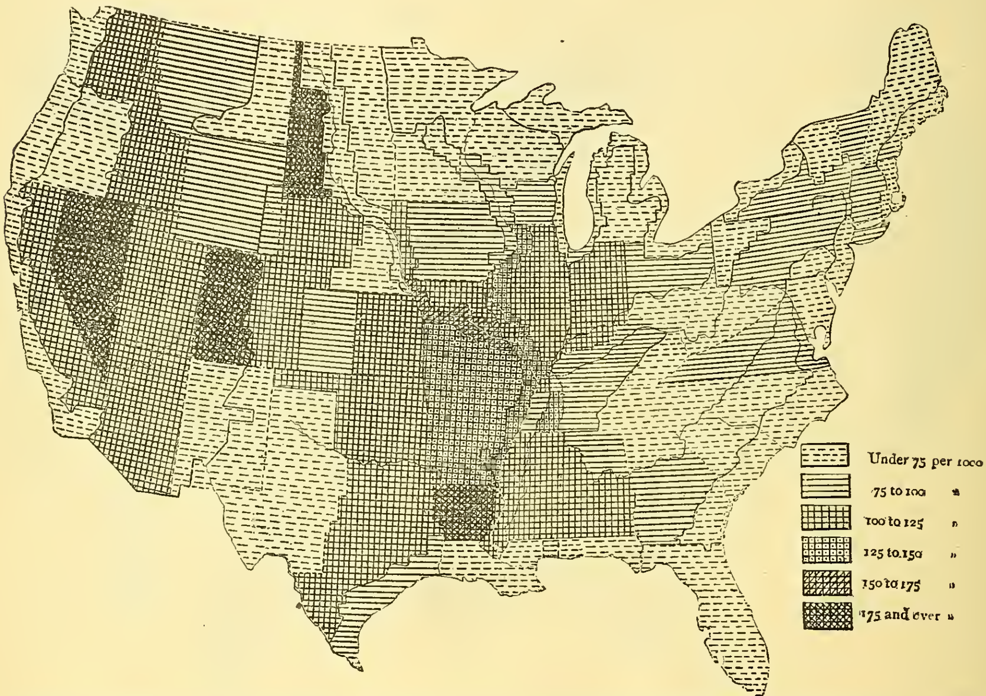


CHART IV.—SHOWING THE DISTRIBUTION OF DEATHS FROM PNEUMONIA AS COMPARED WITH DEATHS FROM KNOWN CAUSES.

Faithfully yours
Edw S Morse

SCIENCE.

FRIDAY, AUGUST 20, 1886.

COMMENT AND CRITICISM.

THIS AND THE TWO SUCCEEDING numbers of *Science* will be largely given up to the reports of the meeting of the American association at Buffalo. In this number is given the address in full of the retiring president, Prof. H. A. Newton of Yale, and, with this, abstracts of several of the vice-presidents' addresses. We are also able to present our readers with a portrait of Prof. Edward S. Morse, of Salem, the incoming president. Professor Morse, was born at Portland, June 18, 1838. His career as a scientific man is one of the results of the enthusiasm aroused by the elder Agassiz, Professor Morse being one of the well-famed group of young Americans who came about Agassiz during his first years in this country. Professor Morse's investigations of the molluscoids, worms, and lower arthropoids, his marked success as a lecturer in biology, his enthusiastic study of Japan and the Japanese, which he has partially set forth in his admirable 'Japanese homes and their surroundings,' are the works which lead us to congratulate the association on their choice.

CAPITALISTS AND LABORERS.

THE adjustment of the relations between capitalists and laborers is the greatest problem presented for solution in the present age. It is one that has baffled the skill of the wisest men in times past. There is a bitterness and alienation between these classes that threaten the peace of society and the stability of government. There are millions of discontented people to a greater or less extent under the influence of socialists, who openly publish doctrines subversive of all good government, and contrary to religion and morality. Their leaders are bold and reckless, and avow their purpose to disturb society in order to make what they call a just division of property.

Quotations, from writers worthy of confidence, were given, in order to show that the condition of the laborer is far better in all respects than it was fifty years ago. In the increase of wages, and the lessening of the hours of toil, he gains from fifty to one hundred per cent in money returns. Advantages of education, comforts, and privileges, and means of relief from sickness and pain, that formerly were unknown, are now common. This improvement in the condition of the poor gives no reason for the haughty rebukes of their employer, nor for his advise to them to be content with their condition. With all our boasted advantages of modern civilization, the condition of a large portion of the laboring classes is pitiable. Thousands have no employment, and thousands more are compelled to live on a mere pittance, and submit to conditions destructive of all manhood and nobility of spirit.

In New York city there are two hundred thousand women and girls employed in ninety-two trades. They earn from four to eight dollars per week. Hundreds of cases are reported where women work from fourteen to seventeen hours per day at from four to seven dollars per week. Loss of time, from ill health and inability to obtain work, reduces their earnings till they barely sustain life. Many persons receive twelve and a half cents a day. Many of them are wronged, and on various pretexts deprived of their pay. The rules of many factories are abusive and degrading. The home life of such laborers is pitiable, being passed in circumstances where decency and womanly respect are impossible. About nineteen thousand tenement houses accommodate about fifty persons each, and some of them three times as many. The condition of a large number of the poor is a reproach to our age.

It is a sore evil that has resulted from the effectiveness of machinery. It separates the wage-workers into a permanent class, making it more and more difficult for them to rise above it.

The improved condition of the laborer makes him more restless, gives him new views and higher wants, which he seeks to gratify. He now longs for more rational living, better food, better clothing, a better house, the education of his children, and time for self-improvement. While his circumstances have improved, he sees greater improvement in those of others. The product of the union of capital and labor is greater than formerly, and the laborer demands as his just due a larger share.

The causes of discontent among laborers are serious and wide-spread. One cause is the difference in views as to the relations between em-

Abstract of an address before the section of economic science of the American association for the advancement of science at Buffalo, Aug. 19, by the Rev. Joseph Cummings, LL.D., of Evanston, Ill., vice president of the section.

ployers and employed. Labor has been degraded and despised. There is still a feeling that there must be fixed classes in society, and that the majority must work hard enough to relieve the minority from labor. Once it was the privilege of the employer to command, and the duty of the laborer to acquiesce; but this feeling of inferiority on the part of the employed is gone, and the age of civility is past. The workman has made practical the doctrine of human equality, and looks on those around him as his equals. He no longer respects any distinctions founded on birth and circumstances and not on personal worth and power. He holds truly that labor is service for an equivalent, and that the employer and employed stand as equals in an interchange of service. He does not admit that wages are paid by the employer, but regards them as the product of the joint effort of the employer and employed, of which the laborer should receive his just proportion. In fact, the employer has no more right to dictate to the laborer how he shall seek his interests, and what associations he shall form, and what trades-unions he shall establish, than the laborer has to dictate to the employer in corresponding matters. A great part of the alienation between classes, and the bitterness of the poor toward capitalists, lies in the fact that wages have been substituted for all other ties, and the laborers are regarded but as a part of 'the plant' in a great manufacturing establishment. In American society there is a marked manifestation of the degradation of labor. All labor which involves personal attention, and especially labor in household service, is still thought degrading. The term 'servant' is still used, but it should be banished from a civilized people, and become as obsolete as 'slave' and 'serf.'

There are serious errors that in some form have been advocated by leading political economists, which, under the teachings of such modern popular writers as Henry George, have caused serious evil. They are such maxims as this: that "all wealth is created by labor, and the title to all wealth ought to be vested in the laborers who have produced it." These maxims are fallacious; but they are received with great favor by the multitude, who are led to believe that the accumulation of great fortunes is a wrong to the laborers, and that such fortunes should be divided for the public good.

For the discontent of the laborers, and their disagreement with the capitalists, various remedies have been proposed, but they have proved, in practice, vain and ineffective. This may be said of strikes, lock-outs, and the doctrine of unrestricted competition. A reasonable mode for the settlement of difficulties would seem to be a conference between the classes or their representatives. When a settlement cannot thus be reached, it would seem the wisest course to refer the points in dispute to arbitrators chosen in the usual way. Boards of arbitration may be either temporary or permanent. There are many reasons in favor of permanent boards, which might be as effective in preventing difficulties as in their settlement.

We are persuaded that the present difficulties that threaten the peace and order of society will never be removed till a higher standard of ethics shall prevail. They are the direct result of selfishness, encouraged by the prevalent selfish theory of morals. These are personal sins and social wrongs that civil government may not by law or force correct. It is not according to the will of God, as made known by natural or revealed religion, that a few should control vast fortunes, using them to gratify selfish personal desires, while multitudes suffer not only for want of knowledge, but of bread, and struggle through a brief existence, realizing in no proper sense the true object of life. Nothing is right that is not in accordance with the divine will; hence no man can have the right, though he has the power, to do wrong. Because a gifted man has power to accumulate property, he has no right to arrogantly say, "This is mine and I will spend it as I please." The wealth of the world is designed for the public welfare; and it is the duty of those who have it in charge to consider themselves as only agents, bound to use it so as to serve the greatest good. He who has wealth and does not intend to act thus, is false to his trust, and is the enemy of society.

In the Christian use of money will be found the great remedy for social wrongs. The right use of money will require much tact, wisdom, and skill. Multitudes on multitudes of the poor have low, selfish, sensual aims; and indiscriminate giving to them would only encourage indolence and vice. They need education and culture, and higher ideas of life. All these the right use of money now worse than wasted would secure.

AN INVENTORY OF OUR GLACIAL DRIFT.

After an introduction, and a reference to recent acquisitions in the field of geography and other departments of geology, the southern limits of the great glacial formations of North America were sketched and illustrated by wall map. In addition to the already known limits in the east, new facts were given respecting the outline in Dakota and Montana, the line being found to pass

Abstract of an address before the section of geology and geography of the American association for the advancement of science at Buffalo, Aug. 19, 1886, by T. C. Chamberlin, vice president of the section.

nearly due west from the latitude of Bismarck to within forty miles of the Rocky Mountains, where it curves rapidly to the north, and skirts the mountains as far into British America as yet traced. Within the United States the limit of north-eastern drift barely touches that of demonstrative local glaciation from the Rocky Mountains. Westward of this, in the valleys of Flathead, Pend D'Oreille, and Osoyoos lakes, and Puget Sound, are deposits of drift regarded as prolongations of the more general drift of British Columbia, which, if not a continuous mantle, at least passes beyond the character of simple local mountain drift. South of this general drift are deposits of ancient glaciers in the Cascades, Sierras, Rockies, some of the intermediate ranges, and, according to some authorities, the Appalachians. The lacustrine deposits of the great basin region were correlated with the glacial deposits in time and causation.

A wealth of significance lies in the sinuosities, vertical undulations, and varying characters of the southern border. It undulates over the face of the land essentially as much as an arbitrary line from New York harbor to Puget Sound, and could be reduced to horizontality — as it must have been to have marked the margin of some ancient ice-bearing body of water — only by incredible warpings and dislocations. The border of the drift presents three notable phases; one part terminating in a thickened belt, a terminal moraine; another in a thin margin; and a third in an attenuated border of scattered pebbles. The morainic border prevails in the Atlantic region, and lies on or near the limit as far west as central Ohio, beyond which it retires from it. Throughout the rest of the stretch to the Rocky Mountains the attenuated edges prevail. The latter are thought to represent, one a glacial and the other a glacio-natant action. The attenuated borders are believed to delimit an earlier ice incursion, and the morainic border a later one, which overrode the former in the coast region but fell behind it in the interior, having its extension in similar moraines in the interior.

Corroborative testimony is found in facts drawn from orographic attitudes, drainage, erosion, decomposition, ferrugination, vegetal accumulations, and lacustrine oscillations in the great basin. The interval between the two epochs is measured geologically by the cutting down of the beds of the Allegheny, Monongahela, and upper Ohio rivers some two hundred to three hundred feet, chiefly in rock; of the upper Missouri River to greater depth; and by an elevation of the upper Mississippi of eight hundred to one thousand feet. Of the earlier drifts, two important subdivisions seem indicated by present data, and several subordinate ones of the later. The distribution of these was outlined. A third series of drift sheets, of greater uniformity of material and regularity of deposition, occupying the great basins of the St. Lawrence valley, the Red River of the North, and limited areas of the coast region, and delimited in part by beach ridges, was sketched. The major opinion concerning the oldest series favors their glacier origin, but this opinion is not unanimous. Concerning the second, or moraine-bordered group, opinion is overwhelming that they are direct glacier products. Concerning the third series, the weight of opinion favors their subaqueous deposition, either in fringing lakes or in more general submergence. The differentiations of the characters of the three groups were further sketched. Of unstratified bowldery clays or tills, there is the richest variety, ranging through varying combinations of material, texture, and aggregation. Three genetic classes were recognized: 1°, subglacial tills; 2°, englacial or superglacial tills; 3°, subaqueous tills; and 4°, tills ridged by the thrust of the margin of the ice.

Of moraines, terminal, lateral, medial, and interlobate varieties are found. The great terminal moraines overshadow all others in interest and importance. The distribution of the chief ones were shown upon the map. The Nantucket and Cape Cod moraines were regarded, with more confidence than ever, as the equivalents of the Kettle Range of Wisconsin, and the Altamont and Gary moraines of Dakota. Outside of these chief moraines, there are occasional belts of older drift aggregated in the similitude of peripheral moraines. Examples are found in central Indiana, western Montana, and the plains of the British Possessions. Back from the two principal terminal moraines lie several similar partially determined belts, usually of less prominence and continuity.

Our most unique moraines are the interlobate, developed between the tongues into which the great ice sheet of the second epoch was divided at its margin. About a dozen of these, located in half as many states, were recognized; but only a part present full evidence of true interlobate character. Beautiful lateral moraines abound in the mountainous regions of the west, and some were developed by local glaciation supervening upon the ice retreat of the east. Our medial moraines are unimportant, and confined essentially to mountainous glaciation. Allied to the true moraines are special forms of aggregation of the subglacial debris, among which were enumerated: 1°, till tumuli; 2°, mammillary and lenticular hills; 3°, elongated parallel ridges, trending with the ice movement; 4°, drift billows; 5°, crag and tail; 6°, pre-crag and combings; and 7°, veneered hills. The most remarkable are the mammillary, lenticular, and elongated ridges, frequently grouped under the term 'drumlins.' The lenticular varieties prevail in southern New Hampshire, central and eastern Massachusetts, north-eastern Connecticut, and Nova Scotia; the elongated variety, accompanied by shorter, in central New York; and all varieties in eastern Wisconsin, extending into the northern peninsula of Michigan. About three thousand have been mapped. The total known number probably aggregates ten thousand. No theory of their formation has yet received wide acceptance, beyond a general agreement that they are subglacial accumulations.

Turning to the assorted drift, two classes commonly embraced there were excluded. First, the 'orange sands' of the Mississippi valley, commonly accepted as Champlain deposits. They do not appear to possess the distinctive characteristics of glacial gravels, but are residuary in aspect. If they belong to the glacial period at all, it must be to its earliest stage. Their reference to the Champlain epoch is clearly an error. The second class, set aside as not being strictly glacial, were those reworked by wholly non-glacial agencies; or, in other words, the secondary drifts. Eliminating these, there remain the products of glacial waters working co-ordinately with the ice, of which two classes were recognized: 1°, those that gathered immediately within and beneath the ice body itself, or against its margin; and 2°, those which were borne to distances beyond its limit by the glacial drainage or by peripheral waters. In the first, the presence and restraint of the ice was an essential factor; in the second, it was only a source of material. Of the first class, there are: 1°, the products of streams flowing on the surface of the ice; 2°, of streams plunging from the surface to the base through crevasses; 3°, of subglacial streams in tunnels beneath the ice; 4°, of streams in ice cañons at the border; and 5°, debouchure deposits of streams at the margin. The products embrace a great variety of sub-types of gravel heapings, including isolated mounds, conical peaks, clustered hummocks with inclosed pits and basins, and sharp, steep-sided ridges, often of phenomenal length—all possessing great irregularities of material and stratification, embracing, frequently, manifest disturbances. The elongated variety,—identical in all essential respects with the great osars of Sweden,—are finely developed in eastern New England, especially in Maine, and the border of New Brunswick; while the hummocky variety, constituting the ill-defined class of kames, are abundant throughout New England, New York, northern New Jersey, Pennsylvania, Ohio, Indiana, the greater part of Michigan, northern Illinois, eastern and northern Wisconsin, northern Minnesota, north-central Iowa, eastern Dakota, and many portions of Canada. These osars and kames are among the most fascinating phenomena of the drift; but to differentiate them, and to determine to what extent they are superglacial, subglacial, and debouchure phenomena, is a triumph of discrimination not yet attained. It is of most practical importance at present to distinguish debouchure and submarginal gravel heapings, representative of the position of the glacier's edge, from the gravel veins of the glacier's body. The semi-morainic kames are the type of the one; the winding windrows of gravel, the osars, of the other. The osars frequently end in osar fans, and the kames graduate into pitted gravel plains. These pitted plains and others, not identical in type, constitute one of the singular and not least puzzling features of the assorted drift. They have a wide range; but find their most phenominal development in Wisconsin, Michigan, Ontario, and the coast of New England. The kames also graduate into true moraines; and every stage of gradation may be observed. In the progress of their accumulation, they were thrust by the adjacent ice, and heaped into ridges as genuinely morainic as though made of unwashed material. They have an especial development along the interlobate tracts.

Of valley drift formed by streams heading on the glaciers, the intermediate phases were passed with simple reference, and attention directed to two extreme phases: 1°, the moraine-headed valley trains; and 2°, the loess tracts. The former are deposits of glacial floods, when the slope gave impetus to the drainage; the latter were construed as the products of slack drainage. The former are found to show progressively coarser material toward their origin, and to merge into elevated expanded heads blending with the moraines from which they took their origin. Associated with these are glacial aprons of overwash drift, that fringe the outer sides of moraines in favorable situations. These phenomena point unequivocally to a glacial origin, and to vigorous drainage conditions. Contrasted with them are the broad tracts of fine silt, designated 'loess,' that occupy the Mississippi up to east-central Minnesota, the Missouri up to southern Dakota, the Illinois and Wabash as far up as their great bends, and the Ohio up to south-eastern Indiana. They are so correlated with the border of the ice, in the later stages of the earlier epoch, that they seem clearly to be products of glacial drainage of a fluvio-lacustrine character, indicating low gradients and slack drainage. This stands in marked contrast to the conditions necessarily indicated by the moraine-heading coarse gravel streams; and herein lies an important discrimination of the drainage and orographic attitudes of the two glacial epochs.

In addition to the till-like phases previously noted, two assorted deposits were considered. They range in altitude from below the sea-level to three thousand feet and beyond, and vary greatly in individual extent. The great examples are the immense sheets of assorted drift overspreading the great basins of the St. Lawrence, and the Winnipeg basin. These often present, among their surest credentials, overflow channels to the southward, crossing divides often hundreds of feet above existing outlets, and varying in altitude among themselves at least two thousand feet. Some of the more important were enumerated. Reference was also made to the iceward termination of these lacustrine deposits, a phenomenon yet but partially studied. The surfaces of these ancient lakes not only stood at altitudes greatly different from the present, but were tilted, if not distorted, as compared with existing water levels, rising as a general rule, toward the north. Data are being rapidly gathered, in the effort to determine how much of this was due to ice attraction, to ice weighting, to thermal changes, to intercurrent crustal changes independent of glacial presence, and to other and undiscovered causes. Reference was made to the scorings which the glacial floor presents, and some of the more remarkable features alluded to. The number of recorded observations of striae reaches nearly three thousand.

Turning to the more purely intellectual products springing from the glacial phenomena, it was noted that our former ample assortment of theories of the origin of the drift has become practically reduced to one,—the glacial. With few exceptions, the investigators of glacial phenomena in the United States accept as demonstrated the glacial origin of the greater mass of the drift. This is less true of Canadian investigators. Subordinate to this dominant hypothesis, there are various degrees of belief respecting the extent of auxiliary glacio-natant agencies.

Our wealth of working hypotheses has increased as our theory of genesis has become fixed upon the fruitful doctrine of the glacier origin of the drift. The recent introduction of strictly glacial methods has been prolific in stimulus and in interpretation. The working hpotheses necessary for the tracing out of moraines, the discrimination of the tills, the differentiation of the kames, osars, and similar products, and for the analysis of the drainage phenomena, have become rich beyond the limits of convenient statement, and suggestive to a degree unimagined a decade since. Under these, the advance of a year is becoming as the advance of a decade.

If we turn to the broader speculations respecting the origin of the glacial epoch, we find our wealth little increased. We have on hand practically the same old stock of hypotheses, all badly damaged by the deluge of recent facts. The earlier theory of northern elevation has been rendered practically valueless; and the various astronomical hypotheses seem to be the worse for the increased knowledge of the distribution of the ancient ice sheet. Even the ingenious theory of Croll becomes increasingly unsatisfactory as the phenomena are developed into fuller appreciation. The more we consider the asymmetry of the ice distribution in latitude and longitude, and its disparity in elevation, the more difficult it becomes to explain the phenomena upon any astronomical basis. If we were at liberty to disregard the considerations forced upon us by physicists and astronomers, and permit ourselves simply to follow freely the apparent leadings of the phenomena, it appears at this hour as though we should be led upon an old and forbidden trail,—the hypothesis of a wandering pole. It is admitted that there is a *vera causa* in elevations and depressions of the earth's crust, but it is held inadequate. It is admitted that the apparent changes of latitude shown by the determinations of European and American observatories are remarkable, but their trustworthiness is challenged. Were there no barriers against free hypotheses in this direction, glacial phenomena could apparently find adequate explanation; but debarred—as we doubtless should consider ourselves to be at present—from this resource, our hypotheses remain inharmonious with the facts, and the riddle remains unsolved.

THE ECONOMICAL ASPECT OF AGRICULTURAL CHEMISTRY.

PROFESSOR WILEY opened his address with statistics showing the value of the agricultural products of the United States. He then gave figures showing the chemical constitution of the different products, and laid stress upon the necessity of supplying the growing crops with sufficient potassium, phosphorus, and nitrogen. The value of the potash, phosphoric acid, and albuminoids or nitrogen entering into a single harvest he estimated as follows, valuing potash at five cents per pound, phosphoric acid at six cents, and nitrogen at eighteen cents. The total value of each of these ingredients is, then, potash, $598,067,446;

Abstract of an address delivered before the section of chemistry of the American association for the advancement of science at Buffalo, Aug. 19, by Prof. H. W. Wiley of the agricultural department, vice-president of the section.

phosphoric acid, $418,865,930; nitrogen, $2,326,-852,674; total, $3,343,786,050.

These quantities of plant food removed from the soil annually seem enormous, but it must be remembered that they are not all lost: much of them is left in the soil in roots, straw, stalks, etc. Those, however, who are acquainted with the method of farming practised in the newer parts of our country know that corn-stalks and straw are generally regarded as nuisances, to be removed as easily and speedily as possible. It is not tilling but killing the soil that is practised. Stables are removed to get out of the way of the accumulating manure, and the corn-stalks are raked together and burned to prepare the field for a new crop. True, in many localities the waste of such a proceeding, especially in nitrogen, is understood. Yet it must be confessed that over vast areas of our agricultural lands there is no conception of the idea of possible exhaustion of the soil, and no systematic method of preventing it. The refuse of the crop, the straw, the stalks, etc., are put out of the way as easily and quickly as possible, and without thinking of the robbery which is thereby committed. The stores of plant food which have accumulated in our virgin soils are indeed great, but they cannot withstand this constant drain on them. The effects of this system of culture soon show themselves in diminished yield, as is seen in the great wheat fields of the north-west and of California, which do not produce at the present time more than half the crop at first obtained from them.

If we place at 40 pounds the annual contribution of potash of an acre of land to the crop, the number of crops which could be produced in a given depth, as far as this constituent of soil is concerned, is easily computed. The weight of dry soil per acre to a depth of nine inches is approximately 3,000,000 pounds. A soil containing .3 per cent of potash would have, therefore, 9,000 pounds, which, at 40 pounds a year, would last for 250 years. But fortunately, by the decomposition of feldspathic rocks and others containing potash, and also by the transfer in various ways of the subsoil to the soil, a provision is found which will prevent the entire exhaustion of the soil. Thus it happens, that, in many parts of the world where fields have been under cultivation for hundreds of years, there is still a sufficient amount of this manurial substance to insure the production of a crop.

Further, it must not be forgotten that there are many manurial substances containing potash which are accessible, and which will furnish immense stores of this substance to the future agriculturist. Chief among these natural deposits must be mentioned the mines of kainit, which have their greatest development near Stassfurt. These mines have already furnished immense quantities of potash, and there is no immediate danger of their exhaustion.

The available quantity of phosphorus as plant-food may be estimated in the same way. The quantity of phosphoric acid in soils varies from none at all to almost one per cent. If we take the mean content of phosphoric acid in a soil to be .15 per cent, the total quantity per acre to a depth of nine inches would be 4,500 pounds. If the contribution to each crop is 20 pounds per acre, the phosphoric acid would last for 225 years without any artificial supply.

The stores of phosphoric acid, however, which a provident past has saved for us, are even greater than the deposits of potash. Apatite is a somewhat abundant mineral; and in South Carolina and Alabama, and other states of the union, are found large beds of phosphates. Some idea may be formed of the extent of these deposits by studying the dimensions of the largest bed of them yet discovered, having its centre at Charleston, S. C. This bed has been traced for a distance of 70 miles parallel with the coast, and has a maximum width of 30 miles. In view of the fact that only preliminary surveys have been made of the phosphatic beds in North Carolina, Alabama, and Florida, and that these surveys have shown the presence of immense quantities of these deposits, it is just to conclude that the mineral wealth of the country, in this particular, is of no mean proportions.

The quantity of phosphates imported into the United States (not including guano) has diminished with the increase of home production, having fallen from 133,955 tons, worth $1,437,442, in 1883, to 27,506 tons, worth $367,333, in 1885.

For the fiscal year ending June 30, 1885, there was exported from the United States farm products having a value of $530,172,835. The value of agricultural products imported was $249,211,-975, more than half of which was sugar, tea, and coffee. The excess of exports over imports was therefore $280,960,860.

It must be remembered, however, that the values of exports are given at the seaboard, and are fully 25 per cent greater than for the values given at the farm. To compare, therefore, exports with total production, the sum above given must be diminished by one-fourth, becoming $397,629,626, or 11 per cent of the total net value of the farm production of the country. Allowing for the small quantities of valuable plant-food introduced in our agricultural imports, we may safely place the loss of these ingredients, due to exportation, at 10 per cent of the whole.

The exportation of agricultural products, becomes, therefore, a slow but certain method of securing soil exhaustion; and this accounts for the fact that countries — or those portions of countries which are devoted to almost exclusive agricultural pursuits, thus causing a continuous exportation of agricultural products — become the homes, not of the richest, but of the poorest communities.

It would be useless to deny in this connection that our own country, with a soil enriched by centuries of accumulated nitrogen, has grown rich from its agricultural exports. But when the last of our virgin soil shall have been placed under cultivation, a continuous stream of such exports will certainly impoverish the nation, and reduce all who practise such agriculture to the condition which has already been reached by those who have for years grown tobacco, corn, cotton, and wheat on the same soil, and sold the products without paying back to the field the percentage of profits which was its due. On the other hand, the farmer who is fortunate enough to be permitted to patronize the home market, who sells his maize and takes home a load of manure, adds not only to the plethora of his purse, but also to the fertility of his soil.

Thus, in the light of agricultural chemistry, we see clearly the deep scientific basis of the teachings of political economy which show the value of the home market. While, therefore, the statement that the chief factor in the prosperity of a country is its agriculture, remains in every sense true, yet, from the data discussed, it as readily appears that agricultural prosperity is most intimately connected with the advancement of every other industry. Agricultural chemistry teaches the farmer to welcome the furnace and the mill, for in their proximity he secures a sure return to his fields of the plant-foods removed in his crops.

We have seen by the foregoing discussion, that, without any artificial additions, the soil. excluding the subsoil, contains enough of the two most important and valuable mineral constituents of plants to produce an average crop annually for two hundred and fifty years. In point of fact, however, the impoverishment of the soil takes place at a much slower rate than this theory would indicate. It would indeed be a sorry thought to consider that in a quarter of a millennium more the agricultural area of the earth would be incapable of producing further yields. Doubtless much of this reserve food is brought from the subsoil; and, if it be possible for the subterraneous stores of these materials to gradually work their way surfacewards, even the remote future need not fear a dearth of them.

There is also a certain conservatism in crops, a vegetable 'good breeding,' which prevents the growing plant from taking all the food in sight. As long as there is abundance, the plant is a hearty eater; but, when the visible quantity of food falls to a certain minimum, it remains for a long time without any rapid diminution. This fact is well illustrated in the experiments of Lawes and Gilbert at Rothamstead, where wheat was grown on the same unmanured field for forty years in succession.

Professor Wiley then passed to a discussion of the sources of supply of nitrogen used as plant-food, and, after giving an extended account of the most recent researches, summed up the results as follows: —

1. The combined nitrogen, which is the product of vegetable and organic life, forms the chief source of nitrogen for the growing plant.

2. Before it is assimilable by the plant it undergoes a process of oxidation, which is due solely to a living organism.

3. The nitrates thus formed are absorbed by the plant, and the albuminoids of the new growth are formed from the nitric nitrogen by a process of reduction. The nitrates themselves are subject to the action of a ferment, by which a deoxidation takes place, and free nitrogen and nitrous oxide are evolved.

4. The diminution in the quantity of available nitrogen thus supplied is restored by the fixation of free nitrogen by the action of organisms in the soil, or by the oxidation of free nitrogen by the interior cells of the plant acting in a manner analogous to the nitric ferment in the soil; or by the oxidation of free nitrogen by electrical discharges or by combustion.

5. The quantity of combined nitrogen brought to the soil and growing plant by the rain-water and the atmosphere, arising from the last two phenomena, is an inconsiderable amount, when compared with the whole weight required by the crop.

Since, with a proper economy, the natural supplies of potash and phosphoric acid may be made to do duty over and over again, and last indefinitely, the economist, who looks to the welfare of the future, need have no fear of the failure of these resources of the growing plant. Indeed, it may be said that the available quantities of them may be increased by a wise practice of agriculture based on the teachings of agricultural chemistry.

But with the increase of population comes an increased demand for food, and, therefore, the stores of available nitrogen must be enlarged to supply the demands of the increased agricultural product. It is certain that, with new analytical methods, and the new questions raised by investigation, many series of experiments will be undertaken, the outcome of which will definitely settle the question of the entrance of free nitrogen into vegetable tissues. If this question be answered affirmatively, agricultural science will not place bounds to the possible production of foods. If the nitrofying process does go on within the cells of plants, and if living organisms do fix free nitrogen in the soil in a form in which at least a portion of it may be nitrified, we may look to see the quantities of combined nitrogen increase *pari passu* with the needs of plant life. Thus, even intensive culture may leave the gardens and spread over the fields, and the quantities of food suitable for the sustenance of the human race be enormously increased.

In regarding the agricultural economies of the future, however, it must not be forgotten that a certain degree of warmth is as necessary to plant development as potash, phosphoric acid, and nitrogen. If it be true, therefore, that the earth is gradually cooling, there may come a time when a cosmic athermacy may cause the famine which scientific agriculture will have prevented. Fortunately, however, for the human race, the cereals, the best single article of food, are peculiarly suitable to a cold climate. Barley is cultivated in Iceland, and oatmeal feeds the best brain and muscle of the world in the high latitudes of Europe.

It is probably true that all life, vegetable and animal, had its origin in the boreal circumpolar regions. Life has already been pushed half way to the equator, and slowly but surely the armies of ice advance their lines. The march of the human race equatorwards is a forced march, even if it be no more than a millimetre in a millenium. Some time in the remote future the last man will reach the equator. There, with the mocking disc of the sun in the zenith, denying him warmth, flat-headed, and pinched as to every feature, he will gulp his last mite of albuminoids in his oatmeal, and close his struggle with an indurate in hospitality.

NOTES AND NEWS.

ACCORDING to the report of Gustavus Hinrichs of the weather service of Iowa, that state, since the middle of May, has been subjected to a drouth, the most severe on record. The most serious drouth preceding the present one prevailed during June and July of 1863, when for sixty days no serviceable rains fell in Iowa City; but rains had been sufficiently abundant till the end of May, and nearly five inches of water fell during the first ten days of August. In the early summer of 1886, the last good rain fell on May 13. After that time, there was no rain reaching half an inch until August 4, — eighty-three days without a serviceable shower! The total rainfall during that period was less than one inch, while the normal rainfall would be nearly ten and a half inches. But, notwithstanding this extreme drouth, it cannot be said that there is a failure of crops; because farming operations in that state are so diversified that a total failure is almost an impossibility.

LETTERS TO THE EDITOR.

***Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Glaciers and glacialists.

THE number of *Science* for the 23d of July last contains a paper by Mr. Jules Marcou, in which he refers to my memoir on Professor Guyot (published by the U. S. national academy), and denies statements cited by me from a publication by Professor Guyot with regard to the latter's glacier discoveries. Mr. Marcou commences his criticism on the subject with the following paragraph: "At Princeton Guyot was long isolated from intercourse with Swiss naturalists; and at the close of his life, while suffering under the malady which proved fatal in 1884, he put forth claims of doubtful value. These are the facts." Then follow the facts as Mr. Marcou understands them.

Mr. Marcou's statement is wrong in important points. Professor Guyot gives an account of his own discoveries of 1838 in his memoir of Professor Agassiz, which was read before the national academy, the first part in October, 1877, the second in April, 1878. This is six years before his decease, while he was still engaged in his laborious topographical survey of the Catskills The following is the paragraph from the Agassiz memoir: —

"In the spring of 1838 I had the pleasure of a visit from my dear friend Agassiz in Paris, where I then resided. The main topic of conversation was, of course, the glaciers He put me *au courant* of Charpentier's views, as yet imperfectly published (his book having been issued only two years later, in 1840), and adding his own idea of a general glacier era, he urged me to turn my attention to these phenomena. I asked to be allowed to suspend my judgment until my own observations should justify my adhesion to so startling a theory, but promised to visit the glaciers that very summer. I did so, and an exploring tour of six weeks in the Central Alps rewarded me beyond my expectation. The glacier of the Aar, on which Agassiz began two years later (1840) his regular system of observations, taught me the law of the moraines. The glacier of the Rhone gave me the law of the more rapid advance of the centre of the glacier, and that of the formation of the crevasses, both transversal and longitudinal. The glacier of Gries showed me the laminated, or ribboned (blue bands) structure of the ice deep down in the mass of the glacier, and the law of the more rapid advance of the top over the bottom. On the southern slope of Mont Blanc, the great glacier of La Brenva, with its twin rocks, rising like two dark eyes from the middle of the ice (they are, indeed, called by the mountaineers the 'eyes of the glacier'), made me understand that the motion of the glacier takes place by a gradual displacement of its molecules under the influence of gravity, giving it a sort of plasticity, and not by a simultaneous gliding of its whole mass, as believed by de Saussure. All these laws, deduced from a first, but attentive, study of the phenomena of the glaciers, were, at that time, — excepting that of the moraines, — new for science. They were expounded by me, and illustrated by diagrams, at the meeting of the geological society of France, in session at Porrentruy, the same summer of 1838; and I had the great satisfaction of seeing them fully confirmed by the subsequent observations of Agassiz and others, which furnished the precise numerical data then wanting for their complete elucidation. This paper, however, though duly mentioned in the proceedings of the geological society (*Bulletin*, vol. ix. p. 407), was not printed, owing to a protracted illness of its author in the winter following But on the occasion of a claim by Prof. J. D. Forbes to the discovery of the laminated, or ribboned, structure of the ice, the portion relative to this subject was printed, and the whole manuscript, on a motion of Agassiz, was deposited, by a formal vote, as a voucher, in the archives of the Society of natural sciences of Neuchatel, the original draft being now in my hands. If I mention this circumstance, it is because the regrettable omission of the publication of my paper was the occasion of the unfortunate misunderstanding which estranged two such men as Agassiz and Forbes, and which I feel bound, in a measure, to explain."

The manuscript referred to in the latter part of this citation was sent to the Society of natural sciences of Neuchatel early in 1883, was read at the session of the society on the 12th of April, 1883, and published in its *Bulletin* of the same year. I have a copy of the published paper, which I received from the secretary of the Neuchatel society. It is in French, as first written, and its title page, and also the cover, bears the heading, 'Observations sur les glaciers des Alpes en 1838, par M. Arnold Guyot.' I had thus, in Guyot's memoir of Agassiz, and this publication by the Society of natural sciences of Neuchatel, the fullest authority for my statements, and also, in this and other ways, abundant reason for confidence in Professor Guyot. Moreover, his memoir of Agassiz bears evidence throughout that his friendship for Agassiz, as I know from long and intimate intercourse with him, was, to the end, that of a brother.

In the same memoir, Guyot says of Venetz and Charpentier — names mentioned by Mr. Marcou — and of Agassiz's great results:

"If to Venetz and Charpentier belongs the honor of having first proved the transportation of the Swiss erratic bowlders by the agency of ice, and the existence of great glaciers formerly extending to the Jura, to Agassiz we must accord the merit of having given to these facts their full significance; of having brought them before the world at large, and having made the glacial question, as it were, the order of the day. By his sagacity he found glacial action where it was never suspected before, pointed it out to the astonished and unbelieving English geologists on their own soil; found it in North America; traced it with undoubted evidence in the temperate regions of South America; and believed, though with hardly sufficient reason, that he had seen it on the vast plains of the Amazon. He proved the phenomena to be well-nigh universal." Thus Guyot does justice to his friend, and recognizes the earlier work of Venetz and Charpentier.

My academic memoir of Guyot closes with the following sentence: "As fellow-students, we have special reason to admire in Guyot — as he wrote of Humboldt — 'that ardent, devoted, disinterested love of nature, which seemed, like a breath of life, to pervade all his acts; that deep feeling of reverence for truth, so manifest in him, which leaves no room for selfish motives in the pursuit of knowledge, and finds its highest reward in the possession of truth itself.'" I know this to be a just tribute.

Mr. Marcou's remark condemnatory of Professor Agassiz's 'successor at Harvard college,' for "having denied, *in toto*, in a publication founded by Agassiz, — 'The memoirs of the Museum of comparative zoölogy,'— his [Agassiz's] great discovery of the 'ice age,' but having, more than that, ignored him altogether as the discoverer of the existence of ancient glaciers in the British Dominions, in New England and New York, in Brazil, in the Straits of Magellan, and in Chili," is essentially groundless. 'The memoirs of the museum,' referred to, contain, among its volumes, a work entitled 'The climatic changes of later geological time, by J. D. Whitney,' and this is the only ground presented by Mr. Marcou for the charge he makes. Mr. Whitney's work opposes accepted views on ancient glacier distribution, and therein opposes Agassiz, and nearly all geologists living; but he has not a word of disparagement for Agassiz, and gives no just cause of personal complaint. Mr. Marcou's charge against Mr. Alexander Agassiz has no other foundation, and is not true to the views he holds, and has always held, with regard to his father's work and discoveries connected with glaciers and the 'ice-age.' The memoirs of the museum of comparative zoölogy, founded by Mr. Alexander Agassiz, and not by his father, has been for some time sustained, and the museum work carried on, with the grandly generous outlay on Mr. Agassiz's part of several hundred thousand dollars; and he has never made the stipulation, which the objector seems to require, that the publications should contain nothing in opposition to his own, or his father's opinions.

James D. Dana.

New Haven, Aug. 11.

Lacustrine deposits of Montana.

The examination of the Gallatin valley in Montana, by the writer, under the supervision of Dr. F. V. Hayden, during the summer of 1885, has developed some points of general interest in relation to the old lake basins of that region. Dr. Hayden was the first to demonstrate the fact that the western country, during the tertiary period, was covered to a greater or less extent with lakes, the waters of which, as the tertiary period progressed, gradually changed from brackish to fresh; until in pliocene time there were numerous fresh-water lakes scattered all over the area of the west, from the Mississippi valley to the Pacific coast.

The first of the basins described by Dr. Hayden was the one lying east of the Rocky Mountains, and extending from the Niobrara River to an unknown distance south of the Platte River. He estimated that this lake must have occupied an area of from 100,000 to 150,000 square miles. To the beds deposited in this lake the name of the Loup Fork group was given; and they were found to shade imperceptibly into an upper group, to which he gave the name of Post-Pliocene, the lower strata having been referred to the pliocene from a study of the abundant vertebrate remains found in them.

In 1871 the writer accompanied Dr. Hayden's expedition of that year from Utah across the Snake River plains, through Idaho to Montana. Old lake-beds were found filling many of the valleys,—the expansions of all the more important rivers and many of their tributaries having once been lakes. The lacustrine deposits consisted mainly of sands, arenaceous clays, and what were called 'marls.' They were recognized to be precisely like the beds of the Loup Fork group, generally light colored, white, creamy yellow, or ashy gray, and were referred by Dr. Hayden to the pliocene, from their lithological characters. He supposed that the lakes dated back to the pliocene, and that the waters gradually subsided during quaternary times. Specimens of the rocks were collected, in 1871 and 1872, and deposited in the Smithsonian institution. The only fossils obtained in 1871 were a fragment of the jaw of Anchitherium agreste, associated with a helix. Pliocene fossils were found by Dana and Grinnell, in 1874, in a basin on a branch of Smith's River in Montana, but the beds from which they were obtained were only fifty feet in thickness, and differ from the beds of the other lacustrine areas in the mountains. The data as to the age of these supposed pliocene deposits is therefore meagre. Some facts of rather recent discovery, however, seem to indicate that possibly their age, and their contemporaneity with the original Loup Fork beds and the post pliocene of Hayden, may eventually be established by the study of the lithological characteristics of the various basins. At any rate, certain lines of investigation are suggested that promise interesting results.

Somewhat more than a year ago Mr. George P. Merrill, of the national museum, informed me that in arranging the 'pliocene marls' and sands that I had collected in 1871, he was struck with their peculiar appearance; and upon subjecting them to a microscopic examination, he had found them to be composed mainly of volcanic material, several of them, in fact, being wholly composed of volcanic or pumiceous glass. These specimens were from some of the valleys in the upper branches of the Jefferson River. Although some of the coarser strata of the deposits were recognized in 1871 as being of volcanic origin, that the peculiar ashy gray, drab, and cream-colored beds so characteristic of the lacustrine areas were of a similar origin, was first demonstrated by Mr. Merrill's examinations. This discovery gave additional interest to the study of the Gallatin valley lacustrine area, which has been our field of study for the past two seasons.

The specimens collected in the summer of 1885 have also been examined, and they reveal the fact that the so-called marls and sands are composed largely of pumiceous glass, which was in all probability ejected into the air from volcanic vents, and deposited in the quiet waters of the lake. The character of the beds is such that they are very readily eroded and broken down, which probably accounts for the removal of so enormous a mass from the central portions of the valley. How great the thickness of the original deposit was, it is impossible to say exactly; still, the remnants on the south east side of the basin, near Bozeman, represent a thickness of at least eight hundred to a thousand feet. Only the eastern side of the valley has as yet been re-examined, and the beds are so generally concealed along the edge of the mountains that it is difficult to obtain a connected section in detail: the general section, however, has been determined. As in the case of the Loup Fork section, near the mountains, and in the lake-basins of other portions of Montana, there is a progression from calcareous beds up through loosely coherent sands to conglomerates, which cap the series. Creamy-white limestones with veins of quartz or chalcedony are the lowest rocks of the lake series in the Gallatin valley; and above them are light yellowish-gray, marly-looking sands, distinctly stratified. They are highly calcareous, but, after treatment with hydrochloric acid, the residue is found to be mainly made up of particles of glass. In the central portion of the section near Bozeman, the beds are composed almost purely of pumiceous glass, while the upper portions show a mingling of particles of crystalline rocks with the glass. The crystalline particles were evidently derived from the mountains near by, when they formed the shore of the lake. The pumiceous particles in the Gallatin valley specimens are sharp and angular, and show no evidence of attrition. The conclusion seems inevitable that this material was thrown into the air from some volcanic vent or vents, perhaps in repeated showers, and deposited in comparatively quiet waters. As the lake became more and more filled up, there appears to have been more agitation in its waters, and particles worn from the shores were mingled with the volcanic materials. That the latter was not carried in by water, seems probable, for the central portions of the beds are almost, if not entirely, made up of glass alone; and moreover, the finely comminuted condition of the particles, and their homogeneity in close proximity to the shore, confirm the view that they are wind-carried. The general resemblance of the Montana sections to those of the Loup Fork region led me to look up in the national museum some of the Loup Fork fossils collected by Dr. Hayden from 1856 to 1857, and described by Dr. Leidy. Sufficient material for microscopic examination was found adhering to many of the bones, and, in nearly every case, pumiceous particles were recognized in the sand. Specimens sent to the writer within the last three months, from several localities in northern and north-western Nebraska, and from north-western Kansas, have also contained similar volcanic glass. Mr. G. P. Merrill, in the 'Proceedings of the national museum for 1885' (p. 99–100), has described volcanic dust from southern Nebraska. Dr. M. E. Wadsworth (*Science*, vi. p. 63) describes similar material from south-east of the Black Hills in Dakota; and Prof. J. E. Todd discovered, in 1885, in eastern and north eastern Nebraska, beds of siliceous material, which were identified by Mr. J. S. Diller as being composed largely of volcanic glass (*Science*, vii. p. 373). We find, therefore, that not only is there a resemblance in appearance and in the order of succession between the Loup Fork beds and the lacustrine strata of Montana, but that in both, volcanic dust or pumiceous glass enters largely into their composition; and it is suggested that future investigations may possibly lead to a determination of their age through the careful study of this volcanic material.

The fresh-water tertiary formations east of the Rocky Mountains, and even in the mountains, have been supposed to differ from those in the west (in Idaho, Nevada, and Oregon), where the accumulation of volcanic sediments in the old lake-basins has been recognized by Newberry, King, Russell, Gilbert, and others. Will we not, therefore, have to cut down very materially the great length of time generally believed to have elapsed in this region from the beginning of this lacustrine period to the present time, when we find that a great portion of the sediment that once filled the lakes is due, not to the products of erosion, as has hitherto been supposed, but to repeated showers of volcanic dust? Again, do not these volcanic materials, which must have fallen in showers over a large extent of country,—accumulating in some cases in beds forty to ninety feet thick,—account for the perfect preservation of the vertebrate remains which characterize the formations in so many parts of the west; and is there not also suggested one possible cause for the extinction of some of the many groups of animals which have at present no descendants in this region, and whose only remains are the bony fragments found in these lacustrine deposits?

A. C. Peale.

U. S. geological survey.

Carnivorous prairie dogs.—Carnivorous orioles.

The statement of R. W. Shufeldt that his pair of young prairie dogs took kindly to a meat diet (*Science*, viii. p. 102) attracted my attention and interest, for it recalled to my mind an experience of my own in the summer of 1838. Having a pair of the marmots at this moment under observation here, I determined to try them with a piece of raw beef, and the eagerness with which they *plunged* at it (for their avidity cannot be characterized by any milder word) was certainly something very astonishing. Their ordinary vegetable food they take *quietly*, but the beef seemed to set them frantic. They acted as though they were famishing, — they seized it so fiercely, fighting with one another for it, and hastening back to ask for more. And so it has continued. Their owner fears to feed them with it exclusively, but gives them more or less daily, and the contrast between their eagerness for the meat and their quiet consumption of vegetables is a very instructive lesson. Their stomachs, out on the plains, always hold vegetable contents and nothing else. This was doubtless the first piece of meat ever tasted by either of these. Whence this craving appetite?

The experience of 1838 to which I referred was this: That was in the earlier days of my 'natural history,' three years before my first ichthyological paper was written. I had taken three young Baltimore orioles from their nest, but feared that I should lose them, for they refused every variety of food I offered them. At that time I was collecting birds zealously, and was skinning several of them daily. As I was preparing a specimen, one of the young orioles was sitting on my table, very stupid indeed, head drawn in, not life enough to utter a sound, thoroughly dumpish. Without knowing why, I picked up a bit of the bird's flesh and offered it to him. To my great surprise he swallowed it on the instant, and roused himself at once. That one mouthful had done him so much good that he wanted more. I took him on my finger and fed him piece after piece, till his throat was swelled out like an over-fed chicken's crop, and I feared to give him more. He settled himself down with great satisfaction, and went to sleep. I fed his brother and sister in the same way; and from that time till they were fully grown they had not a mouthful of food except the flesh of the birds I was skinning. Their eagerness for the meat was extreme. They learned the bird-skinning business to perfection. As soon as they saw me prepared for work, they all gathered about the specimen, ravenous for meat, and I almost always commenced to skin my bird, with an oriole sitting on each hand, and one on the specimen itself, and with three little heads down over the abdomen, where the first cut was to be made (they knew the point well enough): and the instant I opened the skin, in went three bills, digging and tearing fiercely for their food, and continuing at it as I continued my work, till their appetites were satisfied.

I do not know that this fact concerning the Baltimore oriole has ever been reported. I recollect mentioning it to Mr. Audubon, but it was after his account of the species had been published.

W. O. Ayres.

New London, Conn., Aug. 11.

Flooding the Sahara.

In our own country an evaporation of two feet per year is a small figure, and twice that amount has been recorded in some cases; so that it would seem to be safe to assume that it would exceed the latter value in the north of Africa. Taking Mr. LeConte's figures (*Science*, vol. viii. p. 35), and an evaporation of *two* feet per year, and the cubic feet evaporated, on an area of 3,100 square miles would be $2 \times 864{,}230 \times 10^5$ cubic feet $= 1{,}728{,}460 \times 10^5$ cubic feet per year. But the inflow, according to his assumptions, would be $1{,}262{,}277 \times 10^5$ cubic feet per year; so that at the rate of two feet of evaporation per year, the amount evaporated would be 1.3 times the amount of the inflow. In other words, at the rate of inflow assumed, the depression to be flooded would *never* be so far filled as to make a surface of 3,100 square miles; and if the evaporation be four feet per year, the inflow would necessarily be nearly three times that assumed by Mr. LeConte.

De Volson Wood.

Hoboken, Aug. 14.

Barometer exposure.

The discussions in *Science* relating to the effect of high winds upon the indications of a barometer in a room, have been highly interesting. I only desire at this time to present a few facts that bear upon the problem, and to correct a few misconceptions. No one that has attempted making a fire in a very cold room, on a very windy day, with a refractory chimney in the fore ground, can be easily convinced that there is much of a draft up a cold chimney, even with a hurricane. Even if there were such draft, the air must flow in through all the cracks, especially on the windward side, and equilibrium would thus be kept up. It should be noted also that the wind does not blow steadily, but rather in gusts; consequently there can be no such thing as a permanent lower pressure inside than outside a room, but a momentary depression by a gust would be relieved almost immediately by the lull.

This is shown beautifully by a barograph properly arranged. All references will be to a barograph inclosed in a tight glass case, such as has been adopted by Mr. Hough of Albany. The fluctuations are so rapid that they cannot be seen on a sheet carried at the rate of one to two inches per day, but only upon one carried from seven-tenths of an inch to one inch per hour. In the latter case, with a very high wind sometimes, but rather the exception, there will be seen fine serrations, at intervals of one or two minutes, having the appearance of a very fine saw. These serrations are quite regular, and are seen only during the high wind. The greatest fluctuation cannot be more than eight one-thousandths of an inch and seldom are above four one thousandths to six one thousandths. It is probable that the wind influences these fluctuations, but it is very difficult to determine just how. That a high wind does not always produce them is quite remarkable. Returning to our drawing chimney, it would seem an interesting computation as to how long a gust would need to last in order to draw out of a chimney one foot square sufficient air to produce the supposed depression.

If we consider that the barograph is inclosed in an almost air-tight case, we have still another addition to our problem. Even if there were a withdrawal of air from the room, is it possible for the influence to reach the inside of the case before the lull has made a change? A partial answer to this question may be had by experimenting with the case. If the door be opened rather suddenly a partial vacuum is formed, or a jar occurs, which moves the float, and the pencil falls or rises according as the barometer has previously had a tendency down or up. This effect is only two one-thousandths of an inch; and it is very rare that an influence greater than that can be brought to bear upon the apparatus under these conditions. It would seem as though the effect produced by opening or closing the case may be many times greater than the utmost that can come from an intermittent wind.

If we turn to the original letter by Mr. Clayton (vol. vii. p. 484), we shall find these particular cases given by him: 1°. "On March 16 the wind's velocity rapidly rose from five to thirty-five miles, and the barometer suddenly fell five one hundredths of an inch;" 2°, "During a sudden gust attending a shower, last summer, the barometer fell a tenth of an inch, and immediately rose again as the gust ended;" 3°, "It [the pressure] fell as much as a tenth of an inch during a seventy-mile wind in February." It will be seen that each of these cases occurred under abnormal conditions, and just at the time when we would naturally expect such fluctuations; but they can hardly be due to the wind, as they are often noted when there is no high wind. The wind's action is intermittent, and there is no evidence whatever of this most important fact making itself known. It is a matter of regret that Mr. Clayton did not open and shut his trap-door at intervals of five or ten minutes, for an hour or so. He would have settled the question beyond doubt if he had done this.

Much has been written in regard to the evidence of observations on Mount Washington. Mr. H. A. Hazen has given a partial discussion of the Mount Washington records in the 'Annual report of the chief signal officer,' for 1882. He there has shown that the effect of the wind upon the computed elevation changes sign at a velocity of twenty-five to thirty miles per hour; i. e., instead of the effect being zero when there was no wind, it was really zero with a wind of twenty-five to thirty miles per hour. This is a fair indirect proof either that the wind does not cause the fluctuation, or, if it does, that another force is superposed upon it.

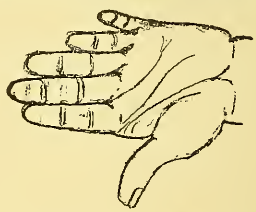
It is hazardous drawing conclusions upon the facts thus far developed. It may be that the wind can produce more than one effect, and that the serration effect above alluded to is not the only one to be considered. The weight of evidence seems to be rather against any great depression being produced. Mr. Clayton will do meteorology a great service by trying a few experiments. If his barograph, shut, is carried along only two inches a day, opening the trap-door ten minutes will give only one seventy-second of an inch for the pencil to move in. The difficulty can be obviated, however, by letting an attendant note the movement of the pencil (if there be any) and carefully take the time of the fluctuations, if the time of manipulating the trap-door be also taken, a comparison of times will settle the question.

Gan.

Aug. 10.

A case of inherited polydactylism.

In the spring of 1883 I saw and examined a case of inherited polydactylism, which I think worth recording. While enjoying the hospitality of a friend, in a charming ravine opening into Napa Valley from the mountains on the west side, my attention was drawn, by my intelligent hostess, to the hands of a German laborer at work in the garden. There were six well-formed, usable fingers on each hand. The metacarpals were of the normal number, but the fifth bore two fingers. The supernumerary little finger differed from the true little finger only in being much smaller.



I give a rude drawing of the left hand, made on the spot, showing the size and position of the supernumerary finger.

I inquired concerning his family history in this regard. His account is given in the following diagram, in which I have italicized those who are or were polydactylous:

Maternal Grandfather. *Maternal Grandmother.*

Father. *Mother.*

Sisters. Bro.

Peter Weitner, *a*, b, c, d; *a*.

Children.

It is seen that the deformity was inherited from his mother's maternal grandmother; that, besides himself, it has affected one sister, out of four, and one brother, and has been transmitted to the children of the sister, thus affecting at least four generations.

Joseph Le Conte.

Berkeley, Cal., Aug. 5.

"Thumb marks."

One of the anatomical characteristics recently brought within the area of anthropological investigation is the marking on the skin of the hand, especially of the thumb. Indeed, a proposition has been made to use this characteristic for identifying the Chinese emigrants to California. In Germany, especially, attempts have been made to show that these markings have racial significance. Has it ever been noticed that this custom has been borrowed from China, where the thumb and finger markings are used for purposes of identification, and by illiterates in signing papers? In the 'Proceedings of the China branch of the Royal Asiatic society,' for 1847, p. 11, is an article on land-tenure in China, by Thos. T. Meadows. Appended to this article is a copy of a deed bearing the thumb-signature of the grantor, a woman. Chinese sailors shipping on junks are made to sign with five fingers, in order to get a more certain identification. Dr. D. B. McCartee informs us that the Chinese class the striae at the ends of the fingers into 'pots' when arranged in a coil, and 'hooks' when they form a curving loop. They say that two men's thumbs may be alike, but that it is hardly possible that their hands would make similar pot-hooks.

Walter Hough.

U. S. national museum, Aug. 10.

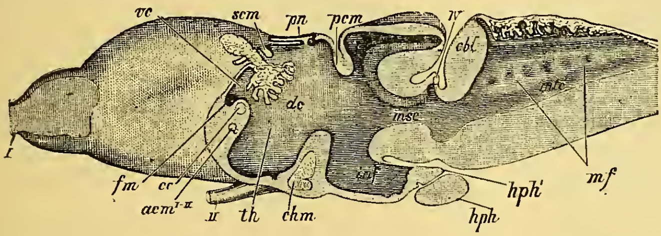


Fig 1. — A vertical section of the frog's brain (*Rana esculenta*): *acm*, anterior commissure; *cc*, or *cal*, corpus callosum; *dc*, or v^3, third ventricle; *fm*, foramen of Monro; *lt*, lamina terminalis; *pr*, pineal gland; *lv*, lateral ventricle; *vc*, ventriculus communis.

The corpus callosum in the lower vertebrates.

The corpus callosum, or great commissure of nerve fibres connecting the cerebral hemispheres, has long been one of the landmarks of comparative anatomy. In every modern work upon zoölogy, this commissure is given as a brain character which distinguishes the mammals from the lower orders of vertebrates. In fact, Owen long maintained that the corpus callosum proper was wanting in the marsupials and the monotremes; and his authority on this point was generally accepted until Flower, in 1865, demonstrated that this commissure is well developed in these animals, although much smaller in relation to the size of the anterior commissure. These observations were soon confirmed by Sander.

It is an interesting fact, as an example of knowledge apparently going backwards, that the earlier anatomists, in studying these commissures, hit much nearer the truth than their successors. For instance, that acute observer, Meckel, so long ago as 1816, correctly described the corpus callosum in the brain of the duck, and Reissner found it in the brain of the frog, in 1867. Other authors gave more or less accurate accounts of this organ in the lower vertebrates. More recently, in 1875, Stieda found it in the brain of the turtle. In face of these statements, all subsequent authorities, including Mihalkovics, Rl. Rückhard, Bellonci, and Stieda (with the exception of his one observation mentioned above), hold that the corpus callosum first arises among the mammals. This error, as it now appears, has sprung from two causes: first, from the difficulty of following the nerve-fibre courses in these small brains, a difficulty which has been to a great extent removed by improved microscopic methods; second, from the following fact: the anterior commissure in the mammalian brain consists of two divisions, one going to the olfactory lobes, the other to the temporal lobes. Recent authors have been led to confuse the commissure which really represents the corpus callosum, with the first-mentioned division of the anterior commissure, the truth being that the distribution of this commissure has never been precisely observed.

During the past winter I had an opportunity of studying the cerebral commissures in types of all the lower orders, in the most thorough manner; and found that the corpus callosum, so far from being a structure peculiar to the mammals, is present in the reptiles, birds, and Amphibia, and probably also in the Dipnoi and other fishes. In short, this commissure is a primitive character of the vertebrate brain. An account of the steps which led to this conclusion would exceed the due limits of this article, but an outline of the results may be given.[1]

For our present purpose, we must recall the embryonic position of the mammalian corpus callosum as a delicate bundle, traversing the thin wall which unites the hemispheres, and known as the 'lamina terminalis.' Below this, in the lamina, is another fibre-bundle, the anterior commissure. In the placental mammals, these bundles, from the time of their first development, are separated by an interval or

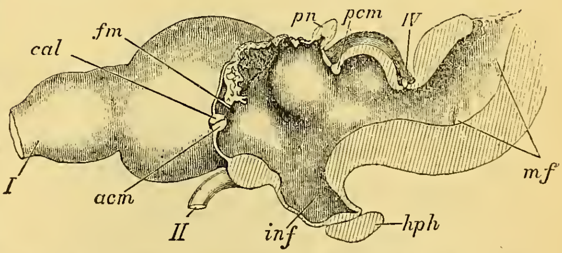


Fig. 2. — A vertical section of the turtle's brain (*Emys Europaea*).

septum; but in the marsupial brain, at an early stage, they lie close together in the middle line, very much as they are represented in fig. 3, in the turtle's brain (*cal* and *acm*), the upper bundle bending upwards, like a horseshoe; the lower passing outwards in the floor of the lateral ventricle (*lv*).

In the brain of the frog, in vertical section (fig. 1), we observe two bundles similarly placed in the lamina terminalis. The lowermost (*acm*) consists of two parts of unequal size, the larger part passing for-

[1] See *Morphologisches jahrbuch*, xii, August.

wards to the olfactory lobes, the smaller passing backwards. They correspond in distribution to the two divisions of the anterior commissure in the mammal. Does the upper bundle, then, represent the corpus callosum? When we follow the distribution

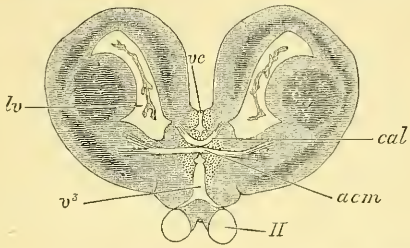


FIG. 3. — Transverse section of the fore-brain of the turtle in the plane of the cerebral commisures.

of its fibres to the upper inner cell-area of the hemispheres, this question seems clearly answered in the affirmative. But here arises a difficulty; this bundle lies below the foramen of Monro, and its fibres pass upwards *behind* the foramen, and then forwards above it. This is exactly the reverse of their position in the mammalian brain; but an explanation is found in the fact that the frog's brain retains many fish characters, and, among them, a large ventricle (the ventriculus communis) common to the two hemispheres, with the cerebral commissures lying in its floor. The brain of the turtle gives us a step nearer the mammalian type; for here, as in the mammal, the cerebral commissures lie in the front wall of the common ventricle, and the callosal bundle passes upwards in *front* of the foramen of Monro, and its fibres spread like rays over the entire inner wall of the hemispheres. Removing all further doubt that this bundle is homologous with the corpus callosum, is the fact that connected with it, as in the mammals' brain, are fibres passing backwards and downwards into a region which corresponds with the

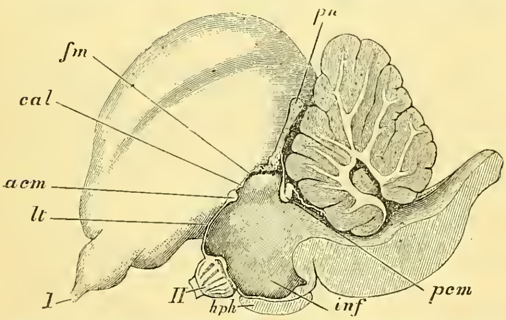


FIG. 4. — A vertical section of the brain of the duck (*Anas boschas*).

mammalian hippocampus. These fibres are usually described as the commissural portion of the fornix. The snake's brain (Tropidonotus) gives us a higher step, for, although the corpus callosum is a less distinct bundle, fibres are observed descending in the lamina terminalis, which in their relations closely resemble the columns of the fornix, —another structure which has been supposed to be peculiar to the mammals. In this brain also the olfactory and temporal divisions of the lower bundle have precisely the same relations as in the mammalian anterior commissure, demonstrating beyond a doubt that the lower bundle represents the entire anterior commissure, and not merely its tempor l division, as Stieda and Mihalkovics contend. Upon drawing apart the hemispheres of the freshly removed brain of a duck, we observe a delicate thread of fibres slightly above a large and distinct lower commissure. The former, in transverse section (fig. 5), is seen passing directly upwards into the inner wall of the hemispheres, and below it is a powerful transverse commissure. We cannot fail to recognize that these two bundles are essentially similar in distribution and position to those in the turtle, and that the upper one is a rudiment of the corpus callosum.

Here is seen an apparent anomaly. In the frog's brain, the proportion of the corpus callosum to the anterior commissure is as 2 to 1; in the turtle it is about 5 to 4, while in the birds it is about 1 to 6. Thus, with an ascending scale of intelligence, we find a diminishing corpus callosum, a relation the reverse of that which obtains in the mammals. The

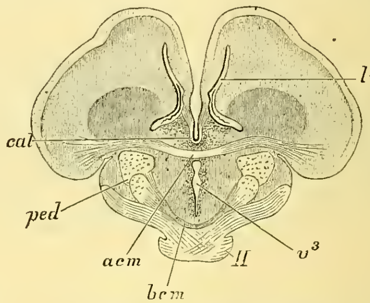


FIG. 5. — A transverse section of the duck's brain through the commissures.

explanation of this is probably that in the Sauropsida generally the inner wall of the hemispheres is thin, and in the birds it is reduced to a mere sheet of nerve-tissue, and this reduction of distribution area has effected a reduction of the commissure. In all these animals the united commissures are even smaller in proportion to the hemispheres than they are in the monotremes.

HENRY F. OSBORN.

A brilliant meteor.

You may think worthy to record the following memoranda of an unusually large and brilliant meteor, reported by Mr. E. Stockin of Watertown, Mass., and seen from that place on Sunday evening, Aug. 8. Time, about 8.45 P. M. Direction, north-east to east. The attention of both Mr. and Mrs. Stockin was first called to the meteor by the flash, which illuminated surrounding objects. On turning, they saw the meteor, apparently about thirty degrees above the horizon. It was of a bright red color, of about one-fourth the size of the moon, occupying five or six seconds in its descent, disappearing behind some buildings while still brilliant, and leaving a trail of brilliantly colored sparks, and subsequently a white streak visible some seconds. The exact direction of the meteor from the observer could be ascertained, if desirable, by means of positions noted at the time.

C. H. AMES.

Boston, Mass.

SCIENCE.—SUPPLEMENT.

FRIDAY, AUGUST 20, 1886.

METEORITES, METEORS, AND SHOOTING-STARS.

You are kindly giving to me an hour to-night in which I may speak to you. I do not have enough confidence in myself to justify me in speaking to such an audience as this upon one of those broad subjects that belong equally to all sections of the association. The progress, the encouragements, and the difficulties in each field are best known to the workers in the field, and I should do you little good by trying to sum up and recount them. Let me rather err, then, if at all, by going to the opposite extreme.

Two years ago your distinguished president instructed and delighted us all by speaking of the pending problems of astronomy, what they are, and what hopes we have of solving them. To one subject in this one science, a subject so subordinate that he very properly gave it only brief notice, I ask your attention I propose to state some propositions which we may believe to be probably true about the meteorites, the meteors, and the shooting-stars.

In trying to interest you in this subject, so remote from the studies of most of you, I rely upon your sense of the unity of all science, and at the same time upon the strong hold which these weird bodies have ever had upon the imaginations of men. In ancient times temples were built over the meteorite images that fell down from Jupiter, and divine worship was paid them; and in these later days a meteorite stone that fell last year in India became the object of daily anointings and other ceremonial worship. In the fearful imagery of the Apocalypse, the terrors are deepened by there falling 'from heaven a great star burning as a torch,' and by the stars of heaven falling "unto the earth as a fig tree casteth her unripe figs when she is shaken of a great wind." The "great red dragon having seven heads and ten horns, and upon his heads seven diadems," is presented in the form of a huge fire-ball. "His tail draweth the third part of the stars of heaven, and did cast them to the earth." Records of these feared visitors, under the name of flying dragons, are found all through the pages of the monkish chroniclers of the middle ages. The Chinese appointed officers to record the passage of meteors and comets, for they were thought to have somewhat to say to the weal or woe of rulers and people.

By gaining in these later days a sure place in science, these bodies have lost their terrors; but so much of our knowledge about them is fragmentary, and there is still so much that is mysterious, that men have loved to speculate about their origin, their functions, and their relations to other bodies in the solar system. It has been easy, and quite common too, to make these bodies the cause of all kinds of things for which other causes could not be found.

They came from the moon; they came from the earth's volcanoes; they came from the sun; they came from Jupiter and the other planets; they came from some destroyed planet; they came from comets; they came from the nebulous mass from which the solar system has grown; they came from the fixed stars; they came from the depths of space.

They supply the sun with his radiant energy; they give the moon her accelerated motion; they break in pieces heavenly bodies; they threw up the mountains on the moon; they made large gifts to our geological strata; they cause the auroras; they give regular and irregular changes to our weather.

A comparative geology has been built up from the relations of the earth's rocks to the meteorites; a large list of new animal forms have been named from their concretions; and the possible origin of life in our planet has been credited to them.

They are satellites of the earth; they travel in streams, and in groups, and in isolated orbits about the sun; they travel in groups and singly through stellar spaces; it is they that reflect the zodiacal light; they constitute the tails of comets; the solar corona is due to them; the long coronal rays are meteor streams seen edgewise.

Nearly all of these ideas have been urged by men deservedly of the highest repute for good personal work in adding to human knowledge. In presence of this host of speculations it will not, I hope, be a useless waste of your time to inquire what we may reasonably believe to be probably true. And if I shall have no new hypotheses to give you, I offer as my excuse that nearly all possible ones have been already put forth. This as-

Address to the American association for the advancement of science at Buffalo, Aug. 18, 1886, by Prof. H. A. Newton, of New Haven, the retiring president of the association.

sociation exists, it is true, for the advancement of science, but science may be advanced by rejecting bad hypotheses as well as by framing good ones.

I begin with a few propositions about which there is now practical unanimity among men of science. Such propositions need only be stated. The numbers that are to be given express quantities that are open to revision and moderate changes.

1. The luminous meteor tracks are in the upper part of the earth's atmosphere. Few, if any, appear at a height greater than one hundred miles, and few are seen below a height of thirty miles from the earth's surface, except in rare cases where stones and irons fall to the ground. All these meteor tracks are caused by bodies which come into the air from without.

2. The velocities of the meteors in the air are comparable with that of the earth in its orbit about the sun. It is not easy to determine the exact values of those velocities, yet they may be roughly stated as from fifty to two hundred and fifty times the velocity of sound in the air, or of a cannon ball.

3. It is a necessary consequence of these velocities that the meteors move about the sun and not about the earth as the controlling body.

4. There are four comets related to four periodic star-showers that come on the dates April 20, August 10, November 14, and November 27. The meteoroids which have given us any one of these star-showers constitute a group, each individual of which moves in a path which is like that of the corresponding comet. The bodies are, however, now too far from one another to influence appreciably each other's motions.

5. The ordinary shooting-stars in their appearance and phenomena do not differ essentially from the individuals in star-showers.

6. The meteorites of different falls differ from one another in their chemical composition, in their mineral forms, and in their tenacity. Yet through all these differences they have peculiar common properties which distinguish them entirely from all terrestrial rocks.

7. The most delicate researches have failed to detect any trace of organic life in meteorites.

These propositions have practically universal acceptance among scientific men. We go on to consider others which have been received with hesitation, or in some cases have been denied.

With a great degree of confidence, we may believe that shooting-stars are solid bodies. As we see them they are discrete bodies, separated even in prolific star-showers by large distances one from another. We see them penetrate the air many miles, that is, many hundred times their own diameters at the very least. They are sometimes seen to break in two. They are sometimes seen to glance in the air. There is good reason to believe that they glance before they become visible.

Now these are not the phenomena which may be reasonably expected from a mass of gas. In the first place, a spherical mass of matter at the earth's distance from the sun, under no constraint, and having no expansive or cohesive power of its own, must exceed in density air at one-sixth of a millimetre pressure (a density often obtained in the ordinary air pump), or else the sun by his unequal attraction for its parts will scatter it. Can we conceive that a small mass of gas, with no external restraint to resist its elastic form, can maintain so great a density?

But suppose that such a mass does exist, and that its largest and smallest dimensions are not greatly unequal; and suppose further that it impinges upon the air with a planetary velocity: could we possibly have as the visible result a shooting-star? When a solid meteorite comes into the air with a like velocity, its surface is burned or melted away. Iron masses and many of the stones have had burned into them those wonderful pittings or cupules which are well imitated, as M. Daubrée has shown, by the erosion of the interior of steel cannon by the continuous use of powder under high pressure. They are imitated also by the action of dynamite upon masses of steel near which the dynamite explodes. Such tremendous resistance that mass of gas would have to meet! The first effect would be to flatten the mass, for it is elastic; the next to scatter it, for there is no cohesion. We ought to see a flash instead of a long burning streak of light. The mass that causes the shooting-star can hardly be conceived of except as a solid body.

Again, we may reasonably believe that the bodies that cause the shooting-stars, the large fire-balls, and the stone-producing meteor all belong to one class. They differ in kind of material, in density, in size. But from the faintest shooting-star to the largest stone-meteor, we pass by such small gradations that no clear dividing lines can separate them into classes. See wherein they are alike: —

1. Each appears as a ball of fire traversing the apparent heavens, just as a single solid but glowing or burning mass would do.

2. Each is seen in the same part of the atmosphere, and moves through its upper portion. The stones come to the ground, it is true, but the luminous portion of their paths generally ends high up in the air.

3. Each has a velocity which implies an orbit about the sun.

4. The members of each class have apparent motions which imply common relations to the horizon, to the ecliptic, and to the line of the earth's motion.

5. A cloudy train is sometimes left along the track, both of the stone-meteor, and of the shooting-star.

6. They have like varieties of colors, though in small meteors they are naturally less intense and are not so variously combined as in large ones.

In short, if the bodies that produce the various kinds of fire-balls had just the differences in size and material which we find in meteorites, all the differences in the appearances would be explained; while. on the other hand, a part of the likenesses that characterize the flights point to something common in the astronomical relations of the bodies that produce them.

This likeness of the several grades of luminous meteors has not been admitted by all scientific men. Especially it was not accepted by your late president, Prof. J. Lawrence Smith, who by his studies added so much to our knowledge of the meteorites. The only objection, however, so far as I know, that has been urged against the relationship of the meteorites and the star-shower meteors, and the only objection which I have been able to conceive of that has apparent force, is the fact that no meteorites have been secured that are known to have come from the star-showers. This objection is plausible, and has been urged, both by mineralogists and astronomers, as a perfect reply to the argument for a common nature to all the meteors.

But what is its real strength? There have been in the last hundred years five or six star-showers of considerable intensity. The objection assumes that if the bodies then seen were like other meteors, we should have reason to expect that among so many hundreds of millions of individual flights a large number of stones would have come to the ground and have been picked up.

Let us see how many such stones we ought to expect. A reasonable estimate of the total number of meteors in all of these five or six star-showers combined makes it about equal to the number of ordinary meteors which come into the air in six or eight months. Inasmuch as we can only estimate the numbers seen in some of the showers, let us suppose that the total number for all the star-showers was equal to one year's supply of ordinary meteors. Now the average annual number of stone-meteors of known date from which we have secured specimens has, during this hundred years, been about two and a half.

Let us assume, then, that the luminous meteors are all of like origin and astronomical nature; and further assume that the proportion of large ones, and of those fitted to come entirely through the air without destruction, is the same among the star-shower meteors as among the other meteors. With these two assumptions, a hundred years of experience would then lead us to expect two, or perhaps three, stone-falls from which we secure specimens during all the half-dozen star-showers put together. To ask for more than two or three is to demand of star-shower meteors more than other meteors give us. The failure to get these two or three may have resulted from chance, or from some peculiarity in the nature of the rocks of Biela's and Tempel's comets. It is very slender ground upon which to rest a denial of the common nature of objects that are so similar in appearance and behavior as the large and small meteors.

It may be assumed, then, as reasonable that the shooting-stars and the stone-meteors, together with all the intermediate forms of fire-balls, are like phenomena. What we know about the one may with due caution be used to teach facts about the other. From the mineral and physical nature of the different meteorites, we may reason to the shooting-stars, and from facts established about the shooting-stars we may infer something about the origin and history of the meteorites. Thus it is reasonable to suppose that the shooting-stars are made up of such matter and such varieties of matter as are found in meteorites. On the other hand, since star-showers are surely related to comets, it is reasonable to look for some relation of the meteorites to the astronomical bodies and systems of which the comets form a part.

This common nature of the stone-meteor and the shooting-stars enables us to get some idea, indefinite but yet of great value, about the masses of the shooting-stars. Few meteoric stones weigh more than one hundred pounds. The most productive stone-falls have furnished only a few hundred pounds each, though the irons are larger. Allowing for fragments not found, and for portions scattered in the air, such meteors may be regarded as weighing a ton, or it may be several tons, on entering the air. The explosion of such a meteor is heard a hundred miles around, shaking the air and the houses over the whole region like an earthquake. The size and brilliancy of the flame of the ordinary shooting-star is so much less than that of the stone-meteor that it is reasonable to regard the ordinary meteoroid as weighing pounds, or even ounces, rather than tons.

Determinations of mass have been made by measuring the light and computing the energy needed to produce the light. These are to be regarded as lower limits of size, because a large part of the energy of the meteors is changed into heat and motion of the air. The smaller meteors visible to the naked eye may be thought of without serious error as being of the size of gravel stones, allowing, however, not a little latitude to the meaning of the indefinite word 'gravel.'

These facts about the masses of shooting-stars have important consequences. The meteors, in the first place, are not the fuel of the sun. We can measure and compute within certain limits of error the radiant energy emitted by the sun. The meteoroids large enough to give shooting-stars visible to the naked eye are scattered very irregularly through the space which the earth traverses; but in the mean each is distant two or three hundred miles from its near neighbors. If these meteoroids supply the sun's radiant energy, a simple computation shows that the average shooting-star ought to have a mass enormously greater than is obtained from the most prolific stone-fall.

Moreover, if these meteoroids are the source of the solar heat, their direct effect upon the earth's heat by their impact upon our atmosphere ought also to be very great: whereas the November star-showers, in some of which a month's supply of meteoroids was received in a few hours, do not appear to have been followed by noticeable increase of heat in the air.

Again, the meteoroids do not cause the acceleration of the moon's mean motion. In various ways, the meteors do shorten the month as measured by the day. By falling on the earth and on the moon, they increase the masses of both, and so make the moon move faster. They check the moon's motion, and so, bringing it nearer to the earth, shorten the month. They load the earth with matter which has no momentum of rotation, and so lengthen the day. The amount of matter that must fall upon the earth in order to produce in all these ways the observed acceleration of the moon's motion, has been computed by Professor Oppolzer. But his result would require for each meteoroid an enormous mass, one far too great to be accepted as possible.

Again, the supposed power of such small bodies, —bodies so scattered as these are, even in the densest streams,—to break up the comets or other heavenly bodies; and also their power, by intercepting the sun's rays, to affect our weather, must, in absence of direct proof to the contrary, be regarded as insignificant. So, too, their effect in producing geologic changes by adding to the earth's strata has, without doubt, been very much over-estimated. During a million of years, at the present rate of, say, fifteen millions of meteors per day, there comes into the air about one shooting-star or meteor for each square foot of the earth's surface.

To assume a sufficient abundance of meteors in ages past to accomplish any of these purposes, is, to say the least, to reason from hypothetical and not from known causes. The same may be said of the suggestion that the mountains of the moon are due to the impact of meteorites. Enormously large meteoroids in ages past must be arbitrarily assumed, and, in addition, a very peculiar plastic condition of the lunar substance, in order that the impact of a meteoroid can make in the moon depressions ten, or fifty, or a hundred, miles in diameter, surrounded by abrupt mountain walls two, and three, and four miles high, and yet the mountain walls not sink down again.

The known visible meteors are not large enough nor numerous enough to do the various kinds of work which I have named. May we not assume that an enormous number of exceedingly small meteoroids are floating in space, are falling into the sun, are coming into our air, are swept up by the moon? May we not assume that some of these various results, which cannot be due to meteoroids large enough for us to see as they enter the air, may be due to this finer impalpable cosmic dust? Yes, we may make such an assumption. There exist, no doubt, multitudes of these minute particles travelling in space. But science asks not only for a true cause, but a sufficient cause. There must be enough of this matter to do the work assigned to it. At present we have no evidence that the total existing quantity of such fine material is very large. It is to be hoped that through the collection and examination of meteoric dust we may soon learn something about the amount which our earth receives. Until that shall be learned, we can reason only in general terms. So much matter coming into our atmosphere as these several hypotheses require would, without doubt, make its presence known to us in the appearance of our sunset skies, and in a far greater deposit of meteoric dust than has ever yet been proven.

A meteoroid origin has been assigned to the light of the solar corona. It is not unreasonable to suppose that the amount of the meteoroid matter should increase toward the sun, and that the illumination of such matter would be much greater near the solar surface. But it is difficult to explain upon such a hypothesis the radial structure, the rifts, and the shape of the curved lines, that are marked features of the corona. These seem to be inconsistent with any conceivable arrangement of meteoroids in the vicinity of the sun. If the meteoroids are arranged at random, there should be a uniform shading away of light as we go from the sun. If the meteoroids are in streams along cometary orbits, all lines bounding the light and shade in the coronal light should evidently be projections of conic sections of which the sun's centre is the focus. There are curved lines in abundance in the coronal light, but, as figured by observers and in the photographs, they seem to be entirely unlike such projections of conic sections. Only by a violent treatment of the observations can the curves be made to represent such projections. They look as though they were due to forces at the sun's surface rather than at his centre. If those complicated lines have any meteoroid origin (which seems very unlikely), they suggest the phenomena of comets' tails rather than meteoroid streams or sporadic meteors. The hypothesis that the long rays of light which sometimes have been seen to extend several degrees from the sun at the time of the solar eclipse are meteor streams seen edgewise, seems possibly true, but not at all probable.

The observed life of the meteor is only a second, or at most a few seconds, except when a large one sends down stones to remain with us, What can we learn about its history and origin ?

Near the beginning of this century, when small meteors were looked on as some form of electricity, the meteorites were very generally regarded as having been thrown out from the lunar volcanoes. But as the conviction gained place that the meteorites moved not about the earth but about the sun, it was seen that the lunar volcanoes must have been very active to have sent out such an enormous number of stones as are needed in order that we should so frequently encounter them. When it was further considered that there is no proof that lunar volcanoes are now active, and that when they were active they were more likely to have been open seas of lava, not well fitted to shoot out such masses, the idea of the lunar origin of the meteorites gradually lost ground.

But the unity of meteorites with shooting-stars, if true, increases a hundred fold the difficulty, and would require that the comets have the same origin with the meteorites. No one claims that the comets came from the moon.

That the meteorites came from the earth's volcanoes is still held by some men of science, particularly by the distinguished astronomer-royal for Ireland. The difficulties of the hypothesis are, however, exceedingly great. In the first place, the meteorites are not like terrestrial rocks. Some minerals in them are like minerals in the rocks. Some irons are like the Greenland terrestrial irons. But no rock in the earth has yet been found that would be mistaken for a meteorite of any one of the two or three hundred known stone-falls. The meteorites resemble the deep terrestrial rocks in some particulars, it is true, but the two are also thoroughly unlike.

The terrestrial volcanoes must also have been wonderfully active to have sent out such a multitude of meteorites as will explain the number of stone-falls which we know, and which we have good reason to believe have occurred. The volcanoes must also have been wonderfully potent. The meteorites come to us with planetary velocities. In traversing the thin upper air, they are burned and broken by the resisting medium. Long before they have gone through the tenth part of the atmosphere the meteorites usually are arrested and fall to the ground. If these bodies were sent out from the earth's volcanoes, they left the upper air with the same velocity with which they now return to it. What energy must have been given to the meteorite before it left the volcano, to make it traverse the whole of our atmosphere and go away from the earth with a planetary velocity. Is it reasonable to believe that volcanoes were ever so potent, or that the meteorites would have survived such a journey ?

No one claims that the meteors of the star-showers, or their accompanying comets, came from the earth's volcanoes. To ascribe a terrestrial origin to meteorites is, then, to deny the relationship of the shooting-star and the stone-meteor. Every reason for their likeness is an argument against the terrestrial origin of the stones. To suppose that the meteors came from any planets that have atmospheres, involves difficulties not unlike to, and equally serious with, those involved in the theory of a terrestrial origin.

The solar origin of meteorites has been seriously urged, and deserves a serious answer. The first difficulty which this hypothesis meets, is that solid bodies should come from the hot sun. Besides this, they must have passed without destruction through an atmosphere of immense thickness. Then there is a geometric difficulty. The meteorite shot out from the sun would travel, under the law of gravitation, nearly in a straight line out and back again into the sun. If in its course it enters the earth's atmosphere, its relative motion, that which we see, should be in a line parallel to the ecliptic, except as slightly modified by the earth's attraction. A large number of these meteors, that is, most if not all well-observed fireballs, have certainly not travelled in such paths. These did not come from the sun.

It has been a favorite hypothesis that the meteorites came from some planet broken in pieces by an internal catastrophe. There is much which mineralogists can say in favor of such a view. The studies of M. Stanislas Meunier, and others, into the structure of meteorites, have brought out many facts which make this hypothesis plausible. It requires, however, that the stone-meteor be not regarded as of the same nature as the star-shower meteor, for no one now seriously claims that the comets are fragments of a broken planet. The hypothesis of the existence of such a planet is itself arbitrary; and it is not easy to understand how any mass that has become collected by the action of gravity, and of other known forces, should, by internal forces, be broken in pieces and these pieces sent asunder. The disruption of such a planet by internal forces, after it has by cooling lost largely its original energy, would be specially difficult to explain.

We cannot, then, look to the moon, nor to the earth, nor to the sun, nor to any of the large planets, nor to a broken planet, as the first home of the meteoroids, without seeing serious if not insuperable objections. But since some of them were in time past certainly connected with comets, and since we can draw no line separating shooting-stars from stone-meteors, it is most natural to assume that all of them are of a cometary origin. Are there any insuperable objections that have been urged against the hypothesis that all of the meteoroids are of like nature with the comets, that they are in fact fragments of comets, or it may be sometimes minute comets themselves? If such objections exist, they ought evidently to come mainly from the mineralogists, and from what they find in the internal structure of the meteorites. Astronomy has not as yet furnished any objections. It seems strange that comets break in pieces, but astronomers admit it, for it is an observed fact. It is strange that groups of these small bodies should run before and follow after comets along their paths, but astronomers admit it as fact in the case of at least four comets. Astronomically, there would seem to be no more difficulty in giving such origin to the sporadic meteor, and to the large fire-ball, and to the stone-meteor, than there is in giving it to the meteor of the star-shower. If, then, the cometic origin of meteorites is inadmissible, the objections must come mainly from the nature and structure of the meteoric stones and irons. Can the comet in its life and history furnish the varied conditions and forces necessary to the manufacture or growth of these peculiar structures?

It is not necessary, in order to answer this question, to solve the thousand puzzling problems that can be raised about the origin and the behavior of comets. Comets exist in our system, and have their own peculiar development, whatever be our theories about them. It will be enough for my present purpose to assume as probably true the usual hypothesis that they were first condensed from nebulous matter; that that matter may have been either the outer portions of the original solar nebula, or matter entirely independent of our system and scattered through space. In either case, the comet is generally supposed, and probably must be supposed, to have become aggregated far away from the sun. This aggregation was not into one large body, to be afterwards broken up by disruption or by solar action. The varieties of location of the cometic orbits seem inexplicable upon any such hypothesis. Separate centres of condensation are to be supposed, but they are not *a priori* unreasonable. This is the rule rather than the exception everywhere in nature.

Assume, then, such a separate original condensation of the comet in the cold of space, and that the comet had a very small mass compared with the mass of the planets. Add to this the comet's subsequent known history, as we are seeing it in the heavens. Have we therein known forces and changes and conditions of such intensity and variety as the internal structure of the meteorites calls for? What that structure is, and, to some extent, what conditions must have existed at the time and place of its first formation, and during its subsequent transformations, mineralogists rather than astronomers must tell us. For a long time it was accepted without hesitation that these bodies required great heat for their first consolidation. Their resemblance to the earth's volcanic rocks was insisted on by mineralogists. Prof. J. Lawrence Smith, in 1855, asserted without reserve that "they have all been subject to a more or less prolonged igneous action corresponding to that of terrestrial volcanoes." Director Haidinger, in 1861, said, "with our present knowledge of natural laws, these characteristically crystalline formations could not possibly have come into existence except under the action of high temperature combined with powerful pressure." The likeness of these stones to the deeper igneous rocks of the earth, as shown by the experiments of M. Daubrée, strengthened this conviction. Mr. Sorby, in 1877, said, "it appears to me that the conditions under which meteorites were formed must have been such that the temperature was high enough to fuse stony masses into glass; that the particles could exist independently one of the other in an incandescent atmosphere subject to violent mechanical disturbances; that the force of gravitation was great enough to collect these fine particles together into solid masses, and that these were in such a situation that they could be metamorphosed, further broken up into fragments, and again collected together.'

Now, if meteorites could come into being only in a heated place, then the body in which they were formed ought, it would seem, to have been a large one. But the comets, on the contrary, appear to have become aggregated in small masses. The idea that heat was essential to the production of these minerals was at first a natural one. All other known rock formations are the result of processes that involve water or fire or metamorphism. All agree that the meteorites could not have been formed in the presence of water or free oxygen. What conclusion was more reasonable than that heat was present in the form of volcanic or of metamorphic action?

The more recent investigations of the meteorites and kindred stones, especially the discussions of the Greenland native irons and the rocks in which they were imbedded, are leading mineralogists, if I am not mistaken, to modify their views. Great heat at the first consolidation of the meteoric matter is not considered so essential. In a late paper, M. Daubrée says: "It is extremely remarkable that, in spite of their great tendency to a perfectly distinct crystallization, the silicate combinations which make up the meteorites are there only in the condition of very small crystals, all jumbled together as if they had not passed through fusion. If we may look about us for something analogous, we should say that instead of calling to mind the long needles of ice which liquid water forms as it freezes, the fine-grained texture of meteorites resembles rather that of hoar-frost, and that of snow, which is due, as is known, to the immediate passage of the atmospheric vapor of water into the solid state." So Dr. Reusch, from the examination of the Scandinavian meteorites, concludes that "there is no need to assume volcanic and other processes taking place upon a large heavenly body formerly existing but which has since gone to pieces."

The meteorites resemble the lavas and slags on the earth. These are formed in the absence of water, and with a limited supply of oxygen, and heat is present in the process. But is heat necessary? Some crystallizations do take place in the cold; some are direct changes from gaseous to solid forms. We cannot in the laboratory reproduce all the conditions of crystallization in the cold of space. We cannot easily determine whether the mere absence of oxygen will not account fully for the slag-like character of the meteorite minerals. Wherever crystallization can take place at all, if there is present silicon and magnesium and iron and nickel, with a limited supply of oxygen, there silicates ought to be expected in abundance, and the iron and nickel in their metallic form. Except for the heat, the process should be analogous to that of the reduction of iron in the Bessemer cupola, where the limited supply of oxygen combines with the carbon and leaves the iron free. The smallness of the comets should not, then, be an objection to considering the meteoric stones and irons as pieces of comets. There is no necessity of assuming that they were parts of a large mass, in order to provide an intensely heated birth-place.

But although great heat was not needed at the first formation, there are many facts about these stones which imply that violent forces have in some way acted during the meteorites' history. The brecciated appearance of many specimens, the fact that the fragments in a breccia are themselves a finer breccia, the fractures, infiltrations, and apparent faultings seen in microscopic sections and by the naked eye—these all imply the action of force. M. Daubrée supposes that the union of oxygen and silicon furnishes sufficient heat for making these minerals. If this is possible, those transformations may have taken place in their first home. Dr. Reusch argues that the repeated heating and cooling of the comet, as it comes down to the sun and goes back again into the cold, is enough to account for all the peculiarities of structure of the meteorites. These two modes of action do not, however, exclude each other. Suppose, then, a mass containing silicon, magnesium, iron, nickel, a limited supply of oxygen, and small quantities of other elements, all in their primordial or nebulous state (whatever that may be), segregated somewhere in the cold of space. As the materials consolidate or crystallize, the oxygen is appropriated by the silicon and magnesium, and the iron and nickel are deposited in metallic form. Possibly the heat developed may, before it is radiated into space, modify and transform the substance. The final result is a rocky mass (or possibly several adjacent masses), which sooner or later is no doubt cooled down throughout to the temperature of space. This mass, in its travels, comes near to the sun. Powerful action is there exerted upon it. It is heated. How intense is that heat upon a cold rock, unprotected apparently by its thin atmosphere, it is not possible to say. We know that the sun's action is strong enough to develop that immense train, the comet's tail, that sometimes spans our heavens. It is broken in pieces. We have seen the portions go off from the sun, to come back, probably, as separate comets. Solid fragments are scattered from it to travel in their own independent orbits. What is the condition of the burnt and crackled surface of a cometic mass or fragment as it goes out from the sun again into the cold? What changes may not that surface undergo before it comes back again, to pass anew through the fiery ordeal? We have here forces that we know are acting. They are intense, and act under varied conditions. The stones subject to those forces can have a history full of all the scenes and actions required for the growth of such strange bodies as have come down to us. Some of our meteors, those of the star-showers, have certainly had that history. What good reason is there for saying that all of them may not have had the like birthplace and life?

The pieces which come into our air in any recurring star-shower belong to a group whose shape is only partly known. It is thin, for we traverse it in a short time. It is not a uniform ring, for it is not annual, except possibly the August sprinkle. How the sun's unequal attraction for the parts of a group acts as a dispersive force to draw it out into a stream, those most beautiful and most fruitfull discussions of Signor Schiaparelli have shown. The groups that we meet are certainly in the shape of thin streams.

It has been assumed that the cometic fragments go continuously away from the parent mass, so as to form, in due time, a ring-like stream of varying density, but stretched along the entire elliptic orbit of the comet. The epochs of the Leonid star-showers in November, which have been coming at intervals of thirty-three years since the year 902, have led us to believe that this departure of the fragments from Tempel's comet (1866, I.) and the formation of the ring was a very slow process. The meteors which we met near 1866 were therefore thought to have left the comet many thousands of years ago. The extension of the group was presumed to go on in the future until, perhaps tens of thousands of years hence, the earth was to meet the stream every year. Whatever may be the case with Tempel's comet and its meteors, this slow development is not found to be true for the fragments of Biela's comet. It is quite certain that the meteors of the splendid displays of 1872 and 1885 left the immediate vicinity of that comet later than 1840, although at the time of those showers they had become separated two hundred millions of miles from the computed place of the comet. The process, then, has been an exceedingly rapid one, requiring, if continued at the same rate, only a small part of a millennium for the completion of an entire ring, if a ring is to be a future form of the group.

It may be thought reasonable in view of this fact about Biela's comet, established by star-showers of 1872 and 1885, to revise our conception of the process of disintegration of Tempel's comet also. The more brilliant of the star-showers from this comet have always occurred very near the end of the thirty-three year period. Instead of there being a slow process which is ultimately to produce a ring along the orbit of the comet, it certainly seems more reasonable to suppose that the compact lines of meteors which we met in 1866, 1867, and 1868 left the comet at a recent date. A thousand years ago this shower occurred in the middle of October. By the precession of the equinoxes and the action of the planets the shower has moved to the middle of November. One-half of this motion is due to the precession, the other half to the perturbing action of the planets. Did the planets act upon the comet before the meteoroids left it, or upon the meteoroid stream? Until one has reduced the forces to numerical values, he may not give to this question a positive answer. But I strongly suspect that computations of the forces will show that the perturbations of Jupiter and Saturn upon that group of meteoroids hundreds of millions of miles in length,—perturbations strong enough to change the node of the orbit fifteen degrees along the ecliptic,—would not leave the group such a compact train as we found it in 1866. If this result is at all possible, it is because the total action is scattered over so many centuries. But it seems more probable that the fragments are parting more rapidly from the comet than we have assumed, and that, long before the complete ring is formed, the groups become so scattered that we do not recognize them, or else are turned away so as not to cross the earth's orbit.

Comets, by their strange behavior and wondrous trains, have given to timid and superstitious men more apprehensions than have any other heavenly bodies. They have been the occasion of an immense amount of vague and wild and valueless speculation by men who knew a very little science. They have furnished a hundred as yet unanswered problems which have puzzled the wisest. A world without water, with a strange and variable envelope which takes the place of an atmosphere, a world that travels repeatedly out into the cold and back to the sun, and slowly goes to pieces in the repeated process, has conditions so strange to our experience, and so impossible to reproduce by experiment, that our physics cannot as yet explain it. But we may confidently look forward to the answer of many of these problems in the future. Of those strange bodies, the comets, we shall have far greater means of study than of any other bodies in the heavens. The comets alone give us specimens to handle and analyze. Comets may be studied, like the planets, by the use of the telescope, the polariscope, and the spectroscope. The utmost refinements of physical astronomy may be applied to both. But the cometary worlds will be also compelled, through these meteorite fragments, —with their included gases and peculiar minerals, —to give up some additional secrets of their own life, and of the physics of space, to the blowpipe, the microscope, the test-tube, and the crucible.

SCIENCE.

FRIDAY, AUGUST 27, 1886.

COMMENT AND CRITICISM.

CAPT. C. E. DUTTON, of the U. S. geological survey, has been recently engaged in making a study of Crater Lake in Oregon, and the latest advices received from him show that he has discovered probably the deepest body of fresh water in the country. Leaving Ashland, Oregon, on the 7th of July, his party, escorted by ten soldiers provided through the courtesy of the general commanding the military department of the Columbia, reached the brink of the wall of the lake on the 13th, having brought with them boats so mounted on the running gear of wagons as to bear transportation over a hundred miles of mountain road without injury. The boats bore the transportation without strain or damage, and preparations were at once begun for lowering them nine hundred feet to the water. The steepness of the wall was very great, being at the place selected about 41° or 42°, and the descent partly over talus, above covered with snow, and rocky broken ledges lower down. The boats entered the water quite unharmed. The process of sheathing them, rigging the tackle, and lowering them occupied four days. A couple of days were occupied in making journeys around the walls of the lake by boat, — the only possible way, — and in examining the rocks and structures of the wall in its various parts. Next followed a series of soundings. The depth of the lake considerably exceeded the captain's anticipations, though the absence of any thing like a talus near the water line already indicated deep water around the entire shore. The depths range from 853 to 1,996 feet, so far as the soundings show, and it is quite possible and probable that depths both greater and shallower may be found. The average depth is about 1,490 feet. The descent from the water's edge is precipitous; at four or five hundred yards from shore, depths of fifteen to eighteen hundred feet are found all around the margin. The greatest depths will probably exceed two thousand feet, for it is not probable that the lowest point has been touched. The soundings already made indicate it as being the deepest body of fresh water in the country.

THE GREAT VALUE of chemical analysis in solving problems which are otherwise incapable of solution, was never better demonstrated than in the recent ice-cream poisoning which occurred in New Jersey. Various theories had been advanced to explain it, any one of which would have accounted for the symptoms produced in the sufferers. The tyrotoxicon discovered by Professor Vaughan, the vanilla bean used in the flavoring extract, and the gelatine employed to give stiffness, were credited with being the possible *materies morbi* by their respective advocates; but no one seems to have suspected foul play. The death of one of the victims was followed by a post-mortem examination, and the organs of the deceased were submitted to Professor Austen of Rutgers college. He has just announced the discovery of arsenic in sufficient quantity to cause death. It is more than probable, that, were the truth known, in all the cases of poisoning by food-products, malice would be found to play a more important part than either decomposition or germs introduced from without.

TWO PERSONS ARE REPORTED as having died from cholera at Chippewa Falls, Wis. That the cause of death in these cases was Asiatic cholera is in the highest degree improbable. Italy seems to be alone among European countries in having this scourge now prevalent, and that any one at so remote a point as the town mentioned should show symptoms of cholera, is hardly to be credited. It is, of course, possible that clothing infected with cholera might be carried in trunks, and opened at a point so far removed, and that those exposed might thus contract the disease, for there is good evidence to prove that infection has been thus conveyed; but it is more than probable that if cholera reaches this country, it will be from the seaboard. When the facts become known, it will doubtless be found, as has so often happened, that the cause of death in the cases at Chippewa Falls was a severe form of cholera morbus.

UNDER A RECENT ORDER of the treasury department, all restrictions on imported rags have been removed, and they have been placed upon the same footing as other merchandise; that is, to be excluded, disinfected, or admitted according to the discretion of the local health officer. A great deal of unwarranted hostile criticism has been indulged in with reference to rag-disinfection in the port of New York. At a time when an epidemic of cholera was imminent, the health officer of that port consulted with the health officials of the neighboring cities, and of the state, and the action which he took in reference to the disinfection of rags was based upon that conference, and has received the endorsement of the sanitary authorities of the country. While New York has from the very first been vigilant, other cities have been careless and negligent; and that contagious disease has not been introduced by means of infected rags, is due to good luck rather than to good management. That there should be some federal control of such matters goes without saying, for, while state rights are to be respected, there is such a thing as carrying that principle too far. The right to permit contagion to enter and ravage the country, because a quarantine would be expensive, is not a right which any state can claim as guaranteed it by the constitution. If the general government can restrict the sale of oleomargarine, it can certainly be no great stretch of its powers to adopt such general measures as will apply to all its ports of entry, by which commerce and the public health are at the same time protected.

DR. HARRINGTON, OF BOSTON, has recently had under his care four patients suffering from chromium poisoning. The first case was that of a cap-maker, who, after handling and cutting a large quantity of dark-blue cloth for the manufacture of military caps, began to suffer from an intolerable itching of the hands, face, neck, and scalp, which was followed by ulceration, causing running sores. The symptoms disappeared after she ceased work upon this cloth, and returned when she renewed her work upon it. The second case was that of a clergyman, who was similarly affected after wearing a pair of brown woollen gloves. The other cases were young children, who had, previous to the appearance of the first symptoms, put on for the first time new suits of brown woollen clothes. An analysis of the goods in all the four instances revealed chromium. The chromium mordants are now being extensively employed in dyeing, much more so than formerly, and the range of colors produced by their aid is very great, including brown, brownish red, claret red, olive, yellow, old gold, purple, blue, black, buff, and gray. Dr. Harrington, at the conclusion of his paper describing these cases, read before the Massachusetts medical society, says that it is yet to be determined whether in these cases the compounds formed by the mordant and the dye-stuffs are in themselves the active poison, or are decomposed by the secretions of the body, with liberation of simple chrome compounds.

THE BUFFALO MEETING.

THE least that can be said of the meeting of the American association for the advancement of science which has just closed, is that it was thoroughly enjoyable. The arrangements made by the local committee for the entertainment of the association were admirably adapted to promote the objects of the meeting. The simple habits of the members led them to welcome rather than to regret the absence of official festivities on a large scale, but prepared them to enjoy the hospitalities tendered by leading citizens and organizations, which were noteworthy both for their ample scale and their unostentatious simplicity. On the excursions to Grand Island and to Niagara, every opportunity for pleasure and profit was afforded without in any way troubling the members by detailed programmes or burdensome attentions.

The smallness of the meeting was its only disappointing feature. The beautiful summer climate of Buffalo, its central position between the east and the west, and the prospect of a visit to one of the grandest and most interesting of natural phenomena, just freed from the onerous exactions which such a visit used to entail, would, it was expected, attract one of the largest assemblages of members that had yet been witnessed. Yet, not one-fourth of the membership was found at the meeting. The paucity of southern members was especially noteworthy. One great purpose of the organization is to bring into contact the intellectual element of the north and the south as well as of the east and the west, and the association can render no more worthy service than that of promoting education as well as research in every quarter of our land. It is much to be desired that workers and educators in the south should point out to their colleagues in the north how that stimulus of personal contact, sympathy, and attention, so necessary to the fulness of intellectual development, can best be secured to their section.

The scientific outcome of the meeting is, on the whole, encouraging. The writers of popular essays were out in rather less force than usual. We did not notice on the programme the title of a single paper attacking the theory of gravitation. Communications of doubtful value appeared in about the usual proportion. Statements of careful observations, and well-matured results appeared in larger proportion than usual, yet, there was no announcement of a brilliant discovery, or of a research of extraordinary importance. All that can certainly be noticed is a well-marked tendency to improvement. Notwithstanding this improvement, the question is still open whether the association can reach the highest standard of usefulness by aiming to be primarily a medium for the communication and publication of scientific papers.

That the system in vogue at present is not satisfactory in all points must be conceded by all. A member visits the place of meeting in the morning, and receives a programme for the day, showing what papers are to be read before each section. He finds two or three that he wants to hear, and two or three more that he would like to know something about in order to decide whether he does or does not want to hear them. But the only way to learn anything about one class or the other is to wait patiently till they are called in their turn. There are perhaps two or three papers to precede any in which he is interested. He waits for one, because the author has estimated its length at only ten minutes. But the author occupies twenty minutes with details so prolix and tedious that his hearers are weary when he gets through. Then the presiding officer calls for remarks. No one is ready to proffer any remark, and the next paper is about to be called when some one, out of pure charity, drops a remark. Another replies, and very soon a desultory debate is in progress having little relation to the subject of the paper. Our hearer estimates that an hour will be required to reach the paper he wants to hear, and leaves the room. In order to be sure he returns in half an hour, to find that the authors of the intermediate papers were absent, and that, in consequence, the paper he wanted to hear has already been read. He has thus spent an hour without any profitable result whatever.

The system which leads to such results calls loudly for improvement. Specified hours should be assigned for hearing and discussing specified papers. Debate upon subjects of interest suggested by any communication should be allowed for in advance. Less formality in the presentation of papers should be observed. There is no necessity of entering into the long details with which members so often weary their hearers, who would be satisfied to hear the pith of a communication. It will also be well for members to consider whether the conception of the association as a body organized solely for the reception and publication of original researches might not well be modified. Scientific societies meeting at short intervals are now so numerous that a body which assembles only once a year is at a great disadvantage as a medium of publication.

On the other hand, the social feature of the meetings should be more clearly recognized. No class of men are so much in need of contact with their fellow-workers as those who are exploring the fields of science, and in no other enlightened country is this contact so difficult as in ours. As matters now stand, we believe that the association can do more good by bringing men together to talk over the work of the year, and the prospects of the future, than by remaining a medium for receiving original communications. To do this effectively requires a common understanding among the older members, in virtue of which more of them will be in attendance. This again requires extensive, though not very radical changes in the method of procedure adopted by the standing committee, the several sections, and the association at large. The system which we think should be aimed at is one in which the exposition, by leading members, of their work during the year, whether published or unpublished, shall be a prominent and well understood feature. In a word, everything that can be done to make the meetings attractive and profitable will add in an increasing ratio to the success of the organization. And the most urgent requirement is a plan by which every member shall be able to hear what he wants to without being required to listen to anything he does not want to hear. Such a plan will react upon the members by supplying an incentive to the preparation of communications by those members who might say something of special interest to their fellows, but who are now deterred from so doing by the absence of the proper arrangements for being heard.

Withal, there is the constant necessity of such familiarity on the part of those who are to read papers with what they have to say, and how they intend to present it, that they may not bore their audiences with trifling details.

MULTIPLE ALGEBRA.

PROFESSOR GIBBS'S masterly address upon the subject of 'multiple algebra' was too long and of too technical a nature for presentation in full to our readers, and the quotation of a few passages, and a brief summary of the bearings of the remainder, must suffice to acquaint them with its general drift and importance. His opening remarks were as follows: —

"It has been said that 'the human mind has never invented a labor-saving machine equal to algebra.' If this be true, it is but natural and proper that an age like our own, characterized by the multiplication of labor-saving machinery, should be distinguished by an unexampled development of this most refined and most beautiful of machines. That such has been the case, no one will question. The improvement has been in every part. Even to enumerate the principal lines of advance, would be a task for any one, — for me, an impossibility. But if we should ask in what direction the advance has been made, what is to characterize the development of algebra in our day, we may, I think, point to that broadening of its fields and methods which gives us 'multiple algebra.' Of the importance of this change in the conception of the office of algebra, it is hardly necessary to speak: that it is really characteristic of our time, will be most evident if we go back some two or three score years, to the time when the seeds were sown which are now yielding so abundant a harvest. The failure of Möbius, Hamilton, Grassmann, Saint-Venant, to make an immediate impression upon the course of mathematical thought in any way commensurate with the importance of their discoveries, is the most conspicuous evidence that the times were not ripe for the methods which they sought to introduce. A satisfactory theory of the imaginary quantities of ordinary algebra, which is essentially a simple case of multiple algebra, with difficulty obtained recognition in the first third of this century. We must observe that this 'double algebra,' as it has been called, was not sought for or invented, — it forced itself, unbidden, upon the attention of mathematicians, and with its rules already formed."

The speaker then gave a critical historical review of the different contributions of Hamilton, Möbius, Grassmann, Saint-Venant, Cauchy, Cayley, Hankel, the Peirces, father and son, and Sylvester, to these new methods of mathematical analysis, showing the additions and developments made by each to the various subjects.

In the second part of the paper, Professor Gibbs criticised the methods of some modern writers on these subjects, showing how they failed to grasp the full significance and bearings of the matters they were dealing with, being too much hampered by the old ideas and methods of simple algebra. We quote here a few sentences: —

"This fault has been denounced by Sylvester; and if any one thinks that I make too much of the stand-point from which we view the subject, I will refer him to the opening paragraphs of the lectures on 'universal algebra' in the sixth volume of the *American journal of mathematics*, where, with a wealth of illustration and an energy of diction which I cannot emulate, the most eloquent of mathematicians expresses his sense of the importance of the substitution of the idea of the matrix for that of the determinant. If this is so important, why was the idea of the matrix let slip? Of course, the writers on this subject had it to commence with. One cannot even define a determinant without the idea of a matrix. The simple fact is, that the writers on this subject have especially developed those ideas which are naturally expressed in simple algebra, and have postponed, or slurred over, or omitted altogether, those ideas which find their natural expression in multiple algebra. But in this subject, the latter happened to be the fundamental ideas, and those which ought to direct the whole course of thought." Many illustrations were then given of the applications of these ideas to cases in point.

The author introduced the third part of his paper as follows: "We have considered the subject a good while from the outside; we have glanced at the principal events in the history of multiple algebra; we have seen how the course of modern thought seems to demand its aid, how it is actually leaning toward it, and beginning to adopt its methods. It may be worth while to direct our attention more critically to multiple algebra itself, and to inquire into its essential character and its most important principles. I do not know that anything useful or interesting, which relates to multiple quantity, and can be symbolically expressed, falls outside the domain of multiple algebra. But if it is asked, what notions are to be regarded as fundamental? we must answer, here as elsewhere, those which are most simple and fruitful. Unquestionably, no relations are more so than those which are known by the names of addition and multiplication."

Then followed a long discussion of the fundamental conceptions and methods of modern math-

Abstract of an address before the section of mathematics and astronomy of the American association for the advancement of science at Buffalo, Aug. 19, 1886, by Prof. J. Willard Gibbs, of New Haven, Conn., vice-president of the section.

ematics, which nothing but publication in full could render intelligible, and that only to the mathematicians among our readers. To such, its full publication in the 'Proceedings' will prove of the greatest value.

The fourth part of the paper was devoted to consideration of some of the applications of multiple algebra. From this we quote the following: "First of all, geometry, and the geometrical sciences which treat of things having position in space, — kinematics, mechanics, astronomy, crystallography, — seem to demand a method of this kind, for position in space is essentially a multiple quantity, and can only be represented by simple quantities in an arbitrary and cumbersome manner. For this reason, and because our spatial intuitions are more developed than those of any other class of mathematical relations, these subjects are especially adapted to introduce the student to the methods of multiple algebra. Here nature herself takes us by the hand, and leads us along by easy steps, as a mother teaches her child to walk. In the contemplation of these subjects, Möbius, Hamilton, and Grassmann formed their algebras, although the philosophical mind of the last was not satisfied until he had produced a system unfettered by any spatial relations. It is probably in connection with these subjects that the notions of multiple algebra are most widely disseminated. Maxwell's 'Treatise on electricity and magnetism' has done so much to familiarize students of physics with quaternion notations, that it seems impossible that this subject should ever again be entirely divorced from the methods of multiple algebra. I wish that I could say as much of astronomy. It is, I think, to be regretted, that the oldest of the scientific applications of mathematics, the most dignified, the most conservative, should keep so far aloof from the youngest of mathematical methods; and standing, as I do to-day, by some chance, among astronomers, although not of the guild, I cannot but endeavor to improve the opportunity by expressing my conviction of the advantages which astronomers might gain by employing some of the methods of multiple algebra. A very few of the fundamental notions of a vector analysis, the addition of vectors and what quaternionists would call 'the scalar part and the vector part of the product of two vectors' (which may be defined without the definition of the quaternion), — these three notions, with some four fundamental properties relating to them, are sufficient to reduce enormously the labor of mastering such subjects as the elementary theory of orbits, the determination of an orbit from three observations, the differential equations which are used in determining the best orbit from an indefinite number of observations by the method of least squares, or those which give the perturbations when the elements are treated as variable. In all these subjects, the analytical work is greatly simplified, and it is far easier to get the best form for numerical calculation than in the use of the ordinary analysis."

Then followed illustrations of the various methods of applying multiple algebra to different classes of problems, and the paper closed as follows: "But I do not so much desire to call your attention to the diversity of the applications of multiple algebra, as to the simplicity and unity of its principles. The student of multiple algebra suddenly finds himself freed from various restrictions to which he has been accustomed. To many, doubtless, this liberty seems like an invitation to license. Here is a boundless field in which caprice may riot. It is not strange if some look with distrust for the result of such an experiment. But the further we advance, the more evident it becomes that this, too, is a realm subject to law. The more we study the subject, the more we find all that is most useful and beautiful attaching itself to a few central principles. We begin by studying 'multiple algebras;' we end, I think, by studying 'multiple algebra.'"

SEAT OF THE ELECTROMOTIVE FORCE.

Professor Brackett's address was essentially a résumé of the history of the investigations to find the source of the current in galvanic batteries. No attempt was made to settle the question, which has been so long a bone of contention.

The address was so purely historical in its nature, and, withal, was so condensed and concise, that any abstract would be necessarily little more than an index of its contents. Those who are interested in the subject must await its publication in full in the 'Proceedings' of the association.

Galvani's two accidental discoveries were made in 1789: the one was the influence of an electrical machine in causing contractions in a frog's legs, and the other the production of sufficient electricity to cause the contraction by touching two joined strips of copper and zinc to the moist animal tissues. Naturally from these results there arose a theory of the identity of nerve-force and electricity, — the so-called animal variety of electricity. While this controversy, soon to subside, was started among physiologists, a much more

Abstract of an address delivered before the section of physics of the American association for the advancement of science at Buffalo, Aug. 19, 1886, by Prof. C. F. Brackett, of Princeton, vice-president of the section.

violent one has continued to rage among physicists. Is the electricity of the galvanic cell due to chemical action or to contact of dissimilar substances? It is to the history of the attempts to answer this question that the address is devoted.

PROGRESS OF MECHANICAL SCIENCE.

THE recent enlargement of the scope of this section to include all branches of engineering, and the increasing interest manifested in its meetings, warrant my making some remarks as to the true objects of the section, and the means of increasing its usefulness in the future.

In marked contrast with the past, the present age is one of pronounced material development. Formerly the brightest and most gifted men devoted themselves to religion, philosophy, politics, exploration, art; but for the past hundred years the attention of the leading men of the civilized world has been directed to increasing and cheapening those products which minister to the daily life and comfort of man. Farmers, mechanics, and laborers live now more comfortably than did the middle classes of feudal times; the duration of human life has been materially lengthened, and all portions of society recognize the importance of further progress, and the advantage of organization and invention in securing it.

This era of material progress may be said to have commenced with the final perfecting of the steam-engine, which, together with the various attendant machines, takes the place of hand and animal labor, and which has increased and cheapened the production of the necessaries and luxuries of life; and it has pushed the inventor and the engineer to the front rank in modern society. It may be useful to point out the absolute necessity of verbal and written intercourse between investigators and inventors, that the speculation and curiosity of the former may ripen into the effective invention of the latter. Nothing is more remarkable than the multitude of minds and facts which are required for the perfecting of even a simple machine, nor how little the last man may need to add to complete the invention. Facts and natural laws, known for years as curiosities, are taken up by some inventor, who fails in the attempt to render them of practical use; then a second genius lays hold, and, profiting by the mistakes of the first, produces, at great cost, a working machine. Then comes the successful man, who works out the final practical design, and, whether making or losing a fortune, he yet permanently benefits mankind.

The faculties of invention and discovery are generally separate. One set of men observe facts, and deduce laws therefrom; and another set endeavor to turn the results of this observation and deduction to practical account in the production of labor-saving appliances. This section should be the place where these men may meet one another, and profit by the interchange of ideas. Many of the men whom I see before me are devoting their lives to the study of nature, with no desire to make money out of it, but simply to increase human knowledge; and some of their discoveries will eventually be put into practical shapes for the use and convenience of man. History proves, too, that the scientific observers have the safer and happier part. Their success may not be so dazzling as that of some great inventors, but they do not have to bear such bitter trials and disappointments. To deduce natural laws requires mental accuracy in observing and reasoning; to make them useful in doing the world's work requires imagination and ingenuity. Sometimes long years must pass, and generation after generation of inventors wear their lives out, before a needed machine becomes an accomplished success. Evidently, then, the greater the number of minds that can be brought to bear upon a particular problem, the greater is the chance of early success. I believe that it is the particular province of this section of the association to bring these two classes of minds together, and to promote their intercourse, that the discoverer may learn in what direction fresh information is needed, and that the inventor may be advised as to what is already known.

The well-worn history of the steam-engine gives us an instance of an invention which did not spring full-grown from the brain of the inventor. History informs us that it commenced to exist two thousand years ago, in the eolipile of Hero of Alexandria. His treatise remained hidden until translated and printed in 1547; and then Branca, the Italian architect, constructed one for pounding drugs. Hero's book ran through eight editions in different languages, and attracted the attention of a French inventor, who tried vainly to raise water by steam pressure. Then came the Marquis of Worcester, who died a disappointed man after spending $250,000. Then de Morland tried using steam in cylinders, instead of in contact with the water; Papin built a steamboat, only to have it seized and destroyed while on its way to England, and he, too, died broken-hearted and poor; Savery went back to using the steam directly in contact with water; and finally Newcomen

Abstract of an address before the section of mechanical science of the American association for the advancement of science at Buffalo, Aug. 19, 1886, by O. Chanute, Esq., Kansas City, vice-president of the section.

built an engine that worked; and between 1705 and 1758 quite a number were erected. These engines had a duty of only 5,500,000 foot-pounds per pound of coal, the improvements of James Watt, an instrument maker, increasing the duty to 60,000,000.

My object in giving this sketch is to call your attention, first, to the gradual evolution of an invention by the process of exclusion, by finding out what would not do; and second, the apparent chain of connection, running for over a century, through several generations of inventors, each evidently profiting by the failures of his predecessors, to the extent, at least, of avoiding their repetition. Is it not evident that the earlier inventors would have accomplished greater results had they had a larger range of scientific experiments and advice; and that Watt triumphed because he had the whole faculty of the University of Glasgow at his back, to give him knowledge of natural principles, and information as to what had been done? So with other inventions; the steamboat was being developed from 1760 to 1807; the locomotive, from 1802 to 1829; the telegraph from 1729 to 1844; the sewing machine, with its two thousand patents, from 1790 to 1860; the reaping machine, for seventy-five years, and so on, — the last successful man adding generally but little to what had been done before. The rule is, that "the basis of success lay in a thorough acquaintance with what had been done before, and in setting about improvement in a thoroughly scientific way."

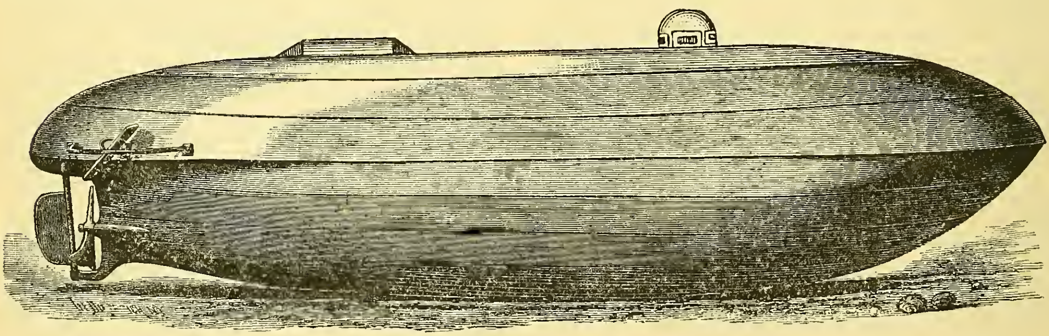
My own observation has acquainted me with the development of the ice-making machine. The economical production of cold by the combustion of fuel was a matter of theory when, in 1755, Professor Cullen experimented in Glasgow with 'quick-lime and spirits of sal-ammoniac' as the best volatile substance for producing cold. His discoveries remained as laboratory experiments until Jacob Perkins, in 1834, obtained a partial success in producing ice by the evaporation of ether. Then came Professor Twining, of New Haven, Leslie, Valance, Harrison, Pontifex Seibe, Windhausen, Tellier, Carré, and Pictet, with more or less doubtful success. Up to 1869, the machine was in the experimental or unsuccessful stage. Then came an experimenter who deliberately read up the whole subject in a library, and made himself master of what patent-attorneys call 'the state of the art,' and of the scientific principles concerned, working, according to his own account, 'harder than he ever had before in his life.' He discarded the usual working fluids, and adopted anhydrous ammonia. After various struggles and successes, the machine was adapted to the difficulties of the case, and put in successful operation in 1874, since which time it has become of immense practical importance in warm climates, for making ice, cooling breweries, etc., though giving an efficiency of but seventy per cent. In 1877, another inventor set himself deliberately to improve the machine. He put a practical mechanic, a chemist, and a patent-attorney to work, and in 1878 built a machine, which, however, gave no improved results. He did not let the matter rest here, however, but persevered, and in 1880 built an entirely successful machine, which did the work for which seven thousand tons of ice had been required. So rapid has been the introduction of refrigerating machines, that there are now several hundred of various makes at work in the United States. They produce as much cold for each ton of coal consumed as would be obtained by the melting of twenty tons of ice, at which rate natural ice is worth only seventy-five to eighty cents per ton, or less than the usual cost of harvesting and storing it.

In comparing this development with that of the steam-engine, we see the difference between the scientific way of working out an invention and the former disjointed way, when each man had to rely chiefly upon his own experiments; and also the difference between ancient facilities and the modern advantages offered by experts, technical publications, scientific societies, etc.

Ordinary technical societies usually discourage speculative papers and discussions, and prefer to hear of accomplished facts; but the busy men who are developing this country need something more,— they need to keep up with discovery before it is reduced to practical account, and they need that personal contact and sympathy with men of science which nothing can replace. Engineers, as well as other practical men, owe it to themselves to come to these meetings, bringing accounts of what they have done and hope to do, and especially of what they have failed to do, and why; and some speculative papers may well be allowed providing always that they are on a sound basis, and stick to facts; for how often is it that the imagined things of to-day become the accomplished results of to-morrow!

To encourage good work in the preparation of papers, might there not be established, by friends of the association and section, prizes for the best papers on a number of important subjects? I hope to see something done in this direction before the close of the meeting. I hope also to see the practice inaugurated for members, during the year or meeting, to propound queries upon subjects about which they wish information or discussion. I should like also to see published annually lists of subjects upon which papers are desired by the section, as was done to some extent in the recent circulars of the section. In this way, live subjects are apt to be most beneficially canvassed, and experiment and discovery kept in the right paths. It may be well, in this connection, to mention some inventions which are now, so to speak, 'in the air;' of course, we all recognize that the flying-machine belongs to this class, in one sense if not in another, and a paper upon it has been presented which may prove of interest to you. What is needed, however, is a sufficiently light motor, without which a flying-machine cannot be expected to succeed. Steam power, also, for agricultural work in its many forms, is not yet an accomplished fact; and we may mention one machine greatly needed, — a cotton-picker. Then, too, there is the electric motor for street traffic, which needs further improvement; also the transmission of power over great distances, electric lighting, etc., etc.

But I have said enough to indicate how large a field may, in my judgment, be covered by this section of mechanical science and engineering, and how its meetings may in the future be made still more useful and interesting than they have been in the past.



TUCK'S SUBMARINE TORPEDO BOAT.

A NEW SUBMARINE TORPEDO BOAT.

THE accompanying illustration represents a new submarine boat, invented by Mr. J. H. L. Tuck, and now being tested in this city, with highly satisfactory results. On Tuesday, August 24, the first public exhibition of the vessel was given in the Hudson River, opposite 86th street, in the presence of a number of scientific men. Manned by a crew of two men, pilot and engineer, she started off at a good rate of speed, disappeared, travelled perhaps half a mile without making a ripple to indicate her whereabouts, and reappeared at the pleasure of the pilot. During the two hours' test, she travelled several miles, answering her helm as readily as a steam yacht. The boat is an iron spindle thirty feet long by eight in diameter, with a propeller, and vertical and horizontal rudders. The motive power is a fourteen horse-power Westinghouse engine, furnished with steam from a caustic-potash reservoir, which is charged from an outside source. Deadlights in the conning-dome forward, together with a compass, enable the pilot to shape his course. Ingress and egress are effected through an aperture in the hatchway near the stern, which may be hermetically sealed from the inside.

NOTES AND NEWS.

THE officers for the next meeting of the American association are as follows: President, S. P. Langley. Vice-presidents: mathematics and astronomy, Wm. Ferrel; physics, Wm. A. Anthony; chemistry, Albert B. Prescott; mechanical science and engineering, Eckley B. Coxe; geology and geography, G. K. Gilbert; biology, W. G. Farlow; anthropology, D. G. Brinton; economic science and statistics, Henry E. Alvord. Permanent secretary, F. W. Putnam; general secretary, W. H. Pettee; assistant general secretary, J. C. Arthur. Secretaries of the sections: mathematics and astronomy, Henry M. Paul; physics, C. Leo Mees; chemistry, C. F. Mabery; mechanical science and engineering, Geo. M. Bond; geology and geography, T. B. Comstock; biology, J. Henry Comstock; anthropology, F. W. Langdon; economic science and statistics, Wm. R. Lazenby. Treasurer, William Lilly.

— Twenty drops of bromine in an ounce of olive-oil, applied freely four times a day, and the affected part washed with warm water and castile soap twice a day, is said to have completely cured seventy-five cases of ivy poisoning.

— The Brazilian government has appointed a commission of physicians, from Rio, Bahia, Maranhao, and Pará, to study the *beri-beri*. This disease is particularly prevalent through the littoral provinces of the north, and has been gradually gaining ground of late.

— An examination, by an oculist, of the eyes of one thousand one hundred persons who work by the incandescent electric light, fails to show any injurious effects produced by that light. The arc-light may cause eye-trouble if in too close proximity.

— That human hair retains its characteristics for long periods of time, and, indeed, is well-nigh indestructible, is a fact of common observation. A remarkable instance of this is found in a wig which has recently been discovered in an Egyptian temple at Thebes, and is now deposited in the British museum. It is supposed to have been part of the attire of an Egyptain priest, and from the circumstances of its discovery is regarded as being at least 3,400 years old.

— Food given when cold is more likely to be retained by a sensitive stomach than in any other condition, and ice will not be rejected when all other substances are thrown off; acting upon this fact, frozen milk is now given in cases of sickness attended with irritable stomach, especially in fevers.

— London consumes daily two million eggs, and the rest of England an equal number. Of these one-half comes from Italy via the St. Gothard tunnel, and the others are brought from Denmark, Germany, Belgium, and France.

— At the Michigan state sanitary convention, to be held at Big Rapids in November next, the following topics will be discussed: The hygiene of schools; Pasteur and protective medicine; public-health laws; alcoholic drinks, — are they foods or are they poisons? the injuries of every-day drug-taking; what to eat, when, and how; and, the prevention of communicable diseases.

— *La graphologie*, a French journal, describes a new method of reading character, known as 'scarpalogy.' It consists in a study of the heels and soles of shoes. If these are worn down evenly, the wearer is a good business man, energetic and quick in decision; if the outer side is worn more than the inner, he is of an adventurous turn of mind. Weakness of character is indicated by a heel and sole worn most on the inner side.

— Prof. C. L. Ford, of the L. I. college hospital, called attention, in 1862, to the fact that the lower limbs were not always of the same length in the human subject. This statement induced anatomists and surgeons to make an extended series of measurments, and the results confirm the opinion expressed by Professor Ford. Garson, in the *Journal of anatomy and physiology*, sums up these observations. In seventy skeletons examined, he found the lower limbs equal in but seven. His measurements show that in 54.3 per cent the left limb was longer than the right; in 58.5 per cent the left thigh-bone was longer than the right. The right tibia was longer than the left in 41.4 per cent, and the two bones were found equal in but 10 per cent. The difference in the length of the lower limbs varies from one-eight of an inch to one inch and five-eights, without any deformity being recognizable. In a series of measurements of the collar-bones, only six, in twenty-two cases examined, were found to be equal.

— The scientific writings of Henry James Clark have received careful attention from Prof. Fred. Tuckerman, in his biographical notice for the catalogue of the Massachussetts agricultural college (1886). The bibliographical list contains twenty-six titles, — three new ones being added to the national academy list. Professor Tuckerman has also improved the national academy list by references to numerous English reprints of Professor Clark's papers. British students will find these of use. The third title, of some interest in the history of American zoölogy, reads as follows: 'Contributions to the natural history of the United States, 1857 – 62 (conjointly with Prof. Louis Agassiz).'

— The practice of medicine in Russia is exceedingly onerous and unremunerative. A physician who fails to respond to the summons of a patient is punished by a fine of from five to one hundred roubles. If the case was a dangerous one, and the physician knew it, he may be imprisoned in the jail for three months. The legal fee for an ordinary visit is from seven and a half to fifteen cents; for an accouchement, seventy-five cents. These laws are strictly enforced. An elderly German physician, an invalid, was called, on a stormy winter night, to attend a case seven miles distant. He objected to go unless he was reasonably remunerated, naming his fee. The messenger left to ascertain whether this amount would be paid, but did not return. The physician was subsequently arrested, tried, and condemned to eight days imprisonment. Besides, he had to pay his lawyer two hundred and fifty dollars in advance.

— A few weeks since, some members of the Davenport (Iowa) academy of sciences explored several mounds in Louisa county in that state. In the one most thoroughly examined, from near the surface to the bottom, were found decayed logs of from six to ten inches diameter, lying in irregular positions, not charred, but lying in and covered by a thin layer of ashes. In this mound was also discovered a skull, and near it several relics. Under the skull was found a copper axe, entirely covered with cloth, and wrapped in bark, well preserved. Four other copper axes were also found, all showing they had been wrapped in cloth. Near these were three copper awls, one found lying and two sticking upright in the floor of the mound. Also a quantity of shell beads and sheets of mica. Two curved-base pipes were also found near the head, one of ordinary gray pipe-stone, bearing a well-carved figure of a hawk, with pearl eyes; the other was a plain round bowl, but is unique in material, being made of calcite, beautiful in form, and quite translucent. Several other mounds were partly explored, but nothing of special interest was found in them.

— *Il popolo Pisano*, an Italian journal, claims that Pasteur's method of preventing rabies by inoculation with virus, was practised in Italy by Dr. Eusebio Valli as long ago as 1799. He employed for this purpose the saliva of a rabid dog, mixed with gastric juice. Having ascertained by experiments upon the lower animals that this method of treatment was a safe one, he inoculated two residents of Pisa with the same material. Although these persons — one a child, the other an adult — had been bitten by a mad dog, rabies did not develop in them.

— Bichloride of mercury, commonly known as corrosive sublimate, has of late years been largely used by the medical profession in a state of solution, whenever, in the treatment of wounds, antiseptic or germicidal agents were desirable. This same substance is now extensively employed as a germicide in the purification of articles and places which are infected with disease of a zymotic nature. Statistics have recently been collected which tend to prove, that in the strength usually employed, 1 part of the bichloride to 1,000 parts of water, the use of this solution is not without danger when brought in contact with any portion of the surface of the body from which the skin or the mucous membrane has been removed, as, for instance, in open wounds. There have been reported and verified thirty deaths which are attributable to the use of this solution in the strength mentioned. It is, however, when properly employed, not only a very valuable, but also a perfectly safe agent; and it will doubtless be found, that, as an irrigant to exposed surfaces of the human body, more dilute solutions will accomplish all that is desired. Where it is used as a disinfectant for articles of clothing or furniture, no danger can possibly accrue from its use, even in the proportion of 1 to 1,000.

— The great advantage, from a hygienic point, of the electric light over gas in halls where large numbers assemble, is well shown by the elaborate researches of Dr. Breslauer, and recorded in the *Deutsche medicinische zeitung.* The experiments were made in the Munich theatre, and included an inquiry into the air of the different portions of the house as to temperature and the products of combustion. The temperature was increased in the parquet ten times more with gas than with the electric light, and three times more in the gallery. The amount of carbonic acid per 1,000 was, —

	Electric light.	Gas.
In parquet	0.055	3.926
In gallery	0.870	3.151
In centre of gallery	1 178	4.353

This increase in the amount of carbonic acid is one of the principal disadvantages of gas as compared with the electric light. The conclusions which are drawn from these observations are that the air remains much purer and at a lower temperature in all parts of the house, especially in the galleries, when electric light is employed as a means of illumination.

— Turkey has a medical school at Constantinople, at which there are annually more than three hundred students, of which number some sixty graduate. Each course continues during nine months of the year, and six years must be spent in medical study before a diploma can be received. Instruction is given in the Turkish language, as most of the students are Turks.

— Constantinople has at the present time a water-supply from Lake Dercos, twenty miles from the city. This was introduced by a French company, and was intended to supplant or supplement the supply, which the city has had for years, from an open reservoir six miles distant, in which the rain collected, and from which it was brought in iron pipes.

— From the *Medical and surgical reporter* we learn that the willow is now being largely cultivated in America for medicinal purposes. On one farm in Georgia there are 400,000 willows growng, and 80,000 additional slips have recently been put in. At the end of two years the switches are cut and made into bunches like sheaves of wheat. The leaves and the bark contain the medicinal salicin. This substance crystallizes in plates, is white in color, not very soluble in water, and somewhat bitter to the taste. Like other bitters, it promotes the appetite, and aids digestion, and is regarded as an excellent tonic in some forms of dyspepsia. It is also largely used in the treatment of acute rheumatism, and to some extent in malarial fevers as a substitute for quinine. It is said that the willow switches, when dry, are worth two hundred dollars a ton. The leaves and bark are sold at the rate of twenty-five cents a pound.

— A young woman is said by a writer in the *Medical and surgical reporter* to have acquired the habit of eating roasted coffee, eating sometimes as much as half a pound a day, and continuing it for four months. She was very pale, sallow, and nervous; she had a weak pulse, impaired digestion, and got out of breath easily going up stairs.

— Professor Bystroff has recently examined 7,478 children in the schools of St. Petersburg, and finds that 11.6 per cent suffer from headache. He regards it as due to irritability of the brain, brought on by the excessive forcing of the education.

— The entire population of Germany, as enumerated in the quinquennial census of December last, is given at 46,840,587, an increase of 1,606,526 over that of 1880.

— The entire length of railroads of the world, up to the end of 1884, as recently published by the Prussian minister of public works, was 291,000 miles, an increase of twenty-seven per cent, or over sixty thousand miles, during the preceding five years. Of the entire length, very nearly one-half is that of the American railroads, mainly in the United States.

LETTERS TO THE EDITOR.

****Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

A contribution to the psychology of the polar bear (Ursus maritimus Lin.).

The fact that bears occasionally create rotary currents in water by means of their paws, for the purpose of bringing floating objects within their reach, has several times been verified by different observers (Romanes' 'Animal intelligence,' New York, 1883, pp. 351, 352; Darwin's 'Descent of man,' New York, 1875, p. 76). Still, this act of bears has not been so often recorded as to render the present instance uninteresting.

In May, 1886, happening to be in Central park, New York city, I visited the bear-pit. This pit is divided through the centre by a partition of iron bars, black bears being confined on one side and two polar bears on the other. The water supply is furnished by an oblong basin about eight feet long by four or five wide, so placed that the above-mentioned partition runs through its short axis. One of the polar bears was resting on the side of the basin, opposite to the front of the pit, with the side of his head snug against the partition, the body being stretched out alongside the margin of the basin, and his fore-paws hanging over its edge. In his fore-paws he had a portion of an ordinary walking-cane, about a foot and a half long, and from this he evidently derived, by playing with it in the water, a great deal of enjoyment. Let this bear be known as No. 1. The other bear, not being able to reach across the basin, nor to reach over the head to the fore paws of No. 1, and having no plaything of his own, was apparently highly discomfited. This discomfiture he manifested by his quick and uncertain turns around the pit, ever returning to the edge of the basin or the back of No. 1, there to again make an unsuccessful attempt to obtain the cane. Let this bear be known as No. 2.

An interested group of spectators had now collected, and one of them, out of sympathy for No. 2, threw him a small painted stick about eight inches long. This No. 2 immediately began playing with, taking it in his mouth and tossing it around in various directions. Finally the little bit of wood fell into the basin of water within reach of No. 1, who hastily appropriated it, much to the seeming chagrin of No. 2, — this bear once more becoming very restless and uneasy. The stick and the cane, however, were too much for No. 1 to manage, for in his maneuvres, seeming unnoticed of him, he lost his hold upon the stick, and it fell into the water. At once No. 2, who, at the time, was sitting on his haunches at the front side of the basin, appeared to comprehend this, and began pawing the water with the right and left paw alternately, thus creating a current in the water which brought the little piece of wood to him from the other side of the basin in about two minutes. Hastily taking it out of the water, No. 2 laid it on the edge of the basin, for in the mean time No. 1 had changed his hold on the cane in such a way that he confined it between his paw and the side of the basin at the water's level. His paw being at the very remote end of the cane, thrust partly through the bars into the black bear's side of the pit, the cane seemed to be free upon the water. No. 2 now went through the same motions as had secured him the small piece of wood. After keeping his exertions up for about one half-minute, he seemed to perceive that the cane did not move towards him: so careening his head around, he brought into full view the paw of No. 1, and appeared to comprehend that the cane passed between the paw of No. 1 and the basin wall, for instantly he stopped pawing the water, and went to playing with his own piece of wood.

Throughout this whole scene, it seemed to me that there occurred a notable change in the facial expression of each bear as he gained or lost a point. There was no evidence of anger; and while No. 2 was creating the water current, his face wore the impress of the most profound earnestness, which gave way, when the stick was obtained, to an expression of great elation, this in turn being replaced by an intense look of cunning as he set about to obtain the cane.

First agreeing that the terms 'reflex action,' 'instinct,' and 'reason' shall be defined according to the definitions of Dr. Romanes ('Animal intelligence,' p. 17), the action, or series of actions, executed by No. 2 must have been, wholly or in part, either reflex, instinctive, or rational. If reflex, there must have been: —

(*a*) Particular and often recurring stimuli, to have given rise to the acts of No. 2; and also,

(*b*) The acts must have been adaptive, although not intentional.

Manifestly, these two prime conditions did not obtain, and therefore the acts of No. 2 were not reflex, either in whole or in part. If instinctive, then the acts of No. 2 must have been performed "without necessary knowledge of the relation between means employed and ends attained, but similarly performed under similar and frequently recurring circumstances by all the individuals of the same species."

1° Had No. 2 ceased his current-making when he obtained the piece of wood, his act might possibly have been in part instinctive; but having obtained one object by this means, he seems to set the same cause in action to gain another object, which he conceives to be similarly conditioned, and when, apparently by new observations (data), finding that this second object is confined by a force greater than that which he can command by his water-current, he desists immediately from his exertions, it is evident that three several mental processes have occurred, to wit: —

(*a*) The employment of like causes to produce like effects.

(*b*) The exercise of a certain amount of memory (individual education by experience).

(*c*) The correct estimation of the difference in force, exerted upon the cane, between the water-current of his making and the confining power of his mate's paw, e. g., judgment.

2° By the conditions of our definition, it would be necessary, in order that these acts of No. 2 might be instinctive, that the same should be observed of the majority of polar bears when similarly conditioned. An appeal to facts shows that these acts are rarely executed by bears. Hence it follows that the said acts of No. 2 were not, either in part or in whole, instinctive. Finally, by the conditions of the proposition, these acts, being neither reflex nor instinctive, must be rational, or else did not take place, e. g., either reason must exist in certain bears of the polar species, or the mind of man must refuse to think of the acts of said bears. The only attempt at the vitiation of the foregoing argument is conceived to exist in the fact that it rests upon but one observation.

JAMES P. MARSH.

The eccentricity theory of the glacial period.

Croll's eccentricity theory of the glacial period is certainly an attractive theory. The ingenuity and learning of its author have merited and received universal respect. The proposal thus to link together by one additional tie the sciences of astronomy and geology, is in harmony with that profound sense of the unity of nature, which is a dominant sentiment in modern science. In utter despair of the possibility of constructing any reliable time estimates by measuring the amount of erosion or deposition, every geologist would gladly welcome the opportunity of importing into his science something of the chronological definiteness which has been the boast of the astronomer. And it must, I think, be conceded that no very satisfactory explanation of a glacial period by means of purely terrestrial conditions has been proposed.

Nevertheless, there has always been a considerable degree of skepticism in regard to the fundamental conception of the eccentricity theory. The question whether the conditions of aphelion winter and perihelion summer, in an epoch of great eccentricity, would tend to accumulate snow and ice, and produce a glacial period in the hemisphere so conditioned, has never been so answered as to command universal assent. Indeed, J. J. Murphy has argued, with much plausibility, that the glaciated hemisphere would be the one with perihelion winter and aphelion summer.[1] Others have believed that there would be no appreciable effect in the direction of glaciation in either hemisphere. I desire to call attention to a class of well-known facts whose bearing upon the question has not, I think, been adequately regarded. A very brief preliminary discussion will suffice to show the bearing of the facts referred to.

There would evidently be two marked contrasts in the character of the seasons between the two hemispheres at an epoch of high eccentricity. The hemisphere with aphelion winter would have a long winter and a short summer, while the other hemisphere would have a short winter and a long summer. Again, the hemisphere with aphelion winter would have extremes of heat and cold, its summer being very hot and its winter very cold, while the climate of the other hemisphere would approximate a mean throughout the year. It is by no means certain that the effects of these two contrasts upon the matter of glaciation would be in the same direction. As regards the difference in the length of the seasons, I suppose there can be no doubt that increased length of winter would tend to glaciation. Other things being equal, the longer the winter, the larger would be the proportion of precipitation in the form of snow, and the smaller the proportion in the form of rain. And increased snow fall would certainly tend to accumulation of snow and ice.

But what would be the effect of the difference in the intensity of the seasons? Would glaciation be favored by cold winters and hot summers, or by mild winters and mild summers — by a climate of extremes, or by a climate of means? It seems to me that a comparison of the northern and southern hemispheres at present, in the matter of glaciation, will suggest an answer to this question. The present value of the eccentricity of the earth's orbit is so small that its climatic effects are completely masked by geographical conditions. The northern hemisphere now has the perihelion winter, and the southern hemisphere the aphelion winter. So far, therefore, as astronomical conditions control climate, the northern hemisphere should have a climate of means, and the southern hemisphere of extremes. But this relation is completely reversed by geographical conditions. The great amount of land in the northern hemisphere gives that hemisphere a climate of extremes, while the vast expanse of water in the southern hemisphere produces a climate of means. This

[1] *Quarterly journ. of geolog. soc.*, xxv. 350, 1869; *Amer. journ. science*, [2] xlix. 115, 1870.

contrast will appear very striking to any one who will compare the maps of January and July isotherms, respectively, for the globe. The two maps will be seen to differ but slightly in the southern hemisphere, immensely in the northern. I know no reason why a contrast between extremes and means in climate, produced by geographical conditions, should have a materially different effect, as regards glaciation, from a like contrast produced by astronomical conditions. It appears, then, that a comparison of the northern and southern hemispheres may show us whether a climate of means or a climate of extremes is favorable to glaciation.

Now, there can be no doubt that at present the southern hemisphere is suffering a greater degree of glaciation than the northern. As the facts are so well known, it is only necessary to allude to them. New Zealand, with a mean temperature about the same as that of Switzerland, has glaciers extending as nearly to the sea-level as those of Norway.[1] Nor is this due to any exceptionally large snow-fall in New Zealand, for the precipitation there is no greater than in Norway, and considerably less than in Switzerland. Tierra del Fuega, with a mean temperature about equal to that of southern Norway, and with a winter temperature no colder than that of Switzerland, has glaciers extending to the sea.[2] The same is true of the island of South Georgia, if, indeed, perpetual snow does not descend to the level of the ocean (as reported by Captain Cook).[3]

It may, I think, fairly be concluded that glaciation depends less upon the coldness of the winter than upon the coolness of the summer. Not a climate of extremes, but a climate of means, tends to produce glaciation. It appears, accordingly, that the two characteristics of the seasons, in an epoch of high eccentricity would tend in precisely opposite directions, as regards glaciation. In one hemisphere, the length of the winter would tend to glaciation, while the intensity of extremes of temperature would oppose glaciation. In the other hemisphere, the shortness of the winter would oppose glaciation, while the approximation to a mean temperature would favor glaciation. The actual tendency to glaciation would be, then, the algebraic sum of two values of opposite signs. In which hemisphere would the tendency to glaciation predominate? And would the absolute value of the algebraic sum of the two tendencies in either hemisphere be sufficient to have any appreciable influence? I simply suggest these questions, making no attempt to answer them.

I may remark incidentally that there is something aparently unsound in the argumentation by which the advocates of the eccentricity theory seek to show that the hot perihelion summer would not melt the snow and ice. They virtually deny that the perihelion summer would be hot, urging that the temperature could not rise above the freezing-point until the ice was all melted.[4] It may well be conceded that the summer temperature could not rise much above the freezing point in the centre of a polar ice-cap, or at the apex of a snow-capped peak. But at the margin of a snow-field, polar or alpine, the climatic conditions would be very different. The ice-fields of a glacial period would not be created instantaneously in their maximum extent, but would be the results of a slow accumulation for many centuries. As each hemisphere in turn gradually approached the condition in which the climax of its winter would fall in aphelion, the snow-fields would be at first of very small extent. Outside the boundaries of those snow-fields, the land would be heated to a temperature increasingly hot, as year by year the climax of the summer approached the perihelion; and that high temperature of the surrounding areas would produce rapid melting at the margins of the snow-fields. Moreover, even at the extreme of glaciation, the area covered by ice would form but a small part of the surface of a hemisphere. Cold aphelion winters must be accompanied by perihelion summers not only potentially but actually hot.

William North Rice.

Wesleyan University, Middletown, Conn., Aug. 16.

[1] *Science*, iv. 426, 1884.

[2] Darwin, 'Journ. of researches during voyage of H. M. S. Beagle,' p. 224. N. Y., 1875.

[3] Lyell, 'Principles of geology,' vol. i. p. 242. N. Y., 1872.

[4] Croll, 'Climate and time,' pp. 58-67. New York, 1875.

The causation of pneumonia.

In *Science* for Aug. 13, 1886, p. 133, I notice a paragraph relative to results of observations by Dr. Seibert of seven hundred and sixty-eight cases of pneumonia, wherein it appears that pneumonia prevails to its greatest extent "whenever there exists a low or falling temperature, with excessive and increasing humidity, and high winds." This reminds me that readers of *Science* may be interested to know that facts respecting a very much larger number of cases, and respecting pneumonia in different parts of the United States, in England, and in India, — that is to say, in several climates and under different conditions, — confirm to some extent the conclusions reached by Dr. Seibert, as mentioned by *Science*. Such statistics, presented by abstract at the last meeting of the American climatological association, demonstrate, I think, that the sickness from pneumonia is absolutely controlled by the temperature of the atmosphere. The higher the temperature, the less the sickness from pneumonia; and the lower the temperature, the more the sickness from pneumonia. This is equivalent to saying that that part of the conclusion of Dr. Seibert which relates to humidity is an error; because the absolute humidity of the atmosphere is, speaking roughly, inversely as its temperature, and there is most sickness from pneumonia when, or soon after, the air is driest absolutely; and there is least sickness from pneumonia when, or soon after, the air contains the most vapor of water, that is, when the temperature is highest. The error of many who have written on this subject, and probably the error of Dr. Seibert, consists partly in calling the 'per cent of saturation of the air' (technically known as 'the relative humidity,' the humidity of the atmosphere. But the curve for 'relative humidity' is not, when inverted, the same as the curve for pneumonia, as you may see by comparing such curves, on the diagrams I published, based upon over twenty-seven thousand weekly reports of sickness in Michigan, by observers in different parts of the state, and upon over one hundred and twenty thousand observations of the psychrometer during the same time, namely, the seven years, 1878-84. Relative humidity seems to have an opposite relation in the warm months to what it has in the cold months. The fact, which I think I have completely demonstrated, is, that pneumonia is quantitatively proportional to the coldness and dryness of the atmosphere;

and, as this is true for every month of the year, it follows that, if there is any pneumonia which is infectious, it is absolutely dependent upon those meteorological conditions for its action upon the human organism.

In the paper to which I have referred, I have advanced a theory of the causation of pneumonia consistent with the facts demonstrated; and, briefly outlined, it is as follows: Air expired from the human lungs is nearly saturated with vapor of water at a temperature of about 98° F., and this contains about 18.69 grains of vapor in each cubic foot. The quantity of vapor exhaled is at all times greater than the quantity inhaled; but when the air is very cold and dry, the quantity exhaled is excessive, as may be seen when we reflect that air at 32° F. can contain in each cubic foot only about two grains of vapor. The fluid which passes out from the blood into the air-cells of the lungs, and which normally keeps them moist, contains some of the salts of the blood; and the chloride of sodium, not being volatile, is mostly left in the air-cells when the vapor passes out with the expired air. When the air inhaled is excessively dry (as it always is when excessively cold), this salt collects in the air-cells of the lungs in considerable proportion. This is proved by my statistics, which show the increase of pneumonia at such times, taken in connection with the fact that chloride of sodium in the lungs is in excess in pneumonia, which was proved in 1851 by Lionel S. Beale, M.D., of London, England. Dr. Beale also verified the observations by Redtenbacher, made in 1850, that during the onward progress of pneumonia the chlorides disappear from the urine, and reappear when convalescence has been established. In the air-cells, the chlorides are irritating when they become concentrated; but the exudation of fibrine, which is the most prominent condition in pneumonia, is probably favored by a fact in osmosis which is not generally well understood, —namely, that albumen, which it is usually considered will not pass by osmosis, will pass through an animal membrane to a solution of chloride of sodium.

Thus the causation of pneumonia by the inhalation of cold dry air seems to be completely worked out. As a cause of deaths, pneumonia is one of the most important diseases. It is hoped that its prevention may now begin.

Henry B. Baker.

Lansing, Mich., Aug. 17.

The sweating sickness.

In Hume's 'History of England,' volume ii., p. 384, appears the following passage: "There raged at that time, in London and other parts of the kingdom, a species of malady unknown to any other age or nation, the 'sweating sickness,' which occasioned the sudden death of great multitudes, though it seemed not to be propagated by any contagious infection, but arose from the general disposition of the air and of the human body. In less than twenty-four hours the patient commonly died, or recovered; but when the pestilence had exerted its fury for a few weeks, it was observed, either from alterations in the air or from a more proper regimen which had been discovered, to be considerably abated."

The time of this endemic must have been about the summer of 1485, just a short time previous to the coronation of Henry VII. The historian makes no further mention as regards the nature of this malady; in fact is distressingly concise in his account of so interesting a disorder.

Now, the object of my letter is apparent: I wish a little more definite information concerning this so-called 'sweating sickness.' But if perchance, in my ignorance, I am inquiring about a disease the name of which is synonymous with one at present in existence, then the modern name will be all-sufficient.

E. W. Evans.

Easton, Penn., Aug. 16.

[The 'sweating sickness' to which our correspondent refers prevailed in England during portions of both the fifteenth and sixteenth centuries; appearing for the first time in 1485, again in 1506, for the third time in 1517, and twice subsequently, in 1528 and 1551. During this last visit, it appeared in London July 7, and during the twenty-three days that it remained caused nearly a thousand deaths. The disease was in the nature of a fever, followed by sweating; commencing with pains throughout the body, flushes of heat, oppression at the stomach, and delirium, after which, a profuse perspiration of an offensive odor. Relapses were apt to occur, sometimes as many as twelve in number. Some regarded the disease as a rheumatic fever, others as a form of ague, and others still as an influenza. The first appearance of the disease, in 1485, was traced to the army that fought at Bosworth; the second, of 1517, occurred when London was crowded with foreign artisans: and that of 1528 was coincident with the great military operations of Francis I. in Italy. At the time the sweating sickness prevailed in England, that country was ravaged by diseases and pestilences of almost every name. Spotted fever, brain fever, epidemic flux, scurvy, diphtheria, small-pox, measles, scarlet fever, and erysipelas, — all figured largely as mortality factors during these two centuries.

That England was not blotted out of existence by pestilential disease during this epoch is a marvel. Houses were constructed without any regard to ventilation; the floors were made of loam covered with rushes, which were not removed, but were covered with others from time to time, until the deposit of twenty years and more had accumulated, — containing bones, broken victuals, and all manner of filth, and saturated with the discharges of man and beast. The streets were in the same condition, the filth being thrown into them from the houses. Of this condition of things Erasmus wrote, "If, even twenty years ago, I had entered into a chamber which had been uninhabited for some months, I was immediately seized with a fever." Add to this the gluttony and intemperance of the English people of this time, and some faint idea may be obtained of the influences at work to undermine the constitutions of our ancestors and prepare them for epidemic disease whenever it should appear. If our correspondent desires to study this disease in detail, he will find a full account in the following works: 'Historia regni Henrici, septimi regis Angliae, vol. ix. of the works of Francis Bacon; 'The epidemics of the middle ages,' J. F. C. Hecker, M. D., published by the Sydenham society; 'A boke or counseill against the disease commonly called the sweat or sweating sicknesse, made by Jhon Caius, doctour in physicke, 1552' (appendix to Hecker's 'epidemics of the middle ages'). A very admirable résumé of this epidemic disease, and of others, will be found in 'Public health,' by Wm. A. Grey, M. B., published by Henry Renshaw, London. — Ed.]

SCIENCE.—SUPPLEMENT.

FRIDAY, AUGUST 27, 1886.

THE ORIGIN OF LANGUAGES, AND THE ANTIQUITY OF SPEAKING MAN.

In the study of every science there arise from time to time difficult questions or problems which seem to bar the way of the student in one direction or another. It becomes apparent that on the proper solution of these problems the progress of the science mainly depends ; and the minds of all inquirers are bent earnestly on the discovery of this solution. Such, in biology, are the questions of the origin of life and the genesis of species. Anthropology, and its auxiliary or component sciences of comparative philology, ethnology, and archaeology, have their share of these problems. Among them, two of the most important are undoubtedly, in philology, the question of the origin of linguistic stocks, and in archaeology, the question of the epoch at which man acquired the faculty of speech. A brief consideration of these questions, in the light cast upon them by the most recent discoveries, may therefore be deemed to form an appropriate introduction to the work of our section.

The question of the origin of languages must be distinguished from the different and larger question of the origin of language, which belongs rather to anthropology proper than to the science of linguistics, and will come under consideration in the later part of our inquiry. Nor yet does our question concern the rise and development of the different tongues belonging to one linguistic stock or family, like the sixty languages of the Aryan or Indo-European stock, the twenty languages of the Hamito-Semitic family, the one hundred and sixty-eight languages enumerated by Mr. R. N. Cust as composing the great Bantu or South African family, and the thirty-five languages of the wide-spread Algonkin stock. Such idioms, however much they may differ, are in their nature only dialects. The manner in which these idioms originate is perfectly well understood. But we have no satisfactory theory to explain the distinction between the families themselves. When, for example, we have traced back the Aryan languages and the Semitic languages to their separate mother-tongues, which we are able to frame out of the scattered dialects, we find between these two mother-tongues a great gulf, which no explanation thus far proposed has sufficed to bridge over. How strongly the sense of this difficulty has been felt by the highest minds engaged in philological study, will be evident from two striking examples. Sixty years ago, Baron William von Humboldt found it (as Dr. Brinton states) "so contrary to the results of his prolonged and profound study of languages, to believe, for instance, that a tongue like the Sanscrit could ever be developed from one like the Chinese, that he frankly said that he would rather accept at once the doctrine of those who attribute the different idioms of men to an immediate revelation from God." Fifty years later Prof. Abel Hovelacque, in his work, 'La Linguistique,' declared, as the final conclusion of science, that there could be no conceivable community of origin between systems so unlike as that of the Indo-European and that of the Semitic tongues. "The abyss between the two systems," he affirms, "is not merely profound : it is impassable."

The number of distinct linguistic stocks is computed to exceed two hundred, most of which are found on the western continent. Various attempts have been made to explain their origin, but none have gained general acceptance. Some of the most eminent philologists have given up the question, in despair of a solution. Yet the simple and sufficient explanation has been lying close at hand, awaiting only, like many other discoveries in science, the observation of some facts of common occurrence to bring it to light. In the present case, the two observers who have made the conclusive facts known to us have both been Americans, and both of them writers of more than ordinary intelligence ; but both were entirely unknown in this branch of investigation, and both, moreover, had the ill-fortune of publishing their observations in works of such limited circulation that their important contributions to science have hitherto failed to attain the notice they deserved.

Before setting forth the facts, it will be well to state at once the result of the inquiry. Briefly, then, the plain conclusion to which all the observations point, with irresistible force, is that the origin of linguistic stocks is to be found in what may be termed the language-making instinct of very young children. From numerous cases, of which the history has been traced, it appears that,

Abstract of an address before the section of anthropology of the American association for the advancement of science at Buffalo, Aug. 19, 1886, by Horatio Hale, vice-president of the section.

when two children who are just beginning to speak are left much together, they sometimes invent a complete language, sufficient for all purposes of mutual intercourse, yet totally unintelligible to their parents and others about them. The first to observe, though not the first to publish, an instance of this nature was Miss E. H. Watson, a lady of Boston, the authoress of several esteemed works on historical subjects. In giving to the world, in 1878, a treatise by her father, the late George Watson, on 'The structure of language,' she prefixed to it an essay of her own on the 'Origin of language,' in which an interesting account is given of the 'childrens' language.' The children in question were twin boys, born in 1860, in a respectable family, residing in a suburb of Boston. They were constantly together, and an intense affection existed between them. "At the usual age," the authoress states, "these twins began to talk, but strange to say, *not* their 'mother-tongue.' They had a language of their own, and no pains could induce them to speak anything else. They persistently refused to utter a syllable of English. Their mother relates that although she could not understand their language, she contrived, by attention, to discover what they wished or meant." The important information is added that "even in that early stage, the language was complete and full; that is, it was all that was needed. The children were at no loss to express themselves in their plays, — their 'chatterings' with each other all day." At last they were sent to a school, where they gradually learned English, as children learn a foreign language, and the memory of their own speech faded from their minds.

Miss Watson, unfortunately, did not become aware of these circumstances until some time afterwards, when all recollection of this peculiar language was lost, except of a single word. Another observer, at about the same time, was more fortunate. A physician of Albany, Dr. E. R. Hun, in an article published in 1868, in the *Monthly journal of psychological medicine*, under the title of 'Singular development of language in a child,' has given a clear and scientific account of a similar phenomenon, with specimens of the language. In this case the speech was invented by a little girl, aged four years and a half, in conjunction with her brother, eighteen months younger than herself. About twenty of the words are given, most of which were used in several allied acceptations, — as *mea*, meaning both cat and furs; *migno-migno*, water, wash, bath; *bau*, soldier, music; *odo*, to send for, to go out, to take away; *waia-waiar*, black, darkness, a negro. The language had its own forms of construction, as in *mea waia-waiar*, 'dark furs' (literally, 'furs dark'), when the adjective follows its substantive. Dr. Hun adds, "She uses her language readily and freely, and when she is with her brother they converse with great rapidity and fluency."

Further inquiries have shown that such cases of child-language are by no means uncommon and these cases, it must be considered, are, after all, merely intensified forms of a phenomenon which is of constant recurrence. The inclination of very young children to employ words and forms of speech of their own is well known, though it is only under peculiar circumstances that this language acquires the extent and the permanence which it attained in the cases now recorded.

In the light of the facts which have now been set forth, it becomes evident that, to insure the creation of a speech which shall be the parent of a new linguistic stock, all that is needed is that two or more young children should be placed by themselves in a condition where they will be entirely, or in a large degree, free from the presence and influence of their elders. They must, of course, continue in this condition long enough to grow up, to form a household, and to have descendants to whom they can communicate their new speech. We have only to inquire under what circumstances an occurrence of this nature can be expected to take place.

There was once a time when no beings endowed with articulate speech existed on the globe. When such beings appeared, the spread of this human population over the earth would necessarily be gradual. So very slow and gradual, indeed, has it been, that many outlying tracts — Iceland, Madeira, the Azores, the Mauritius, St. Helena, the Falkland Islands, Bounty Island, and others — have only been peopled within recent historical times, and some of them during the present century. This diffusion of population would take place in various ways, and under many different impulses; — sometimes as the natural result of increase and overcrowding, sometimes through the dispersion caused by war, frequently from a spirit of adventure, and occasionally by accident, as when a canoe was drifted on an unknown shore. In most instances, a considerable party, comprising many families, would emigrate together. Such a party would carry their language with them; and the change of speech which their isolation would produce would be merely a dialectical difference, such as distinguishes the Greek from the Sanscrit, or the Ethiopic from the Arabic. The basis of the language would remain the same. No length of time, so far as can be inferred from the present state of our knowledge, would suffice to disguise the resemblance indicating the common origin of such dialect-languages. But there is another mode in which the spread of population might take place, that would lead in this respect to a very different result. If a single pair, man and wife, should wander off into an uninhabited region, and there, after a few years, both perish, leaving a family of young children to grow up by themselves and frame their own speech, the facts which have been adduced will show that this speech might, and probably would, be an entirely novel language. Its inflections would certainly be different from those of the parent tongue, because the speech of children under five years of age has commonly no inflections. The great mass of vocables, also, would probably be new. The strong language-making instinct of the younger children would be sufficient to overpower any feeble memory which their older companions might retain of the parental idiom. The baby-talk, the 'children's language,' would become the mother-tongue of the new community, and of the nation that would spring from it.

Those who are familiar with the habits of the hunting tribes of America know how common it is for single families to wander off from the main band in this manner, — sometimes following the game, sometimes exiled for offences against the tribal law, sometimes impelled by the all-powerful passion of love, when the man and woman belong to families or clans at deadly feud, or forbidden to intermarry. In these latter cases, the object of the fugitives would be to place as wide a space as possible between themselves and their irate kindred. In modern times, when the whole country is occupied, their flight would merely carry them into the territory of another tribe, among whom, if well received, they would quickly be absorbed. But in the primitive period, when a vast uninhabited region stretched before them, it would be easy for them to find some sheltered nook or fruitful valley, in which they might hope to remain secure, and rear their young brood unmolested by human neighbors.

If, under such circumstances, disease or the casualties of a hunter's life should carry off the parents, the survival of the children would, it is evident, depend mainly upon the nature of the climate and the ease with which food could be procured at all seasons of the year. In ancient Europe, after the present climatal conditions were established, it is doubtful if a family of children under ten years of age could have lived through a single winter. We are not, therefore, surprised to find that no more than four or five linguistic stocks are represented in Europe, and that most of these are believed to have been of comparatively late introduction. In California, on the other hand, where the climate is mild and equable beyond example, and where small fruits, roots, and other esculents, abound at all seasons of the year, the aborigines are found to speak languages belonging to no less than nineteen distinct stocks. In Brazil, where the same conditions prevail, more than a hundred stocks, lexically distinct, have been found to exist. A review of other linguistic provinces yields results which strongly confirm the views now presented. A curious ethnological fact which tends in the same direction is the circumstance, which has been noticed by Major Powell, that, as a general thing, each linguistic family has its own mythology. Of course, when the childish pair or group, in their isolated abode, framed their new language and transmitted it to their descendants, they must necessarily at the same time have framed a new religion for themselves and their posterity; for the religious instinct, like the language-making faculty, is a part of the mental outfit of the human race.

But we are now brought face to face with another problem of great difficulty. The view which has just been presented shows that all the vast variety of languages on earth may have arisen within a comparatively brief period; and many facts seem to show that the peopling of the globe by the present nations and tribes of men is a quite recent event. The traditions of the natives of America, North and South, have been gathered and studied of late years, by scientific inquirers, with great care and valuable results. All these traditions, Eskimo, Algonkin, Iroquois, Choctaw, Mexican, Maya, Chibcha, Peruvian, represent the people who preserved them as new-comers in the regions in which they were found by the whites. Ethnologists are aware that there is not a tradition, a monument, or a relic of any kind, on this continent, which requires us to carry back the history of any of its aboriginal tribes, of the existing race, for a period of three thousand years. In the Pacific Islands the recent investigations have had a still more striking and definite result. We know, on sufficiently clear evidence, the times when most of the groups, from New Zealand to the Sandwich Islands, were first settled by their Polynesian occupants. None of the dates go back beyond the Christian era. Some of them come down to the last century. In Australia, the able missionary investigators have ascertained that the natives had a distinct tradition of the arrival of their ancestors, who entered by the north-west coast. It is most unlikely that, among such a barbarous and wandering race, a tradition of this nature should be more than two thousand years old. Probably it is much less ancient. We know positively that the neighboring group of New Zealand was settled only about five hundred years ago. Passing on to the old continent, we find that the Japanese historical traditions go back, and that doubtfully, only to a period about twenty-five hundred years ago; those of China only about four thousand years; those of the Aryans, vaguely, to about the same time; the Assyrians, more surely, a little longer; and the Egyptians to the date fixed by Lepsius for Menes, not quite four thousand years before Christ. No evidence of tradition, or of any monument of social man, points to his existence on the earth at a period exceeding seven thousand years before the present time. Yet the investigations which have followed the discoveries of Boucher de Perthes have satisfied the great majority of scientific men that human beings have been living on the globe for a term which must be computed, not by thousands of years, but by tens and probably hundreds of thousands. Writers of all creeds, and of all opinions on other subjects, concur in the view that the existence of man goes back to a remote period, in comparison with which the monuments of Egypt are but of yesterday; and yet these monuments, as has been said, are the oldest constructions of social man which are known to exist. How shall we explain this surprising discrepancy? How shall we account for the fact that man has existed for possibly two hundred thousand years, and has only begun to form societies and to build cities within less than seven thousand years? In other words, how, as scientific men, shall we bring the conclusions of geology and palaeontology into harmony with those of archaeology and history?

Fortunately, the geologists and physiologists themselves, by their latest discoveries, have furnished the means of clearing up the perplexities which their earlier researches had occasioned. We learn from these discoveries that while a being entitled to the name of man has occupied some portions of the earth during a vast space of time, in one and perhaps two geological eras, the acquisition by this being of the power of speech is in all probability an event of recent occurrence. The main facts on which this opinion is based must necessarily, in this summary, be very briefly stated.

The earliest men of whom we have any certain knowledge, the paloeolithic men, as they are styled, are distinguished by scientific investigators, as is well known, into two distinct races, belonging to widely different epochs. Prof. Boyd Dawkins styles the earlier race the 'river-drift men,' and the later the 'cave-men.' The river-drift men were, in his view, hunters and savages of the lowest grade. In his opinion, this race is now "as completely extinct as the woolly rhinoceros or the cave-bear." We have, he considers, no clue to its ethnology; and its relation to the race that succeeded it is doubtful. The cave-men were of a much higher order, and were especially remarkable for their artistic talents. Prof. de Quatrefages distinguishes the types of the two races as the 'man of Canstadt' and the 'man of Cro-Magnon,'—terms derived from places where crania belonging to these races have been found. Prof. A. de Mortillet knows the earlier race as the 'Chellean man' or the 'man of Neanderthal,' and the later as the 'Magdaleoran man,'—designations also derived from localities where their remains or their implements have been discovered. An under-jaw of an individual of this race, the celebrated 'jawbone of La Naulette,' affords what Prof. de Mortillet considers decisive evidence that its possessor had not the faculty of speech. This evidence is thus stated by him: "In the middle of the inner curve of the jaw, in place of a little excrescence called the 'genial tubercle,' there is a hollow, as with monkeys. Speech or articulate language," he continues, "is produced by movements of the tongue in certain ways. These movements are effected mainly by the action of the muscle inserted in the genial tubercle. The existence of this tubercle is therefore essential to the possession of language. Animals which have not the power of speech do not possess the genial tubercle. If, then, this tubercle is lacking in the Naulette jawbone, it is because the man of Neanderthal, the 'Chellean man,' was incapable of articulate speech."

In 1880, another jawbone belonging to this race was found by Prof. Maschka in the Schipka cave, in north-eastern Moravia; and in this jaw, also, the 'genial tubercle' was lacking. The inference derived from this evidence is strengthened by the peculiar shape of the crania belonging to this race, which are singularly low in the frontal region, leading to the belief that the third or lower frontal convolution of the brain, sometimes called 'Broca's convolution,' was imperfectly developed in the men of this race, as it is known to be in the anthropoid apes. It is in this convolution that Dr. Paul Broca has determined the seat of the faculty of language, Any lesion or disease of this part of the brain, as medical men are aware, produces aphasia, or the loss of the power of speech.

The succeeding race, the cave-men, or men of Cro-Magnon, possessed, as their osseous remains show, not only the 'genial tubercle,' but remarkably high and well-developed crania. Prof. de Quatrefages pronounces them 'a magnificent race.' Their carved and engraved implements display a superior artistic faculty. In the opinion of Dr. Broca, they were 'on the threshold of civilization.' They seem to have been contemporaries and perhaps offshoots of the highly endowed populations of early Egypt and Assyria. These singularly gifted populations of north-eastern Africa, south-western Asia, and western Europe were, so far as can be judged from the existing evidence, the earliest representatives of speaking man on the globe. Yet there can be no doubt that they were descended from the river-drift race. We have not here to deal with the origin of a new species, but simply with that of a variety. That in some family of the primitive speechless race two or more children should have been born with the faculty and organs of speech is in itself a fact not specially remarkable. Much greater differences between parents and offspring frequently appear. Among these, for example, is one so common as to have received in physiology the scientific name of polydactylism, — a term applied to the case of children born with more than the normal number of fingers. M. de Quatrefages mentions that in the family of Zerah Colburn, the celebrated calculator, four generations possessed this peculiarity, which commenced with Zerah's grandfather. In the fourth generation four children out of eight still had the supernumerary fingers, although in each generation the many-fingered parent had married a person having normal hands. Plainly, he adds, if this Colburn family had been dealt with like the Ancon breed of sheep, a six-fingered variety of the human race would have been formed; and this, it may be added, would have been a far greater variation than was the production of a speaking race descending from a speechless pair. The appearance of a sixth finger requires new bones, muscles, and tendons, with additional nerves leading ultimately to the brain. There is good reason to believe that the first endowment of speech demanded far less change than this.

Many skilled observers have sought to discover by various indications, such as the accumulation of débris in caves, the layers of earth formed by streams, the growth of bogs, and other evidences, the time which has elapsed from the era of the cave-men and the neolithic race to our own time. All their conclusions are in substantial accord. While the existence of the earlier race, the river-drift race, goes back to an indefinite period, which, according to some opinions, may exceed two hundred thousand years, nearly all the estimates place the appearance of the neolithic race, or men of the polished-stone epoch, within seven thousand years, and that of their predecessors, the cave-men, within eight thousand years, from our own time.

The question of the region in which speaking man first appeared is one on which there is room for a wide difference of opinion. It is a question about which no one will venture to dogmatize. The natural supposition, of course, would be that this first appearance took place somewhere near the centres of the earliest civilization. These centres were in Egypt and Assyria. Between those countries lies Arabia, in which, amidst the sandy desert that protects the land from invasion, there are many oases, large and small, blessed with a most genial climate and a fruitful soil. From that primitive centre, if such it was, the increasing population would speedily overflow into the plains of Mesopotamia and the fertile valley of the Nile; and there, or in their near vicinity, nearly all the animals which were first tamed, and nearly all the plants which were first cultivated, would be found. We need not be surprised, therefore, to find that the great majority of investigators have looked to south-western Asia for the primitive seat of the human race. The most distinct tradition that has come down to us of the earliest belief respecting the creation of man — the tradition which is preserved in the Hebrew narrative — places it in an oasis on the Arabian border, and dates it apparently at about the time when, as all the evidence seems to show, man endowed with speech first appeared.

The conclusions to which this inquiry, guided by the most recent discoveries of science, has directed us, may be briefly summed up. We find that the ideas of the antiquity of man which have prevailed of late years, and more especially since Lyell published his notable work on the subject, must be considerably modified. No doubt, if we are willing to give the name of man to a half-brutish being, incapable of speech, whose only human accomplishments were those of using fire and of making a single clumsy stone implement, we must allow to this being an existence of vast and as yet undefined duration, shared with the mammoth, the woolly rhinoceros, and other extinct animals. But if, with many writers, we term the beings of this race the precursors of man, and restrict the name of men to the members of the speaking race that followed them, then the first appearance of man, properly so styled, must be dated at about the time to which it was ascribed before the discoveries of Boucher de Perthes had startled the civilized world, — that is, somewhere between six thousand and ten thousand years ago. And this man who thus appeared was not a being of feeble powers, a dull-witted savage, on the mental level of the degenerate Australian or Hottentot of our day. He possessed and manifested, from the first, intellectual faculties of the highest order, such as none of his descendants have surpassed. His speech, we may be sure, was not a mere mumble of disjointed sounds, framed of interjections and of imitations of the cries of beasts and birds. It was, like every language now spoken anywhere on earth by any tribe, however rude or savage, a full, expressive, well-organized speech, complete in all its parts. The first men spoke, because they possessed, along with the vocal organs, the cerebral faculty of speech. As Professor Max Müller has well said, "that faculty was an instinct of the mind, as irresistible as any other instinct." It was as impossible for the first child endowed with this faculty not to speak, in the presence of a companion similarly endowed, as it would be for a nightingale or a thrush not to carol to its mate. The same faculty creates the same necessity in our days; and its exercise by young children, when accidentally isolated from the teachings and influence of grown companions, will readily account for the existence of all the diversities of speech on our globe.

WHAT IS NERVE-FORCE?

A DISTINGUISHED biologist has remarked, with great truth, that the study of the nervous system is the true field of battle for physiologists, all other investigations, however interesting and important, being of the nature of skirmishes, preparatory for and surely leading up to the final conflict, in which we must engage before we can hope to gain a position from which nature's most mysterious processes are laid bare to our view. Of all the functions of the nervous system, the one which, at first sight, would seem most accessible to investigation, is that of the nerve-fibre itself. What conception can we form of the physical or chemical changes which take place in those white glistening bands which are for us the only channels through which knowledge of the physical universe can be obtained, and which also enable us to impress upon the world around us the evidence of our conscious personality?

With the discoveries of Du Bois Reymond, the hope arose that nerve-activity might be explained as an electrical phenomenon, and the attempts made to build up a satisfactory electrical theory of nervous action have been numerous and ingenious. The important facts which forbid the identification of nerve-force with electricity are: the absence of an insulating sheath on the nerve-fibre, the slow rate at which the nerve-force is transmitted, and the effect of a ligature on a nerve in preventing the passage of nerve-force, while not interfering with that of electricity. The electrical phenomena connected with the functional activity of nerves (action-current, electrotonus) appear, therefore, to be secondary in their character, and not to constitute the essential process in nerve action. In this connection should be noted an experiment of d'Arsonval,[1] which shows how the electrical phenomena associated with the activity of nerves may be imitated by purely physical means. This observer filled a glass tube, of one or two millimetres interior diameter, with drops of mercury alternating with drops of acidulated water, thus forming a series of capillary electrometers. The tube was closed at its two ends with rubber membranes, and was provided with lateral openings by which its interior could be connected with electrical conductors. A blow upon one of the membranes caused an undulation of the liquid column, which was propagated from one end to the other of the tube, and was accompanied by a wave of electrical oscillation, which was propagated at the same rate. The phenomenon is, according to d'Arsonval, to be explained as follows: The blow upon the membrane changes the form of the surface of contact between the first two cylinders of mercury and acidulated water. This change of form is transmitted to the following cylinders with a rapidity dependent upon the nature of the fluid. But each of these changes of shape is accompanied by the production of an electric current (Lippmann's phenomenon, due to variation of superficial tension), and the tube is therefore traversed by an electric wave, which necessarily has the same rate as the undulation of the liquid column. The analogy between this phenomenon and the wave-like propagation of the action-current in nerves is sufficiently obvious.

In studying the nature of nerve-force, two alternatives present themselves. We may conceive the impulse to be conducted through the nerve-fibre by a series of retrograde chemical changes in the successive molecules of the nerve-substance, the change occurring in one portion of the fibre acting to produce a similar change in the neighboring portion. As this process is associated with the using up of organic material, and the consequent discharge of potential energy in the successive portions of the nerve, the theory may be called 'the discharging hypothesis.' The burning of a line of gunpowder may be taken as an example of this sort of action. On the other hand, we may conceive that the nerve-force is transmitted from molecule to molecule by some

Abstract of an address before the section of biology of the American association for the advancement of science at Buffalo, Aug. 19, 1886, by Dr. H. P. Bowditch, of Boston, Mass., vice-president of the section.

[1] *Comptes rendus soc. biol.*, April 3, 1886.

sort of vibratory action, as sound is transmitted through a stretched wire. As this theory does not involve the using up of any material, but simply the transferring of motion, it may be called 'the kinetic hypothesis.'

Inasmuch as the discharging hypothesis involves the destruction of organic material, we may, if this theory be correct, reasonably expect to find in the active nerve-fibre evidences of chemical decomposition and of heat production. Moreover, if the organic substances are used faster than they are replaced, or their products of decomposition removed, as they would naturally be under constant stimulation, we may expect to observe a diminution of nerve-action during the continuance of the stimulation; in other words, we shall have the phenomena of fatigue. On the kinetic hypothesis, on the other hand, we may expect to find an entire absence of chemical decomposition and fatigue, and, if the moving particles are endowed with perfect elasticity, an absence also of heat production.

The only functional chemical change of nerves for the existence of which an experimental proof has been offered, is the change in the reaction with test-paper. Just as the normally alkaline tissue of muscles becomes neutral or acid in activity, so, according to Funke[1] and Ranke,[2] do nerve-fibres and the white substance of the spinal cord change in activity from an alkaline to an acid reaction. Liebreich[3] and Heidenhain,[4] on the other hand, experimenting with a slightly different method, failed to get any evidence of the acidification of nerves in connection with functional activity. The phenomenon must indeed be a delicate one, since Ranke himself urges that the question should be decided by experiments on the spinal cord, and should not depend upon the 'doubtful results of tests applied to the nerve-trunks.' Now, since the cord contains gray as well as white substance, and as the gray substance, according to Ranke himself, becomes more acid than the white in functional activity, it is clear that an acid reaction of the white substance of the spinal cord may depend upon an acid formed in the gray and passing by diffusion into the white substance. This possibility, which is indeed admitted by Ranke, seems to deprive the experiments on the spinal cord of what little value they possessed as evidence of the production of acid in connection with the activity of nerve-fibres.

The other chemical changes which have occasionally been asserted to occur in active nerves, rest on still weaker experimental evidence, and it is therefore clear that chemical investigation gives us but little reason for maintaining a discharging, in opposition to a kinetic, theory of nerve action.

[1] *Arch. anat. und phys.*, 1859, 835.

[2] *Centralbl. med. wiss.*, 1868, 769; 1869, 97.

[3] *Tagebl. naturf. vers. Frankfurt*, 1867, 73.

[4] *Studien*, iv. 248; *Centralbl. med. wiss.*, 1868, 833.

The first experiments to test the heat-production of active nerves were those of Helmholtz,[1] who, after studying the analogous phenomenon in muscles, extended his investigations to nerve-fibres. He failed, however, when all sources of error were carfully avoided, to obtain any evidence of heat-production in connection with nervous activity, though his apparatus was capable of registering a change of temperature of 0.002° C. Similar negative results were obtained by Heidenhain.[2] On the other hand, Valentine,[3] Oehl,[4] and Schiff[5] maintained that nerve-fibres really are warmed by the passage of the nerve impulse. It seems, then, that the results of thermometric investigations speak no more positively than those of chemical research in favor of a discharging rather than a kinetic theory of nerve action.

The evidence of the activity of a nerve may be either direct or indirect. The direct evidence consists in the occurrence of that change of the electrical condition known as the 'negative variation,' of Du Bois Reymond, or the 'action-current,' of Hermann. The latter writer quotes the former as authority for the statement that this phenomenon becomes less intense in successive repetitions of the experiment, and regards this as evidence of the exhaustion of the nerve-fibre. Unfortunately, Hermann does not refer to the exact passage which contains this statement, and an examination of the chapter on the negative variation of nerves, in Du Bois Reymond's 'Untersuchungen,' fails to show any systematic study of the effects of fatigue on this phenomenon.

The indirect evidence of the activity of a nerve consists in the effect which it produces upon the central and peripheral organs with which it is connected. Of these effects, the contraction of a muscle is the one which is most conveniently observed, but the fact that a muscle is more readily exhausted than a nerve, renders it impossible to study the fatigue of nerves in this way without some special modification of the experiment.

Bernstein[6] was the first to employ the muscular contraction in experiments on the exhaustion of nerves. This observer finally reached the conclusion that a nerve may be exhausted by 5′ – 15′ tetanic stimulation. The experiments of Bern-

[1] *Archiv. anat. und phys.*, 1848, 158.

[2] *Studien*, iv. 250. [3] Moleschott 'Undersuch.' ix. 225.

[4] *Gaz. med. Paris*, 1886, 225. [5] *Pflüger's archiv.*, iv. 230.

[6] *Pflüger's archiv.*, xv. 298.

stein have recently been repeated by Wedenskii,[1] who was unable to find any evidence of the exhaustion of the nerve, even after the tetanic stimulation had continued six hours. A study of the subject upon warm-blooded animals seeming desirable, experiments were made upon cats, in the laboratory of the Harvard medical school.[2] It was found that stimulation of the nerve lasting from one and a half to four hours (the muscle being prevented from contracting by curare) did not exhaust the nerve, since on the elimination of the curare the muscle began to contract.

It thus appears that evidence of fatigue in nerves resulting from functional activity is as difficult to obtain as that of chemical change or of heat-production. It is conceivable that the irritability of a nerve should depend upon its possessing a certain definite chemical composition, constantly maintained by metabolic changes, and yet that the irritation of the nerve should produce no change whatever in its composition.

In support of this view, an analogy may be drawn from the physiology of the muscular system. We find here that the power of the muscles to perform their function is intimately associated with the amount of nitrogenous material undergoing decomposition in the body, but the performance of a given amount of muscular work, if within physiological limits, does not effect the amount of nitrogen excreted. In the case of muscles, to be sure, we have evidence of a considerable decomposition of non-nitrogenous material, and also of heat-production in connection with functional activity, but, if we limit our consideration to the nitrogenous element of muscular substance, the hypothesis above proposed for nerves finds its complete analogy in the muscular system.

We have thus seen that investigations into the chemical changes, the heat-production, and the fatigue of active nerves, all lead to results more favorable to a kinetic than to a discharging theory of nerve action.

We may, therefore, reasonably hope that future researches, if directed on this line, will throw further light on this most mysterious and interesting process.

IN the 'Catalogue of printed books' in the British museum, now issuing in random instalments, one heading which has just been completed — 'Academies' — is of special scientific interest. This and 'Periodical publications' (which is also nearly completed, four of the five parts being out) will indeed include reference to a large proportion of scientific literature, and it is not probable that any library in the world can at all compete with the British museum in its general completeness in these departments. The earlier publication of this list of titles of society publications would have rendered the catalogues of Scudder and Bolton more satisfactory. The volume of 'Academies' is a folio of 1018 pages. London alone occupies one part with nearly 200 pages, though Paris has less than 90. The publications are arranged under the name of the issuing body, and these alphabetically under the town where situated, the towns having their English form and making a single alphabet. Thus Compiegne, Concord, Constantina, Constantinople, and Copenhagen follow in that order. A few countries are introduced into the alphabet for some general societies, though other societies with equal right to a national name are placed under the seat of government. The United States does not appear, and it would be difficult to say where to look for our peripatetic societies. Certainly the American association publications can nowhere be found, though they are doubtless in the museum, as we note one or two other omissions known to us to be there. Only completed series are fully entered; of others, the first volume in the possession of the museum is given, with the added words, 'in progress.' There is no transliteration, but Greek, Russian, Persian, or what not, are mixed in one alphabet with the Roman. Some curious rules have been followed in the alphabetization: thus 'Société cuvierienne' precedes 'Société d'acclimatation,' because of the preposition in the latter; yet Le 'bureau des longitudes' is made to precede La 'société cuvierienne' by dropping the objectionable particles from the full names. These, of course, are minor matters, and it would take a good many such to detract in any serious measure from the value of this excellent and carefully edited work.

— Messrs. Jackman and Webster report in the *Photographic news* their results in photographing the retina of the human eye. A small camera was employed, placed behind an ophthalmoscope, and the albo-carbon gaslight was the means of illumination. In the photograph the normal cupping of the optic disk and the principal blood-vessels are readily discerned. It is evident that but a beginning has been made in this method of research; but, if continued, very valuable results may be obtained. The method of Brainerd and French in photographing the vocal cords and the interior of the larynx promises equally well, and is now employed by a number of laryngologists in making permanent records of abnormalities in these parts.

[1] *Centralbl. med. Wiss.*, 1884, 65.

[2] Bowditch, *Journal of physiology*, vi. 133.

SCIENCE.

FRIDAY, SEPTEMBER 3, 1886.

COMMENT AND CRITICISM.

American canned goods are being imported into France so rapidly and in such quantities as to alarm the producers of that country. As a result of this, we shall probably see a revivification of all the instances reported in the daily papers in past years of poisoning from these articles, some of which may have been due to the negligence of those engaged in the canning process, but most of which were undoubtedly due to carelessness or want of thought in the consumer. That the contents of some of the millions of cans annually put up for market in the United States should spoil is not to be wondered at, inasmuch as every housewife has the same experience in her domestic preserving; but in most of the instances where sickness has occurred from the consumption of such goods, the color or the taste gave ample warning.

It is deeply to be regretted that the work of the summer corps of the New York health department was not carried on this year, as heretofore. The amount of money which was asked of the board of apportionment was $10,000, the same as in past years; but for some reason, which was undoubtedly satisfactory to that body, although exceedingly unsatisfactory to the general public, the amount was not allowed, and the poor children of the metropolis have suffered accordingly. In 1885 this corps, consisting of 50 physicians, entered 28,178 houses of the tenement class, visited 113,410 families, and actually treated 3,934 cases of sickness which would otherwise have gone through their illness, either to recovery or death, unattended by any physician. Inasmuch as 1,850 of these cases were of a diarrhoeal nature, the probability of a fatal termination in the majority was very great: 291 children were found affected with contagious disease, and the necessary steps to isolate and disinfect were carried out, — a sanitary supervision which would not have been exercised had this corps not been on duty. Besides all this good work, there were distributed 11,579 circulars giving directions to poor and ignorant mothers as to the care of their infants, and 5,000 tickets distributed, each guaranteeing its holder a day on the water under the refreshing influence of the ocean breezes. That such work as this, affecting as it does the lives of thousands, should be left undone in a great city like New York, where tens of millions are annually spent for the maintenance of the city government, to save a paltry $10,000, or, what is more likely, to satisfy some personal or political grievance, is little less than criminal. Brooklyn, during the past year, had the services of a volunteer summer corps, and this year has put in the field a paid corps, which is doing excellent service. The action of New York is only paralleled by that of the United States toward the National board of health.

Professor Lemaistre of Limoges describes a new disease which is at the present time quite prevalent among the school-children of France. It is known among the common people as *perlèche*, and is contagious. It consists in an abrasion in the corners of the mouth, which become little ulcers and sometimes bleed: it lasts from two to four weeks. The description given of it corresponds to what is commonly called in this country a 'cold-sore' or 'fever-blister.' In the sore Lemaistre has found a microbe which he calls Streptococcus plicatilis. These have been found in drinking-water, and it is surmised that they have been transferred to the lips of a person, thence to the edge of a cup, and thus all who used the cup became affected. Professor Lemaistre has examined the 5,500 children who attend the 32 schools of Limoges, and has found 312, or 1 in 17, affected with this disease. Although Professor Lemaistre is connected with the Ecole de médecine of Limoges, his explanation is to be accepted with a good deal of caution. It is hardly probable that a new disease has been discovered, or that its method of propagation can be so easily explained. The difficulties surrounding the demonstration of the connection between microbes and disease are so great, and the men competent to trace the various steps in the process so few, that we shall feel compelled to wait for further evidence before we accept *perlèche* as a new disease, and this variety of Streptococcus as its germ.

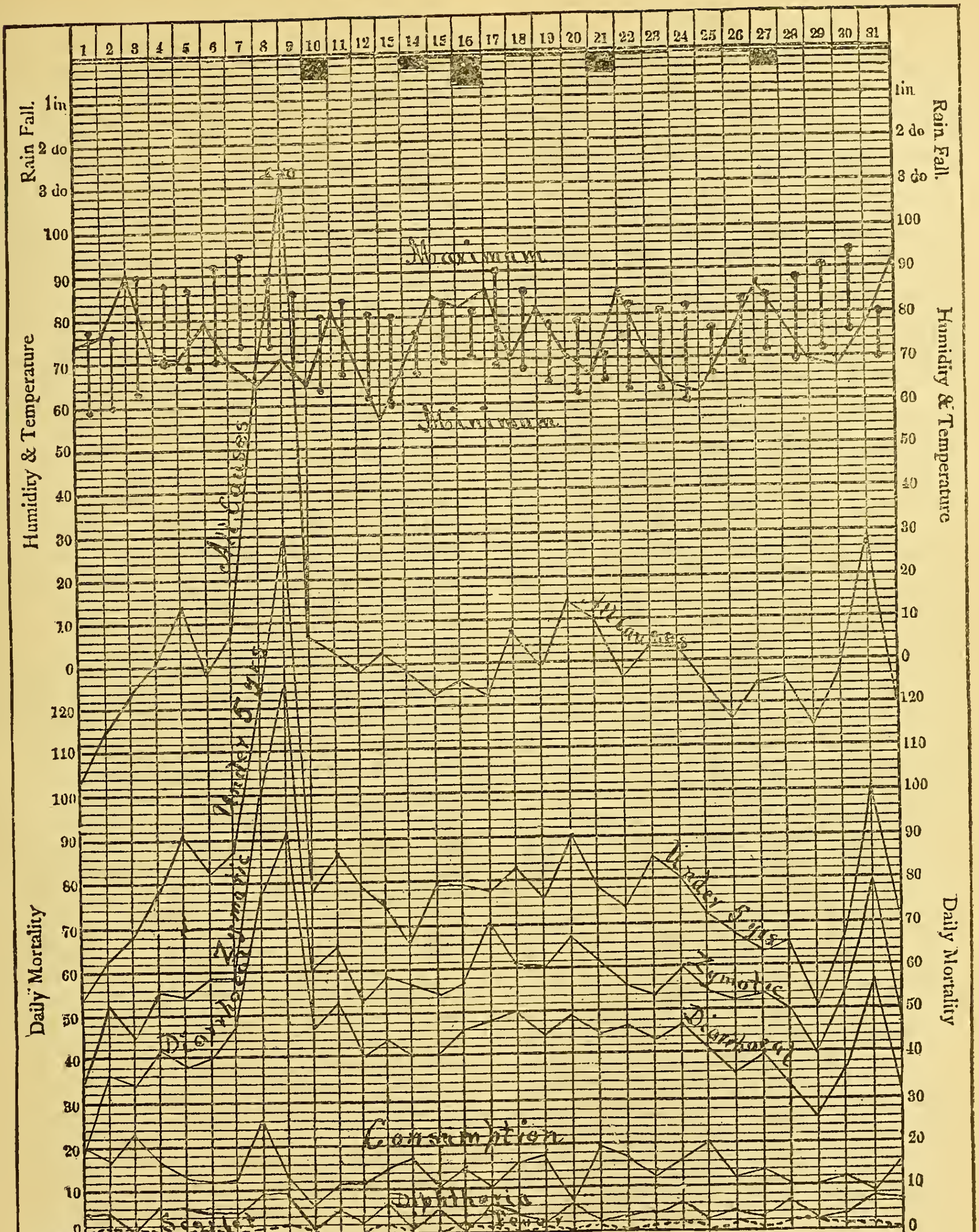
THE HEALTH OF NEW YORK DURING JULY.

THE month of July has the highest mortality of the year, its deaths running up to the startling figure of 4,198, an excess of 1,436 deaths over the month of June. This represents a daily average throughout the month of more than 135. The 8th of the month was characterized by the greatest daily mortality, 240, which has occurred since 1886 set in, and it is more than probable that this will not be exceeded during the entire twelve months. More than one thousand of the monthly increase was due to diarrhoeal diseases; and, of children under five years of age, 1,125 more died than in the preceding month. If this fact is borne in mind in reading the remarks made elsewhere on the failure to provide funds for the summer corps of physicians to visit the tenement houses, the gross outrage of this neglect will be better appreciated. The sudden and fearful rise of the mortality curves as represented in the chart is very striking. It will be remembered that in the early part of the year the lines of scarlet-fever and diarrhoeal diseases were so nearly coincident that at times they could not be distinguished, and that attention was then called to the fact, that, as summer approached, these lines would gradually separate, until in midsummer we should find them at a great distance from each other. That time has come: while scarlet-fever has on no one day of July caused more than two deaths, in one single day, the 8th, 92 persons succumbed to diarrhoeal diseases. Consumption caused 439 deaths, an increase of 6 over the preceding month; and diphtheria, 133, but 3 more than in June.

July was a month in which the temperature did not vary much from the average of the past ten years. The mean was 74.83° F. During the past decade this was exceeded six times. The maximum was 94° F. This was reached on the 7th at 3 P.M., and again on the 30th at 4 P.M. In July of 1885 the mercury touched 99, the highest since 1870. Rain fell on thirteen days of the month, but only to a slight extent, except on the 10th, 14th, 16th, 21st, and 27th; and the total rainfall for the month was but 2.75 inches, the lowest for ten years with the exception of 1881, when but 1.25 inches fell.

THE COMMITTEES OF THE AMERICAN ASSOCIATION.

THE reports of the committees of the American association were in general as unsatisfactory this year as heretofore, notwithstanding the new rule that all committees not reporting should be discharged. The usual report in regard to progress in obtaining proper legislation on the registration of births, deaths, and marriages, was made by Mr. E. B. Elliott, which amounted to little more than stating that Mr. Elliott had conferred with several members of congress. No one doubts the desirability of such registration in this country, and every one must hope to see it carried into effect at some not distant day. The committee on standards of stellar magnitudes stated that they had received reports of some observations made in compliance with the requests of last year; but, as some of them are still incomplete, it is deemed best to extend to July 1, 1887, the period within which the results may be received at the Harvard college observatory. Nothing could be stated by the committee on the International scientific congress; but the committee was continued, and it is hoped that some action will be taken at the meeting of the British association now in progress. The report on indexing chemical literature is referred to under our account of the meetings of that section. The committee on the International congress of geologists reported the proceedings of the Berlin meeting, and announced a fourth to be held in London in 1888. It asked authority to add the name of the association to an invitation to hold the next session in this country. The committee on anatomical nomenclature was continued, and Dr. Frank Baker was appointed in place of Dr. Leidy, ineligible on account of not being a member. The committee on health and diseases of plants was discharged as having accomplished its object. The committee on postal laws in regard to transmission of biological specimens through the mails reported with a copy of a petition to the postmaster-general, and of a proposed law which failed to pass the late session of congress. It is interesting to note in this connection the recent experience of a member of the Entomological society of Belgium, M. de Selys. M. de Selys found it necessary, when he sent to a friend in America some specimens, to fill out blanks in triplicate, stating that he sold these specimens to his friend in America at a given price. It was only after considerable correspondence back and forth with the authorities in Belgium that this method was adopted as the only one by which the specimens could be passed through the American custom-house. The committee on physics-teaching reported that they deemed it desirable that no formal report should be made until they could confer with a corresponding committee of the International educational association. The other committees were discharged according to the rule. Among the proposed amendments to the constitution was one substituting the word 'council' for the words 'standing committee.'



Weekly Mortality	1119	897	930	883
Weekly mean Thermometer	77.9	73.6	71.8	77.5
Weekly mean Barometer	29.949	29.832	29.828	29.808

PROCEEDINGS OF THE SECTION OF ANTHROPOLOGY.

THIS section is, perhaps, the one that is of most general interest, and was, as usual, well attended. The papers presented were of a varied character, and an encouraging increase in the consideration of what may be called 'psychological anthropology' was noticed.

One of the most important papers was presented by Dr. Daniel G. Brinton of Philadelphia. The paper had for its object the determination of the phonetic elements in the Mexican and Maya languages. The European conquerors found these races familiar with the art of writing, and possessing volumes of tradition, besides stone and hard-wood inscriptions. In spite of destruction and neglect, there are enough of these remains to form a respectable *corpus inscriptionum Americanum*. The important question concerning the languages of the Mayas and Aztecs is, To what extent were they phonetic systems? Did they appeal to the meaning, or the sound, of the word? In answering this question, one must remember that the arrangement to the eye of phonetic symbols is an arbitrary one, and that the sound represented may be a word, a syllable, or a sound-element. One must not approach the subject with the expectation of finding any usual arrangement, but must remember that the orders of space and of time do not agree. Some languages are read from right to left, others from left to right; some from above downwards, and some alternately from left to right and the reverse. The only requisition of a phonetic system is that a written symbol shall in some way represent a spoken sound or combination of sounds. Naturally, the most frequently occurring sounds will be the ones most apt to acquire a symbol. The process by which they do so is quite similar to that by which the Cherokee Indian Se-Quo-Yah gave to his nation a written alphabet. He simply listened for the syllabic sounds used by his tribe, and had each represented by a single symbol, taken from or suggested by an English spelling-book. Suffixes and affixes very naturally would soon be represented by a written symbol. In examining the Maya language from this point of view, one finds, for example, the picture of the sun with its rays, indicating the sound of its name (*kin*). We find in the expressions for 'east' and 'west' (*lakin* and *chikin*) that the final syllable is represented by the sun-picture. Turning to the Mexican language, our material is more abundant, and has been better utilized. This language (*Nahuatl*) was thoroughly studied by the Catholic priests. They found that the native phonetics were partly syllabic and partly alphabetic, somewhat as though one would write 'cat' by a picture of a chair, an axe, and a table, each sign representing the initial sound of its name. It is known, that, of the five vowels and fourteen consonants composing this language, three vowels and probably three consonants had reached the stage of being expressed by simple letters: *a* was represented by the sign for *atl* (water); *e*, by *etl* (bean); *o*, by *otli* (footprint); *p*, by *petl* (mat) or *pau* (flag); *t*, by *tetl* (stone) or *tentle* (lips); *z*, by *zo* (lancet). These are exceptions, however, and many phonetics are syllabic. What may be called the 'rebus' mode of writing is, however, the characteristic one. The lover who wooed his bride by sending his message in the form of the picture of a rose, a low mound, an eye, a loaf of bread, and a well, meaning 'Rose Hill I love well,' was going back to the language of the ancient Mexicans. In the Mexican form the order of the rebus signs was immaterial.

In addition to the above illustrations of what can be accomplished in this direction, Dr. Brinton presented some interesting results obtained by Mrs. Nuttall Pinart, and closed with a plea for the scientific study of this group of languages, and the assurance that many unique aspects of the problem of language were there concealed.

A novel and ingenious method of getting an insight into the unconscious mechanism of authorship was described by Mr. T. C. Mendenhall, under the title 'Characteristic curves of composition.' The method consists in counting the number of words of each length, from one letter to fourteen, fifteen, or as long as were found, and plotting the result on a curve, in which the abscissae represented the number of letters in the word, and the ordinates the number of words per thousand of each length. It was shown that while the curve resulting from each thousand words was not entirely regular, that resulting from five thousand was much more regular, and that from ten thousand almost entirely so. The inference from this was, that the phenomenon which the curve represented was a regular one, and that it was an expression of the peculiar vocabulary of the author. Moreover, by comparing the respective curves, one would be able to judge whether two works were written by the same author, and perhaps even decide the controversy whether Bacon wrote Shakspeare. Mr. Mendenhall's method was to count a thousand words at a sitting, and then turn to another part of the book. One soon acquired the art of counting at a glance the number of letters in each word, and, with an assistant to record the result, one thousand words could be counted in a half-hour. Curves derived from

Dickens ('Oliver Twist') and Thackeray ('Vanity Fair') were remarkably similar, thus suggesting that the subject-matter might cause the peculiarity of the curve, while those from John Stuart Mill ('Political economy' and 'Essay on liberty') differed from them in having more long words and fewer short ones, though words of two letters (prepositions mainly) were most abundant in Mill. The average length of the novelist's words was 4.38, and that of the philosopher 4.8.

In the discussion following this paper it was suggested that perhaps the characteristics of the language might be thus represented, and that, before describing certain characteristics as peculiarities of authorship, one must show that they are not due to the language, to the subject-matter, to the form or the fashion. Mr. Mendenhall's method is highly suggestive, and some interesting applications of it may be expected.

Mr. F. W. Putnam presented an interesting communication exhibiting photographs of specimens which show the method of making bone fish-hooks. These specimens and the hooks came from mounds in the Little Miami valley. They show that the process consisted in first boring a hole in the bone at the point which was to form the bottom of the bend of the hook. A cut was then made to either side from this hole, forming the inner surface of the hook, which was completed by rubbing down the piece into shape. Pieces of bone at each stage of the process have been found.

Rev. J. Owen Dorsey gave an account of a secret organization among the Osage Indians, the knowledge of which was obtained by gaining the confidence of some of the members. Similar societies can also be traced among the Kansas and Poncas. There are also close analogies with the Omaha dancing societies, in which secret observances are closely interwoven. There are seven degrees in this secret society. The first is called *Ni-k'ŭ-wac-u*, 'Songs of the giving of life.' The others are as follows: 'Songs of the bird, or dove,' 'Songs of the rushes,' 'Songs of the sacred bag,' 'Songs of the pack-strap' (the name of the sixth is forgotten), and, lastly, 'Songs of the return from war.' The initiation of a woman consists in her reception by the head of the gens, who makes her take four sips of water, emblematic of the river flowing by the tree of life. Cedar twigs, symbolizing the tree of life, are then rubbed between his hands, after which he strokes the woman from head to foot twelve times, — that is thrice in the direction of each of the four winds, — pronouncing the sacred name of a higher power each time that he rubs her with the cedar. The candidate is also tattooed with the round spots on the forehead among the Osages: but one such spot is given among the Omahas and Poncas. The initiation fee is a dozen horses, two copper kettles, several hogs, and a bountiful supply of beef for a feast, of which all the members partake. Each gens of the tribe has a mythical tradition of its origin, which is chanted by the old man who acts as priest. It takes four days and nights to chant the entire tradition of any one gens. Parts of these traditions Mr. Dorsey was able to record. One translates thus: "The first of the race was saying 'Ho, younger brother! the children have no bodies. We shall seek bodies for our children. Ho, younger brother! you shall attend to it.' They stood for the first time on the first upper world. There they were not human beings. One was saying 'Ho, younger brother! the children have no bodies. We must seek bodies for our children.'" Mr. Dorsey showed the chart on which the various designs which are interpreted symbolically were represented. The peculiarity of the symbolism there represented, and yet its general resemblance to similar European customs, is a strong evidence of the fact that the human mind everywhere works in the same direction. Other traditions and customs were given by the author, which brought out the high moral and political instincts of the Osage Indians.

Professor Edward S. Morse made additional contributions to his study of ancient arrow-releases. After describing the evolution of the release by the way of five stages, the last two of which represented the strongest phases, and are still in use, especial stress was laid on the fact that amidst all the change of religious rites, social customs, political organization, and so on, the apparently trivial act of slipping the arrow from the bow has remained unchanged. The persistency of this custom is in contrast to almost all other similar habits. Methods of release practised to-day may be traced back as far as three thousand years.

Mr. J. W. Sanborn related his observations upon the Iroquois league. The league was founded mainly on the law governing intermarriage. A warrior in one clan could marry only with certain other clans. The chief always ruled over his mother's clan, and did not succeed his father. The speaker affirmed that the league was in existence long before the days of Columbus, and was enthusiastic in his opinion of its efficiency.

Mr. H. C. Stone described the 'Eyah Shah, the sacrificial stone of the Dakotas.' The Dakotas worship the bowlders scattered among the hills, and expect to be aided by them in times of distress. But the peculiarity of the 'Eyah Shah' was that it was a place of worship from year to year.

The name means 'red stone.' The stone is a specimen of hornblende, but not red in color. It is decorated by means of a painted design.

Dr. John C. Branner presented some notes on a Brazilian language. The language, which is unlike any other Brazilian tongue, is spoken by a small and rapidly disappearing tribe in the province of Pernambuco. Some of its peculiarities are the use of a dual number; the grammatical distinction between objects belonging to the speaker and those belonging to others; the position of the accusative case at the opening of the sentence; the absence of labial sounds (due perhaps to the use of lip ornaments); and the presence of several sounds not found in the Portuguese language.

Mr. George F. Kunz read a paper on four gold and five silver ornaments from mounds in Florida. One of the gold ornaments weighed 75½ pennyweights, another 60, and two 19½ and 10 pennyweights each respectively. For North American gold-finds they are remarkable. They were suggested to be of Georgia gold origin. An eight-inch ornamented circular shield of gold, a very elaborately ornamented wire gold nose ring and other gold objects from the United States of Columbia, were also described.

At the last meeting of the section the members were agreeably surprised by the startling paper of Mrs. Nuttall Pinart, containing some analyses of Mexican inscriptions. The great novelty of her interpretation consists in interpreting the Mexican symbols as phonetics and not as ideograms, thus completely revolutionizing the current conceptions on this subject. Her method has been applied to the deciphering of certain calendar and sacrificial stones of Mexico, and was suggested by the presence on these of certain phonetic symbols occurring in picture-writings. This so-called calendar stone Mrs. Pinart believes to be the market stone of the City of Mexico. It regulated the times of holding the market days; and perhaps the division of the Mexican year rested upon these times. It also gives evidence to the existence of a communistic government. The means by which these striking results have been obtained can be illustrated by the following case. From the words *tetl* ('stone') and *isctli* ('face' or 'surface') and *pan* ('upon') we obtain, by combination according to the rules of the Nahuatl grammar, the word *teiscpan*, meaning 'publicly,' the name of which, *teiscpanca*, means 'something evident and manifest to all.' Dr. Brinton, who read Mrs. Pinart's communication, remarked upon it. that it was of epoch-making importance, and that if, as is probable, her method should be justified, we will have a new key for unlocking the mysteries of Mexico. It may be well to add that this rebus-writing was an artificial system used by the priests, and that the solution of the problem consists in showing that this secret writing, read as a combination of phonetics, becomes intelligible as a piece of Nahuatl language; just as though a secret language were made by using words the several parts of which formed other words, e.g., 'carpet' would be the picture of a car and of a pet.

The section was much interested in Professor Putnam's general sketch of the recent progress and significance of mound excavations. The usual view that regards all mounds as nearly identical in character and origin was discountenanced, and, in opposition, it was held that only a careful and detailed examination of a large number of mounds would supply the requisite data for a consistent picture of the mound-builders and their works. Nor are we justified in regarding the single characteristic of mound-building as a sufficient basis for considering the builders as belonging to the same race. The character of the mounds, their contents, their apparent purposes, all force upon us the conclusion that we are dealing with different anthropological races and with peoples of different times. One can even find mounds which seem to have been used for a second time while the first mound had been forgotten or at any rate ignored. So, too, with the question of age. Some mounds are evidently of recent origin, while others form a group which may be called ancient. Professor Putnam illustrated his remarks by off-hand sketches of the plans of various mounds which have been excavated under his direction and that of Dr. Metz, in the Lower Miami valley.

On the whole, the organization of the section of anthropology leaves much to be desired. Its popularity is at once a good and an evil; its good consists in attracting general attention to the variety and importance of the problems connected with man; its evil, in that this variety and interest are apt to give admittance to papers of too vague and pointless a character, which have no place in the sciences and neither bring nor suggest any thing new. It is the section that more than any other needs to be conducted on a strictly scientific plane, because its subject-matter is more open to a non-scientific treatment. There is no reason why this section should not be made to represent the high-water mark of American scholarship in the many interesting sciences that centre about anthropology.

THE American association unanimously passed a resolution expressing its gratification at hearing of Dr. Gould's proposed revival of *The astronomical journal*, and its good wishes for its success.

PROCEEDINGS OF THE GEOLOGICAL SECTION.

The geological interest of the meeting at Buffalo naturally centred in the excursion to and discussion of the falls and gorge of Niagara. Dr. Pohlman of Buffalo described the district to be visited on Saturday, and called particular attention to the occurrence of drift-filled antecedent channels on the line selected by the post-glacial overflow of Lake Erie, which would greatly diminish the amount of rock-cutting required in the excavation of the present gorge, and thus reduce the time since the overflow began: indeed, he thought, that, while there may have been rapids in the course of the early Niagara, near the Lewiston margin of the limestone plateau, in which the gorge is cut, the limestone was there so thin, and the shales below it so weak, and branching antecedent channels guided so great a length of the gorge from the plateau margin towards the present falls, that no great cataract was formed until the gorge was cleaned out even as far up as the older suspension-bridge. This would leave but a small amount of deep, hard rock-cutting for the falls to accomplish, and would thus make their beginning much more recent than has generally been supposed.

The geological members of the excursion party therefore gave close attention to these matters, and, as a whole, regarded the heavy drift between the sloping, rocky banks at the whirlpool, and the wide, open valley, with its plentiful drift, at St. David's, as sufficient evidence of an old buried channel connecting these points, and probably heading up above the whirlpool towards the bridges. But there seemed no sufficient reason for any confident belief in a branching old valley from the whirpool towards the Lewiston bluffs: in making this lower part of the gorge there must have been a long period of deep rock-cutting between the first leap of the falls over the bluff and the time of their discovering the old drift channel at the whirlpool. It should be noted that Professor Claypole reported the finding of a ledge of limestone, not seen by the rest of the party, in the drift slope at the whirlpool, which would suggest a less depth for the old valley than was generally accepted. Some antecedent channelling of the rocks was, however, certainly accomplished before the Niagara began its flow, and the washing-out of the drift that filled the old channel was easy work for the river; but by far the greater part of the gorge still seems to be the original work of the falls in solid rock.

The estimate of the age of the falls was presented by Messrs. Woodward and Gilbert of the geological survey, and their remarks greatly interested a large audience that had gathered on the announcement of the discussion. Mr. Woodward had just completed a survey of the Horseshoe Falls, and by comparing his results with those of the state survey in 1842, and of the lake survey in 1875, he found an average recession for the whole face of the fall of about two and four-tenths feet per annum; but, as the central parts of the curve where the water is deepest has retreated from two hundred to two hundred and seventy-five feet in the eleven years since 1875, an average retreat of five feet per annum does not seem at all improbable. Mr. Gilbert then discussed the beginning of the falls as controlled by the drainage of the lakes. When the retreating ice-sheet stood so as to obstruct the St. Lawrence and Mohawk drainage channels to the east, a broad sheet of water, representing a confluent of Erie and Ontario, stood at a high level over the present Niagara limestone plateau, and probably drained south-westward to the Ohio. When further melting opened the Mohawk Channel, the great double lake fell to a lower level, and was separated into its two members, Ontario sinking to the level of its outlet at Rome in central New York, but Erie being held higher by the rim of the Niagara plateau. This was the birth of the river and the falls, and since then they have been at work on the gorge. The age of the falls thus carries us back to a tolerably definite point in the decline of the glacial period.

On the supposition of a uniform rate of recession, the age of the falls equals the length of the gorge divided by the annual recession; but the rate has been undoubtedly varied by changes in a variety of conditions, which must be allowed for. As thus qualified, Mr. Gilbert gave it as his conclusion that the maximum length of time since the birth of the falls by the separation of the lakes is only seven thousand years, and that even this small measure may need significant reduction.

Mr. A. A. Julien, in a paper on 'Methods of testing building-stones for absorption, freezing, and fire,' gave what he considered the proper conditions for such testing, and maintained that the tested stone should be continued under pressure at least a month. He stated that frost was found to be more active in removing particles that had been loosened by chemical weathering than in direct mechanical breaking of unweathered rock. Mr. J. C. Branner reported that he had found glacial striations over the summits of some mountains examined by the Pennsylvania geological survey, so that no direct measure of the maximum thickness of the ice can be determined from this region. It is interesting to note in this connection that Professor Branner and others following him, in a discussion of the scheme of map colors adopted by the International conference of geologists, took occasion to severely criticise the scheme proposed as being too rigid, and wanting in adaptability to new regions. Among the other papers of note, we would call attention to the following: 'The geological features of a district in south-western Colorado,' by Dr. J. B. Comstock; 'The outcrop and thickness of the Tully limestone in the neighborhood of the finger lakes of western New York,' by S. G. Williams; 'The molluscan fauna of the New Jersey marls,' by R. P. Whitfield; 'A revision of the Cayuga Lake (New York) section of the Devonian,' by H. S. Williams; 'A process of mechanical deformation for the Connecticut valley triassic formation,' by W. M. Davis; 'Work in Nebraska,' by L. E. Hicks; 'Our cretaceous flora' and 'Our Devonian and carboniferous fishes,' by Professor Newberry; 'Fossil wood from Ohio,' by Professor Claypole; 'Geography and topography of the head of Chesapeake Bay,' by W. H. McGee; 'Holyoke trap range,' by B. K. Emerson; 'Some dynamic effects of the ice-sheet,' by F. J. H. Merrill.

PROCEEDINGS OF THE SECTION OF CHEMISTRY.

PROFESSOR WILEY prefaced his vice-presidential address by announcing the much-to-be-regretted death of William Ripley Nichols, his predecessor as chairman of the section.

W. H. Seaman, who, with A. C. Peale and C. H. White, forms a committee of the chemical society of Washington for the purpose of bringing about uniformity in the methods of stating water analyses, read a report upon this subject, and desired the approval of the section for the method recommended. After much debate, the matter was referred to a committee of the section, consisting of Professors Caldwell, Langeley, Myers, Mason, and Warder, who are to report another year what action is desirable.

Miss Helen C. De S. Abbott read a paper upon the proximate composition of a bark from Honduras, known as 'chichipati,' which contains a new camphor and a yellow coloring-matter, chichipatin, apparently of value as a dye and substitute for fustic. The same author also presented some considerations of the relations of the chemical constituents of plants to their morphology and evolution, believing that the chemical constituents follow parallel lines with the evolutionary course of plant forms, the one being intimately connected with the other, and the height of the scale of progression being indicated by these constituents, which are therefore appropriate for a basis of botanical classification.

H. C. Bolton, of the committee on indexing chemical literature, after presenting their report showing the large amount of valuable work which was being done, read a paper on the confusion which exists in the abbreviations employed in chemical bibliography, and the desirability of uniformity in designations of scientific periodicals.

C. F. Mabery's paper on the products of the Cowles electric furnace was of particular interest, and attracted much attention. He stated that the past year had been devoted more especially to the development of an increased commercial efficiency of the furnace, so that now three hundred horse-power could, by means of a large dynamo, be applied with greater economy in the results; and by coating the charcoal employed in the furnace with lime, by soaking it in lime-water, the production of graphite was largely avoided and a marked improvement in the working of the furnace introduced. The results — although, as compared to what would eventually be accomplished by electric smelting, they may seem crude — have reached a stage where their commercial success can be demonstrated.

It was also found that when the electrodes entered the mixture in a slanting position the product was increased. They are now also moved in and out with advantage, being gradually withdrawn as the resistance falls. Professor Mabery replied to the criticisms of Hehner of Berlin, Siemens, and others, that no new principle was involved, showing that the Cowles furnace is quite different from all hitherto constructed, and the only one of practical application by which a dynamo of three hundred horse-power could be used, as by means of a resistance-box and the arrangement of the furnace the sudden breaking of the current is prevented from burning out the dynamo. The presence of copper for the reduction of aluminium was shown to be unnecessary; and, by complete exclusion of air from the furnace, buttons of the metal were easily obtained. A product which has attracted considerable attention during the past year is obtained by reducing aluminium in presence of iron. A cast iron is formed containing sometimes as much as ten per cent of aluminium, and this product is used to facilitate the working of crude iron and to introduce into the various grades a small percentage of aluminium. In the reduction of aluminium in the presence of copper, a yellow product is frequently taken from the furnace which is composed of metallic aluminium to the extent of one-half or three-fourths, the balance being silicon and copper. It is also formed in the absence of copper, and then contains a higher percentage of aluminium, and always contains nitrogen. It has a resinous lustre, and decomposes water at 100°.

A paper by Clifford Richardson, on some constituents of the embryo of wheat, showed the unexpected presence of a soft wax, cane-sugar to the amount of more than ten per cent, a new saccharoid, and allantoin, a nitrogenous substance of the uric acid series, together with other similar substances not yet isolated. The relations of these substances to the transfer of nitrogen in the plant were discussed.

William McNurtrie described the chemical examination of specimens of ropy milk and cream, which description, together with the discussion which ensued, showed that this unfortunate condition is brought about probably by some organism, and that cleanliness and disinfection are the best means of prevention.

The poisonous matter sometimes occurring in old cheese and ice-cream, which he has named 'tyrotoxicon,' was described by V. C. Vaughan. He showed it to be of ptomaine nature, and had been able to induce its formation in a mixture of milk, sugar, and eggs, by inoculation with a small portion of ice-cream which contains the poison. This would seem to point to its origin in the growth of some microbe. Its toxic effect is shown in the extremely rapid production of symptoms similar to those observed in cholera infantum.

Thomas Taylor presented an exposition of his views on the characteristic differences in fat crystals, which have already attracted considerable notice in print, and are well known to most of our readers.

Other papers read were as follows: 'Action of heat on ethylene,' by L. M. Norton; 'A new viscometer,' by S. M. Babcock; 'Method for the determination of the melting-point of fats,' and 'The areometric method of estimating fat in milk,' by H. W. Wiley; 'Manufacture of sodium carbonate,' by Adolf Kayser, presented by Alfred B. Young; 'Substituted acrylic and propiaric acids,' by C. F. Mabery; 'Determination of caffeine,' by Dr. Hodgson Ellis; 'Composition of soiling rye,' by William Frear; 'Preliminary analysis of leaves of Juglans nigra,' by Lillie J. Martin; 'Some laws of chemical union,' by C. F. de Laudero and Paul Prieto, read by the secretary; and 'The torsion analytical balance,' by A. S. Springer.

An exhibition of apparatus for the destruction of parasites of cultivated plants will be held at the Horticultural school in Florence during October.

PROCEEDINGS OF THE SECTION OF PHYSICS.

The first matter presented to the section was a recently devised instrument, by Mr. John A. Brashear, which he terms a 'gravity parallelometer. It is used in making the surfaces of a plate of plane glass truly parallel. The art of executing a single plane surface has been carried to a very high degree of perfection, but peculiar difficulties are encountered in making two surfaces parallel. By Mr. Brashear's method a variation in thickness of $\frac{1}{500000}$ of an inch can be detected. In one case, two surfaces about a quarter of an inch apart were made so nearly parallel, that, were they extended, they would not meet in five miles.

Prof. W. A. Rogers described the combined yard and metre, which will be used by the department of standards of the British board of trade in a definite determination of their relative lengths. The latest value of the metre in English measure is 39.37012 inches.

Prof. J. W. Sanborn has been for several years experimenting on the relation of dew to soil-moisture. One means of investigation has been to weigh prepared portions of soil night and morning. His conclusion is, that, except in rare cases, the idea that the soil receives moisture at night is false, and the contrary is really true. This applies where there is no vegetation.

Major H. E. Alvord presented the results of extensive temperature observations at Houghton farm relative to dew formation. Thermometers were placed so as to determine the temperature from several inches below the surface of the ground to about four feet above the surface. The results, from observations during several months in the summer of 1884, show that the minimum temperature during dew formation is about four inches above the ground, which was not unfrequently six or eight degrees lower than the temperature at the surface. The temperature at the surface was less than the temperature several inches lower. Some surprise was expressed at these results, and the dew problem was regarded as still more perplexing. The temperature of the surface on which the dew is formed is an essential factor in the solution. Discussion showed the difficulty in determining the exact temperature of the surface particles, which differs from that of the earth above or of the soil below, and the total inadequacy of the mercury thermometer as a means of determining it.

Prof. T. C. Mendenhall prefaced his paper on electric thermometry by saying that the strictures upon the mercurial thermometer should not be carried too far. It has been of great value, though it may now fail to meet new demands. Electric thermometry is receiving especial investigation at the signal office, particularly from the meteorological stand-point, with some promising results. Professor Mendenhall reported the progress which had been made in the study of atmospheric electricity during the past year. It is not time to begin to think of the origin of atmospheric electricity. The problem is its distribution and the relation, if there be any, to weather changes. Some very interesting results have been reached. In ordinary weather the electrical condition is undergoing constant and rather wide variations, which are very local, as two collectors only a few feet apart may give curves differing considerably, though similar in their wider variations. When an electrical storm occurs, the curves over a wide area may be similar in general outline.

Professor Mendenhall also noted a phenomenon entirely new to him; namely, that resistance coils, after a current is passed through them for some time, upon short-circuiting, will yield a reverse current for hours. This phenomenon can no doubt be classed under the general head of polarization, yet by simple polarization it would be difficult to account for persistence of current. This makes caution necessary in the use of resistance coils, in order that any effects of this kind may be carefully noted. In one instance the apparent resistance of a coil was found to increase fourfold when the current was reversed.

Prof. W. A. Anthony reported the results of experiments showing an increase in the torsional elasticity of metallic wires. In the case of a certain phosphor-bronze wire, it has been increasing, at a decreasing rate, for nine months. Various metals have been investigated. Steel is scarcely better than brass and other substances, and they all show a much wider change than the bronze. To determine whether the phenomenon is dependent upon the age of the wire and the condition to which it is subjected, a piece of wire was freshly drawn. A portion forty centimetres long was used in a torsion pendulum. The period changed from 9.575 seconds to 9.526 seconds in four days. The curve representing the time of vibration shows that the change occurred less rapidly each day. Another piece of the wire, which had been drawn at the same time, and which had been subject to no strain of any kind, was then tested. The curve for this wire was not a duplication, but was almost an exact continuation of the former curve, showing that the same changes had been going on in the two wires. The temperature co-efficient seems to change with the change in torsional elasticity.

The following papers were also presented: 'Counteracting the effect of change of level of the torsion balance,' by Prof. Wm. Kent; 'Time of contact between the hammer and the string in a piano,' by Prof. C. K. Wead; and 'Registering small variations of speed of machinery,' by Prof. W. A. Anthony.

PARIS LETTER.

M. PENNETIER, at a recent meeting of the Academy of sciences, gave the results of experiments of fourteen years' duration concerning the revivification of small animals, such as rotifers and Anguillula tritici, after a protracted state of apparent death due to dehydration. The results are the following: Anguillulae, which M. Pennetier had kept, year after year, in a state of apparent death and in great numbers, have ceased to be subject to revivification, upon being put in moist conditions, after fourteen years. Up to this date, they regained movement and life easily enough, but after it none of them could be brought back to life. M. Vulpian remarked, *à propos* of M. Pennetier's experiments, that he had noticed that every year the number of dehydrated animals that can be recalled to existence decreases regularly, and that most likely the process of desiccation works in the animals some progressive alterations of an unknown nature, which lead to results incompatible with life. M. Vulpian argues also that it cannot be death that desiccation induces; it can only be some sort of lethargy during which life-phenomena and manifestations are at the lowest. This conclusion will be indorsed by most biologists.

This question of the revivification of desiccated animals was treated in a very interesting manner some twenty-five years ago by Broca. Leuwenhoeck was the first who noticed the fact, and Needham and Henry Baker (1743), Spallanzani and Fontana, soon followed. During the present century, Doyère, Pouchet, and Davaine investigated the subject with great care. They found that the facts were quite true; but while Pouchet, following Leuwenhoeck, believed that there was no real death in the case, and that it was only a very good imitation of it, Doyère, following Spallanzani, believed that the desiccated animals were really dead, and that their revivification was a real resuscitation, a new creation of life. In 1860 a committee was appointed by the Société de biologie for the purpose of investigating the question. Brown-Sequard, Balbiani, Berthelot, Dareste, and Robin were members of this committee: Broca had charge of summarizing the results and drawing up the report of the committee. This report was published in 1860, and it remains one of the most accurate statements, and the most scientifically written papers on the subject. After a long series of experiments, the conclusions obtained were that rotifers can be brought back to life after having remained ninety days in a dry vacuum, and having been submitted to the influence of a thirty-minutes' sojourn in an oven heated to 100° Celsius, that is, after having been as completely desiccated as can be. These are precise and accurate facts: the committee remarked, also, that the revivification of Anguillulae may be effected at least twenty-eight years after desiccation; and, following Leuwenhoeck's opinion, M. Broca believed that during desiccation vital phenomena were much reduced, but not wholly suspended. Upon the whole, M. Pennetier's experiments do not give any new result, but they confirm what has already been said. This power of revivification is a very singular one, concerning which a great deal remains to be learned, especially as regards other species. It certainly cannot be believed that desiccated animals which can be re-animated by moisture are really dead: they are in the state called by Preyer *vitae capax*, — a state that is not real actual life, but potential life; a state intermediate between life and death, but much nearer the former than the latter.

A new monthly paper has been recently issued in Paris, of which only two numbers have yet appeared. It is the *Revue de l'hypnotisme*, and is edited by Dr. E. Berillon, with the co-operation of many scientists, such as Bernheim, Hack-Tuke, Grasset, Treland, Luys, Ochorowicz, Magnin, Voisin, Liégeois, and others. M. Berillon has behind him no works to speak for his competency, and is a rather young man. His co-operators are, generally speaking, very able men; but it must be confessed that hypnotism is as yet a rather young science, and requires to be pushed somewhat further before a paper can be usefully devoted to it. The *Revue de l'hypnotisme* contains, however, some valuable contributions, among which we notice especially a paper by Dr. Voisin on therapeutical applications of hypnotism in cases where the disease is more a moral than a physical one. The author relates a case in which hypnotism has been of great use, and has evidently improved the morals of the patient. M. Liégeois contributes an interesting paper on hypnotism induced by telephone: the experiments succeed as well as if the different acts had been directly suggested, without any telephone. These two papers excepted, there is nothing new nor interesting in this young periodical.

M. Molliere of Lyon recently made known an old and very rare book, published a century ago, in which one may find the beginning of Pasteur's theory of pathogenetical germs, or microbes. This book was published at the time of the Marseilles pest, and its title is 'Observations faites sur la peste qui règne a present à Marseille et dans la Provence.' The author was Goiffon, a botanist and physician of Lyon. According to Goiffon, the disease is due to some poison which comes into the body from outside. The poison is believed by him to be some living creature which can multiply without losing its pathogenetic properties. Having never seen any microbes, he considers the cause of the disease as residing in some worm or insect brought from foreign countries with foreign goods. "Measles," says he, "and small-pox, which are recognized as contagious diseases, are perhaps due, as well as many epidemical diseases, to some special sort of little worms, or imperceptible insects, which force themselves into the body of those who become sick, and stick to the clothes of those who propagate the sickness." He believes also that *bovine vert* is "caused by small worms deposited on the hay and grass the herds eat; and the ulcerations that most diseased animals show on the tongue and in the mouth confirm this view." Further on he says that the spread of the disease, when once introduced into a country, is due to the dissemination of the eggs of these worms or insects. The fact that more than a century ago the cause of different contagious diseases was believed to be some living organism, is all the more interesting that it was entirely forgotten. Manget, the Swiss author of many important medical and anatomical works, was the only one who believed in Goiffon's theory; he even remarks that Father Kircher, the well-known scientist and alchemist, had proposed a similar theory. Goiffon's work is a very interesting one, and M. Molliere has done well in republishing this forgotten old book.

MM. Charbonnel-Salle and Phisalix of Besançon have recently published the results of their experiments concerning the pharyngeal and oesophageal secretion of pigeons and other birds, which is used by them to feed their young. It was Hunter who discovered this phenomenon, and first described it. Cl. Bernard compared this secretion with milk, and believed it was caused by a very active cellular multiplication of the epithelium of the oesophageal tract. Other physiologists attributed the secretion to some glands. MM. Charbonnel Salle and Phisalix show that Cl. Bernard's opinion is correct. They find no glands at all; and the secretion is made up of epthelial cells of the oesophagus. It is known that the edible bird's-nest substance found in the nest of Collocalia nidifica and other swifts, is, on the contrary, the secretion of special glands described by Sir Everard Home in 1817, as Bernstein's and J. R. Green's researches also prove. The origin of the two substances is entirely different, but it may be that their chemical nature is less different than might be supposed.

Some days ago, in a saloon of Vincennes, about fifty persons were seated at a dining-table. A passer-by would have remarked that they were very quiet. Not a word was said by a single person. As the dishes went around in due order, the passer-by would have thought, after some twenty or thirty minutes, that the meeting was a very ungenial one, or that the assembly was troubled with some mysterious ailment. On walking into the saloon, he would have understood, however, — as the reader perhaps already surmises, — the cause of this silence. The guests were deaf-mutes. No hurrahs, no laughing, no toasts or speeches, that is, in spoken language. But in gesticulated speech a good deal was said. These people are united in a society to celebrate the memory of Abbé de l'Epée, the charitable and devoted instructor of deaf-mutes, and they meet each year to rejoice over their instructor's useful work.

The same day a very amusing meeting was held in Paris by some five or six persons, and attended by a rather large crowd. It was a meeting to protest against Pasteur's method of healing rabies. It is not useful to review all the foolish speeches that were made in this assembly. The public has sufficiently shown what it thinks of them. It was a very funny scene to witness, and one can form no idea of the ignorance and lack of intelligence displayed by the orators. They were perpetually interrupted by the shouts of the crowd, who were intelligent enough to know when truth was spoken, and when error. It is, however, a pity to hear such ignoramuses discuss in such a way scientific questions they do not understand. Sweet Louise Michel was one of the orators, and was well hooted.

A much more interesting and useful meeting was that of the committee appointed to witness M. Marcel Desprez's experiments on the transmission of force by means of electricity. The problem was to take two hundred horse-power at Creil, fifty-six kilometres from Paris, and to deliver half that amount in Paris. In fact, the horse-power in Creil was eighty-eight; in Paris it was forty. Upon the whole, the experiment succeeded well enough, and the results are satisfactory.

Some sensation was recently created here by the application of the law requiring that all professors aged over seventy or seventy-five, if members of the institute, shall be deprived of office, or, as we say here, *mis en retraite*, retired. Among the victims of this law we notice MM. Hardy, Gavarret, and Sappey, of the medical school, and M. Duchartre of the faculty of sciences. M. Hardy is not a lazy man, and he still works a good deal; but all he can do, as his best friends say, is to give a lecture dated 1850. That is very well, but in 1886 science is much advanced, many things having been discovered since 1850. Students require present-day notions, and do not care for old discoveries. M. Sappey is also a conscientious worker; but he teaches anatomy in such a very tedious and uninteresting manner that his retirement cannot be much regretted. As to M. Gavarret, he has not lectured for some years. M. Duchartre has never done any personal original work worth speaking of. He has written a very unpleasant 'Botany,' and that is all. His departure will create no sensation, and students have nothing to lose by the change, whoever may take his place. M. Sappey's place will most likely be filled by M. Farabeuf, a man very well informed on human anatomy, but entirely ignorant of comparative anatomy. M. Gavarret will be succeeded by M. Gariel, an able scientist and very good teacher. It is not known who will take the two other places, but M. van Tieghem, professor at the Museum d'histoire naturelle, might be called upon to teach botany in the Sorbonne. The choice would be a very good one. No choice will be made at present, and, when it is made, I will inform you.

The annual meeting of the Association for the advancement of science is to take place to-morrow at Nancy. A great number of interesting communications are announced, and the volume recording the proceedings at last year's meeting has been issued to-day.

The competition begun some three months ago for fellowships in different medical schools is just over. As usual, the successful competitors for fellowships in anatomy and physiology are surgeons. Surgeons, as a rule, are familiar with anatomy, that is, human anatomy; but they know nothing about physiology, and the lectures they give on the subject are quite insufficient. It is a great pity for the students, and yet more so for the medical schools. There is little yet to be done in anatomy, so they do not do any personal or original work. They go on practising surgery, and are of no use at all to science. In five years, only one real physiologist has been appointed to a fellowship, Ch. Richet; since then only surgeons or anatomists have been appointed. This is a very unfavorable thing for medical schools, and one easily understands the criticism of foreigners, who remark that the fellowships are always obtained by persons who add nothing, or next to nothing, to the stock of human knowledge. The critics are entirely justified, it must be confessed, and it will be necessary to find some remedy for this state of affairs, which is all the more unsatisfactory because the surgeons who compete for these fellowships do not dare compete for surgical fellowships. Upon the whole, they are not learned enough to depend entirely upon their surgical knowledge. They are neither entirely surgeons nor completely anatomists.

Preparations are being made for the celebration of M. Chevreul's centenary on the 31st of the present month. The National agricultural society is to present him with a gold medal (he has been a member for fifty years), and on the 1st of September there will be a festival tendered him by different persons in the natural history museum. It is not exactly known what will be done, but at all events there will be an exhibition recalling all M. Chevreul's works concerning coloring-matters, dyeing, *corps gras*, candles, glycerine, dynamite, porcelain, and colors. This exhibition is a very good idea, and will meet with great success; for, among the public at large, the notions concerning Chevreul's works are exceedingly vague and uncertain. People all know he is very old, but they do not know how useful he has been, and what service he has rendered to science and industry. In the evening a large dinner will be given, when the ministers of public instruction and of trade will assist, as well as delegates of the faculties and learned bodies, and also delegates representing the branches of industry that have been improved by Chevreul's work. In my next letter I shall have to resume the subject. Many professors and scientists are remaining in Paris to assist at the ceremonial, such as Pasteur, Frémy, Milne-Edwards, Bertrand, Jansen, de Quatrefages, etc.

Yesterday there started for the United States quite a number of travellers of an interesting nature, — a number of splendid horses bought at the last trotting match at Nogent sur Marne by Americans from Illinois, Kansas, Minnesota, Michigan, Wisconsin, etc., for the purpose of keeping up the Percheron breed in America. Your countrymen, such as Messrs. Dunham, Degan, Bowles, and many others, come every year at this time to visit the Perche, and buy the best horses they can find. The medium price is two thousand dollars (ten thousand francs). The first horse so exported crossed the Atlantic in 1839, with Edward Harris of New Jersey. The horses of that breed are very much appreciated still. In 1851, M. Fullington took across the ocean another horse of the same breed; he called it Louis Napoleon, but his friends preferred naming it Fullington's folly. The folly was profitable, however, and the sons of Louis Napoleon are as much valued as those of Philippe Egalité, as Harris's acquisition of 1839 was called. The Percheron stud book is very well kept, only horses born from Percherons in Perche can be recorded. M. M. Dunham, who was here a few days ago, offers each of his stallions some fifty amiable wives, and as each year he buys some three hundred Percherons, one may judge of the importance of his Illinois stud. This year some twelve hundred stallions are leaving France for the States.

The vacations have now begun: most of the professors are out of town. M. Faye was some days ago on the seashore at Villers; Professor Vulpian is in his usual summer resort of Trouville; others are scattered here and there, in mountain or country, or travelling abroad. A great many are in Nancy, for the meeting of the Association for the advancement of science; some are in Germany or elsewhere, awaiting different scientific meetings. It is a happy time for them, and they enjoy a well-deserved rest after a long year's work. V.

Paris, Aug. 11.

NOTES AND NEWS.

The report of the wide-spread earthquake comes as we go to press. It is probable, that, on account of the extent of country over which the shock was felt, it may be possible to arrive at valuable estimates of the rate of propagation of earth-waves. From Washington we learn that Professor Simon Newcomb furnishes the following figures regarding the earthquake: First shock occurred at 9:53:20; second shock about 9:54:30; lasted until 9:59. Major Powell is quoted as saying that there is a line of weakness in the crust of the earth beginning somewhere south of Raleigh, N.C., and extending in a line along the tidewater, past Richmond, Washington, Baltimore, and Troy, N.Y.; that this line of weakness is marked by a displacement; in some places this displacement being a flexure in the rocks, in other places a fault; and in the neighborhood of this displacement are found the principal waterfalls which constitute the water-power of the Atlantic slope. "It will be interesting," he adds, "to discover the relations of the point of origin of this earthquake to this line of displacement or weakness." The officials of the signal-service bureau report that four distinct shocks were felt there. The first began at 9:54, and lasted 40 seconds; the second shock was felt at 10:04, and was followed by another at 10:10, and by another at 10:30.

— The topographical work of the geological survey is progressing in a most satisfactory manner, and the following summary is given of the results attained up to the first of August. Mr. Natter's party in Massachusetts have finished the Framingham sheet and a large portion of the work north of that place, covering, in all, eighty-five square miles; Mr. Johnson's forces in the western mountainous part of the state have completed forty-nine square miles; Mr. Bodfish's division have finished altogether two hundred and twelve square miles in Massachusetts, one-half of which was partly done last year; of the region around the District of Columbia, thirty-five square miles have been completed; Mr. Griswold has a very large party at work in northern Virginia, who have completed seven hundred square miles; the central division, under Mr. Renshaw, is getting under way; Mr. Davis is at work in central Arizona, and has completed eight hundred square miles; Mr. Wilson is at work in the gold region around Oreville, in the gold belt, with two topographical parties and one triangulation party; the topographical work covers three hundred and seventy-seven square miles, but both parties were retarded somewhat by bad weather. Up to Aug. 27, 53 sheets of the general topographical atlas of the United States have been published; there are 48 sheets in proof.

— The coast-survey parties are now in the field busily engaged in pushing the work forward. Two topographic parties and one hydrographic party are already at work on the resurvey of San Francisco Bay. Owing to the very limited appropriation for the Alaska work (only $4,000 being appropriated in lieu of $9,000 asked for), the steamers especially employed for this work at an expense of several hundred thousand dollars are to be immediately called from the field, there being no money to carry forward the necessary work for which an admirable plant had been provided. Professor Davidson has returned from Portland, Ore., where he was engaged in astronomic and magnetic work, to San Francisco, and has resumed his duties in charge of several parties on the Pacific coast. The parties on the transcontinental arc are all at work except Assistant Eimbeck, who would be in the field were it not for the lateness of the season, which is inopportune for locating stations on the summit of the Rocky Mountains. The telegraphic longitude parties are at Salt Lake and Ogden. Sub-assistant Marr is ordered from the magnetic observatory at Los Angeles to report for duty in telegraphic longitude work at Salt Lake. The physical hydrography of Delaware bay and river has been completed as far as this year's appropriation will carry it, and Assistant Merinden is about to transfer his party to New York bay and harbor, where the work of last summer will be continued. If progress is as rapid as it has been heretofore, the resurvey of Long Island Sound will be completed the present season. Assistant Weir will take up the topographical work in the vicinity of Chatham, Mass., in connection with Professor Mitchell's physical survey of Monomoy Shoals. Mr. F. M. Thorn, superintendent of the coast survey, who left Washington for Orchard park near Buffalo, N.Y., has returned to his official duties.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

'Thumb-marks.'

THE letter on 'thumb-marks' in No. 185 of *Science* recalls to mind an extract cut from a newspaper in March, 1883, headed 'Thumb portraits.' The matter was taken from the 'World of wonders.' In it reference is made to the spiral grooves on the skin of the thumb, with the remark that the figure on each thumb remains the same during life, but the marks are different on each. It then goes on to state, "The Chinese take advantage of all this to identify their important criminals, at least in some parts of the empire. We photograph their faces; they take impressions from their thumbs These are stored away, and if the delinquents should ever again fall into the hands of the police, another impression at once affords the means of comparison. The Chinese say that, considering the alteration made in the countenance by hair and beard, and the power many men have of distorting or altering the actual features, etc., their method affords even more certain and easy means of identification than our plan of taking the criminal's portrait."

A year or more ago a gentleman of Cincinnati proposed to take advantage of this fact, and apply the thumb-mark to railroad tickets, to prevent their falling into the hands of scalpers. He brought it to the attention of several railroad managers, who thought favorably of it; but meeting with considerable difficulty in making arrangements to get the mark without too great inconvenience to the purchaser, and likewise, I believe, discovering that the process could not be patented, it was given up. At least, I have not heard any thing of it lately.

JOSEPH F. JAMES.

Miami university, Oxford, O.

Revivification.

It is well known by all zoölogists that many animals, such as tardigrades, rotifers, anguillulae, and others, are subject to revivification, as Needham, Spallanzani, Doyère, and others have shown. Could some reader of *Science* tell me whether experiments of a similar nature have been performed in America on these same animals, and let me know the name of the experimenters, as well as the title, date, and place of publication of their papers? I would be also much obliged if any one could tell me whether the experiments have been performed on other animals, of superior organization. Lastly, can some one give me information concerning Hindoo fakirs, who, it is said, can fall into a state of trance, and remain seemingly dead, and in fact buried for a long time,

SCIENCE.—SUPPLEMENT.

FRIDAY, SEPTEMBER 3, 1886.

PROCEEDINGS OF THE SECTION OF MECHANICAL SCIENCE AND ENGINEERING.

A CONTINUED improvement was manifest in this section, both in attendance and interest, and it may now be considered as fairly established by the side of the older sections, and likely to become one of the largest in the association.

The most valuable paper presented was one on the 'Strength and proportions of toothed wheels,' by Prof. William Harkness of the naval observatory. This paper, of which about half—over 80 p. foolscap—was presented, is the result of a number of years' work of a most varied and exhaustive character. In twenty-three sections it treats of the form of teeth; mathematical theory of the stress on teeth; review of the formulae of previous authors; spur and bevel wheels with iron, brass, and wood teeth; shrouded pinions; sizes of pinions; coefficient of safety; maximum pitch; relation of pitch to face; length of teeth; their thickness; strength of rims; relations between rim and tooth dimensions; sizes and number of arms; naves; keys and bosses; weight and kinetic energy; applications to special cases; recapitulation of formulae; bibliography. In designing clockwork for the transit of Venus and other purposes, the author found no formulae upon which he could rely, those in use giving results widely different from each other, in exceptional cases showing differences of fifteen hundred per cent; he therefore set about determining, in a scientific manner, a formula upon which some reliance might be placed. We have already had occasion to call attention to the remarkable results accomplished when a mechanical problem is attacked in this way. The work of Professor Rogers in developing a method by which precision-screws are economically furnished for machine tools, showed how an astronomer could handle a practical problem, and Professor Harkness has worked by the methods of higher mathematics. He has made and collected a large number of measurements of gears in actual use and of recognized good proportions, and after ascertaining, by the principles of mechanics, the general shape of a correct formula, he has applied the method of least squares to determine the exact form of the same, with the values of the constant terms, which would best agree with these measurements. Over forty authors on the subject are reviewed, from Buchanan, 1808, and Tredgold, 1825, to Redtenbacher, Weisbach, and Reuleaux. One formula, given by Roberton in 1808, was shown to be absurd by Carmichael in 1814, but was nevertheless copied by Farey in 1827, in an excellent work on the steam-engine, and has been in use ever since. Roberton's proof of the formula was that from his experiments he was satisfied he could not be far wrong. In one author, marked, and indeed unlooked-for, advantages appear from the use of the metric system; in a wheel of 2.30 m. diameter, calculated by means of it, the number of teeth is reduced to one tooth 3.21 m. thick and nearly one space. Another uses figures in a demonstration which, interpreted, require that a brass tooth half an inch thick and one inch wide shall carry 13,000 pounds, though the author by mistake got it 130 pounds. 500 representing the safe amount, attention was called to the heavy tooth-stresses of 800 to 900 customary in watches and chronometers, and to that of about 1900 in spring clocks. When put in print, this work cannot fail to be of great and permanent value.

Prof. W. A. Rogers, as chairman of the committee on accurate standards, tools, and methods in the machine shop, gave an account of his work in that direction, and presented a résumé of his experiments in the use of the microscope in connection with machine tools. In this method, dimensions are read through that instrument from accurately divided scales, or, in some cases, determined by calipers or gauges accurately set by means of a comparator. By this system the workman receives from the tool-room of the shop the necessary number of calipers accurately set to the required dimensions by a skilled attendant in charge of the comparator. It is evident that in this way a high and uniform degree of accuracy may be obtained, with much saving of time and avoidance of errors, in which latter respect we would suggest that calipers be returned to the tool-room unchanged, and their settings checked. For all good work, these methods must supercede the present inaccurate and inconvenient use of scales of but moderate precision. and the setting of calipers by the workman, and they will obviate the necessity of the present expensive standard gauges.

The sort of work done by these gentlemen will mark an era in the development of machine construction.

Professor Webb of Hoboken presented his method of determining maximum points and stresses in bridge inclines, which are applicable to trusses of the most irregular form, and to any style of loading, irregular or uniform. The method, as applied to the graphical determination of strains, was illustrated by blackboard sketches and finished drawings, and some of the features of a new notation were explained.

Prof. De Volsen Wood contributed two valuable papers in mechanical engineering. In one of them he showed, by diagram and analytical processes, the application of the equation of 'moment of momentum' to the case of turbines, explaining abstruse points in the action of the latter; in the other, he called attention to the effect of variations in speed upon cylinder condensation, illustrating the same by experimental figures. The section, and indeed the profession, should congratulate itself upon the acquisition of men who bring to their work not only a natural and cultivated knowledge of mechanics, but an intimate acquaintance with and great facility in the use of the higher mathematics. The professor's genius for imparting knowledge is also well known.

The committee on the best methods of teaching mechanical engineering reported that papers would be read upon the subject by a member of the committee and by Dr. Thurston. Professor Alden is an earnest advocate of manual training, and sums up in these four propositions: "Manual processes in education must be primarily for the acquirement of knowledge and discipline;" they "should be such as are adapted to the development of powers, faculties, and habits of mind which have been but little cultivated in the schools;" those "involving the use of tools and construction should be confined to properly designed structures, and should be taught and supervised by experts capable of producing the best quality of standard practical work;" they "should be restricted to those operations for which suitable facilities are provided for carrying out the operations in a practical and thorough manner."

Dr. Thurston outlined the differentiation which has occurred in the profession of engineering, and in engineering schools, defining the titles 'engineer' and 'engineering,' and showing how different the training necessary for each branch of the profession. He called attention, also, to the relation of technical to the ordinary academic education, considering the natural and correct course to be, first, the giving of a general academic, next, a general professional education, and, finally, a special professional training. The usual course has been, too commonly, an attempt to omit real education and to provide only professional training. He thought that the graduate degrees are likely to be, generally, civil engineer, mechanical engineer, mining engineer, etc., etc., and he suggests the conferring of second degrees, if not of the doctorate. The titles 'master in civil engineering' and 'master in mechanical engineering' are already given, and that of 'doctor of engineering' has been given as an honorary degree, no reference being made to the branch in which the recipient labors. The establishment of the latter degree in course is advised.

Dr. Woodward of St. Louis, who has during the past year investigated some of the foreign technical schools, led in the discussion, calling attention to the necessity of using books in connection with manual training exercises to insure a knowledge of the underlying principles. He held also that it is not the amount of instruction that counts, but its quality; and he objected to the attempt to thus train those who are too young to profit fully by it. Dr. Thurston, Professor Wood, and others followed.

Mr. Wm. Kent laid before the society the details of his scheme for an American academy of engineering, which should be composed of the cream of the civil and military, mechanical, mining, electrical, and sanitary engineering societies, with yearly accessions therefrom by regulated and impartial election. It was held that men, organization, and money were all that were needed, and that the first were ready, the second proposed, and the third sure to come. This academy is to be of such high standing as to be the sought authority in all matters of government and civil engineering work, and is to be the custodian of donated and government funds for scientific research, for which purpose expensive and various working laboratories and a library would be required. Many features of the scheme recommended themselves strongly, and such laboratories would doubtless be of immense advantage to the country. The discussion showed marked approval of the scheme, and a valuable suggestion was offered by Dr. Woodward and Professor Webb, to the effect that the granting of masters' degrees to engineers should be in the hands of such a body, in order to protect society from incompetence in these professions. It was felt, too, that the various societies are getting too widely separated, and should in some such manner be brought together.

Dr. Thurston read a paper on the friction of the non-condensing engine. The friction of an engine has been supposed by De Pambour, Rankine, and others, to consist of a constant and a variable part, the resistance of the engine unloaded, the other the increase produced by the fact of its doing work. The last quantity is taken, by De Pambour, as ordinarily about fourteen per cent of the total resistance due the load. As the result of some experiments, "it is found that the friction of the high-speed non-condensing engine, such as is used in electric lighting, is, under standard conditions, practically constant at all loads, but is variable both with speed of engine, and with steam pressure."

Dr. Thurston exhibited a photograph, and described the great dynamo recently designed by Mr. C. F. Brush, for the Cowles electrical smelting and aluminium company of Cleveland, Ohio, and Lockport, N. Y.

Two papers were read on civil engineering subjects, one with reference to the improvement of harbor and river channels, by Prof. Lewis M. Haupt, and the other upon the difficulties met with in the Panama canal, and the rights which France will be disposed to assume in that connection.

Professor Haupt maintained that all structures of any considerable magnitude and weight, intended to regulate currents, and which rested on, or depended upon, sandy or alluvial bottoms for their support, violated to a greater or less extent the fundamental requirements that they should not oppose the ingress of the tide, nor injuriously modify the currents ; also that dikes or jetties were to a great extent below the zero plane or plane of action of waves of translation, and were dependent for their strength upon their mass, and that this was frequently composed of individual fragments of small dimensions, not cemented. It was stated that all such constructions occupy a large volume, produce great pressure and leverage, are wasteful of time and materials, result in serious modification in the regimen of rivers or harbors, are unnecessarily expensive, and if improperly located, they cannot be readily changed. In contrast with this, the professor then suggested a solution, consisting of a floating system of deflectors intended to be attached to buoys or floats, and anchored to heavy moorings, composed of ground chains, held in place by screw discs sunk considerably below the bottom, and proceeded to describe his system.

As a set-off to the papers of more certain value, and perhaps for purposes of recreation, the section listened to a paper detailing observations and experiments, mixed up with some remarkable theories upon the flight of birds, and the serious business of the meeting being over, a last session was devoted to a continuance of the discussion thereon. A letter to the following effect received from a member explains to some extent this action of the section : "In order that this investigation may not be dropped, you may announce that if the gentleman will successfully reproduce before the section the experiments for which he vouches, i.e., if his apparatus, without moving mechanism or outside assistance, supports itself in still air, and moves against a current of air without falling, I will give fifty dollars as a prize for the best paper on the subject, at the next meeting."

An extract from the abstract furnished will also explain to a sufficient extent, for any one acquainted with the laws of mechanics, the supposed peculiar action of gravity in favor of soaring birds. According to the abstract, 'explanations of soaring flight' have been failures, and the 'gravity of the bird's mass' must be resolved 'by the plane of the wings under the law of fluid pressures, and Newton's third law of motion,' in consequence of which 'artificial birds or effigies' 'will imitate the soaring birds,' and 'move against the wind indefinitely!' The abstract concludes with something like a new law in mechanics : "The gravitating force is a continuous motive power when forcing a properly constructed plane to work on air in a certain definite manner, of which the soaring birds are examples." We have often brooded, in that part of our imagination devoted to the figures of mathematics and plus and minus quantities, over the pleasure it would afford to physicists, and ordinary people, could some way be found of changing at will the algebraic sign of gravity or producing negative mass, so that a body might fall upward, but we were scarcely prepared to hear that it could be accomplished by so simple a device as a bird's wing, rough in one direction and smooth in the other, — but the section no doubt needed recreation.

PROCEEDINGS OF THE SECTION OF ECONOMIC SCIENCE AND STATISTICS.

The programme of this section was popular and varied, as usual, for, besides contributions strictly statistical and bearing upon social and political economics, it is customary to refer to the section all papers which are philosophic rather than technically scientific, or which, although based upon sound science, are in an especially popular form. The casual visitor, after being wearied, puzzled, and confounded in the rooms of the other sections, usually finds in this one something interesting and instructive, and its audiences are largely local in character. The Buffalo sessions have been no exception to the rule. The meetings of this section have been well attended, and while the standard of the papers read has been hardly equal to that of last year, when Mr. Atkinson so well led the way, the average has been good, and the section has been comparatively free from the attacks of socialistic and economic cranks, to which it is especially subject.

Following appropriately the address of Vice-

President Cummings, a paper on 'A more humane and novel mode of criminal correction' was read by John Müller, of Ann Arbor, Mich. The audience was in full sympathy with the criticisms of our penal institutions, and the appeal for a more rational and humane treatment of the younger and hopeful classes of criminals, with a view to their safe restoration; but when emasculation of the intractibles was boldly advocated, and argued by reference to the successful subjugation of brute beasts through castration, no encouraging response met the reader. He well described his own paper as 'a popular subject treated in a very unpopular manner.'

Mr. Müller was more fortunate in his treatment of the question, 'How can spelling reform become a success?' Upon the premise that in rational spelling there should be one sign for one sound and but one sound for one sign, he presented an alphabet of twenty-seven characters, which he claimed sufficient for English wants, and quoted eminent teachers to prove that one-third of the time of the pupil can be saved by use of the phonetic spelling, and that children can be taught to read ordinary compositions in five months. Characters proposed by different persons were shown upon the blackboard, and a lively discussion ensued. A serious difficulty arises in the failure of these reformers to agree upon a system, as unanimous consent is manifestly essential to the successful introduction of such a change. In the discussion it was notable that nearly all the critics of English spelling were foreigners.

'Centenarianism in the United States,' was a masterly analysis, by Joseph Jastrow, of Germantown, Penn., of the statistics on the subject named. In the tenth census, the number of persons aged a hundred years or over is given as 4,016, which was declared absurd, especially as more than three-fourths of these are colored people and more than half of all are colored females. The chief cause of these gross errors is exaggeration, both from ignorance and intent. This exaggeration has been steadily decreasing for a half century, the decennial tables showing a uniform decline, with the exception of 1870, when the freed negroes interrupted the downward scale. There being evidences that the errors accompany illiteracy, the best means of correction is to assume as probably most accurate the ratio of centenarians to the whole population, among the natives in the states of least illiteracy. Combined with this, the author used what he termed the 'decimal exaggeration,' or the excess of the number at a 'round' age, as given by the census, viz., at twenty, thirty, etc., over the number at the next year below, — an excess which the doctrine of 'expectation of life' shows to be impossible. Under this method of correction, one-third of the states with least tendency to error being used as the basis, the number of centenarians is reduced to about one hundred and fifty. Up to this point, the native male whites have been regarded as perfectly reliable. This is evidently not the case, and the estimate is hazarded that inasmuch as only one in twenty-five of the alleged cases in the whole country has proved genuine, *two in three* of the remainder may be doubted, as unintentional errors, leaving but fifty centenarians in the United States, or about one to every million of population. The figures of the census are thus reduced by dividing by eighty, — and this great alteration is sustained by similar researches in England.

'The social waste of a great city' was the title of a long and verbose paper read by Dr. L. L. Seaman, of New York city. The author's experience in ten years' medical service in the city hospitals and charitable institutions led him to vigorously denounce the system of control by city politics, the association of charity with correction in the administrative boards, — claiming that it was erroneous and mischievous to assume a close relation between poverty and crime, — and 'the monopolizing and poisoning' of over six hundred acres of the fine island areas on the front of the city by their present uses. The chief service of this paper was in bringing out a severe criticism by Mr. Edward Atkinson, who took a far more hopeful view of the tendency of the times towards improving the condition of the poor and the lessening of crime in our large cities.

E. B. Elliott, actuary of the treasury department at Washington, presented two papers, mainly tabular and statistical. The titles were: 'Formulas for determining the United States gold value of silver bullion, when the London price per ounce of standard silver and the price of sterling exchange between New York and London are known;' and 'Tables showing for a series of years the rates of interest realized to investors in the securities of the United States government.' The interest tables well illustrate the varying credit of the government, from before the war, to the darkest days of 1864, when lack of confidence and 'fiat money' made the earning-power of the gold dollar 16_2 cents per annum, and then through the period of sounder finance and restored confidence to the present time, when 'governments' yield the holder about $2\frac{1}{4}$ per cent. Mr. Elliott's algebraic formulae for silver values are of limited interest, but may be valuable at times. For a constant numerator, he multiplies the number of grains of fine silver in question (S) by the London price per ounce of standard silver in pence (d), and this product by the price of sterling exchange, in United States money (E), or $S \times d \times E$, and uses the computed denominator 106.560. The value of a legal-tender dollar and of other silver coins is obtained by other denominators given, — thus, for the dollar, $\frac{d \times E}{287.372}$. On the 6th of August, with silver worth 42d. per ounce in London, our silver dollar was worth in gold bullion 71.21 cents, our trade dollar (full weight), 75.505 cents, and our subsidiary coin, 68.7 cents to the dollar.

'Recent results in the sorghum sugar industry' was the title of a paper by Dr. Peter Collier, of Washington. Numerous comparisons were made between tests of sugar-cane and sorghum, favorable to the latter as a sugar-producing plant. As an illustration, 72 approved varieties of sugar-cane grown upon Governor Warmouth's plantation in Louisiana being examined, averaged 185 pounds of available sugar to the ton of cane. Similar examinations of sorghums by Dr. Collier and Professor Wiley, at the U. S. department of agriculture, including over one hundred varieties, showed the available sugar, per ton of cane, ranging from 177 to 199 pounds. The sorghum also, on the average, produced a lower per cent of glucose and of rejected solids than the sugar-cane, this being also in its favor. As a rule, sorghum yields a less product per acre than cane, but the cost of cultivation per acre is enough less to more than compensate. The great cost of an acre of cane is well known, while sorghum costs not over ten per cent more than a crop of Indian corn of the same area. Chemical results and the manufacture of sorghum sugar, both on an experimental scale and commercially, in Kansas and New Jersey, are such, to date, as to offer every encouragement to this industry. Dr. Collier thinks the record justifies his prediction of the production of sorghum sugar in this country, in the near future, at a cost not exceeding one cent a pound. Dr. Collier also presented, in the form of graphical charts, with brief verbal explanations, 'Statistics relating to the dairy industry.' Compiled from official figures, these charts conclusively disprove the claim that agricultural land and labor, live stock and products, including butter, have suffered depreciation at all disproportioned to the recent general skrinkage in values, because of the introduction of oleomargarine and other butter substitutes and imitations. On the contrary, the number and value of milch cows in this country, and of their pure products, are steadily increasing; and there is now more and better butter made and consumed in America than ever before, while its price, compared with most food products, has been strikingly well sustained.

'The theory of rent, and its practical bearings,' was discussed by Edward T. Peters of Washington, and with such communistic leanings as to meet little approval.

Mrs. John Lucas, of New Jersey, entered a paper upon silk culture, which was received and assigned a place on the programme, but the author failing to appear at the appointed time, the paper was read by title only.

PROCEEDINGS OF THE SECTION OF MATHEMATICS AND ASTRONOMY.

SO MANY important papers were presented in this section, that we cannot even mention them all. Professor Rogers presented two papers, one on the best form of chronograph, and the other, with Anna Winlock, on 'The limitations in the use of Taylor's theorem for the computation of the precessions of close polar stars.'

The next paper was by Professor Doolittle, of Lehigh university, upon a 'Change in the latitude of the Sayre observatory.' In 1877 Professor Doolittle made a zenith-telescope determination of the latitude of this observatory. Nine years later, he now brings forward a new determination of the same latitude, from the same pairs of stars (fifty-seven in number), with about the same number of observations, the two pieces of work being done with the same instrument, by the same observer, and as nearly as possible under exactly the same conditions. No two equally thorough and equally comparable pieces of work with the zenith-telescope have ever been offered as evidence for or against a change in latitude, and the result is interesting. The difference of the two latitudes comes out

$$\phi_1 - \phi_2 = +0''.393 \pm 0''.063,$$

when the probable error of the declinations is used in the weight-coefficients in each case. Or, since the results may be assumed practically free from the errors of declinations, the result is

$$\phi_1 - \phi_2 = +0''.393 \pm 0''.045.$$

In the remarks that followed, Professor Newcomb stated that to him it only meant that in one or both of these series of observations there was — as with every observer and every instrument — some source of small systematic error which 'no fellow could find out.' Mr. Woodward, of the geological survey, an expert with the zenith-telescope, and also in questions of probable error, stated that in the absence of further observations he should hesitate to say that the observations themselves really indicated a real change of latitude.

Dr. Gould read a very interesting historical account of the early attempts at astronomical photography, showing that it originated in this country, and was for a time most actively pursued here, culminating in those beautiful photographs of the moon taken by Rutherfurd, as well as photographs of several double and multiple stars, and of the clusters Praesepe and the Pleiades. He told how Rutherfurd constructed a micrometer measuring engine, and obtained the first measures of the distances and position-angles of stars upon photographic plates, and how the work was received with considerable skepticism abroad. The speaker then described his own continuation of this same kind of work at Cordoba, and stated that he had brought home plates whose measurement would take a lifetime. Dr. Gould thought that he had the records of many 11th magnitude stars on his plates, the first photographs of such faint stars. Few of the plates were yet measured, and he was becoming solicitous about obtaining the necessary funds to proceed as rapidly as possible with this measurement, as he had detected a tendency, in some of the plates, of the collodion film to become detached from the plates.

A paper by Mr. E. F. Sawyer, entitled 'Some account of a new catalogue of the magnitudes of southern stars,' was presented. Mr. Sawyer has been observing the relative magnitudes of all the stars between the equator and — 30°, using an opera-glass with the stars slightly out of focus, and employing Argelander's method. Dr. Gould paid a high compliment to Mr. Sawyer's work, as did also Mr. Chandler.

A paper by Dr. Elkin, of the Yale college observatory, upon 'A comparison of the places of the Pleiades as determined by the Konigsberg and Yale college heliometers,' was presented by Professor Newton. The results given were provisional; but they show unquestioned change of position with reference to η Tauri since 1840. Most of the brighter stars of the group, as shown by Newcomb in his catalogue of 'standard stars' go with η Tauri, but among the smaller stars there are unquestioned departures from this community of proper motion.

In Monday's session a paper by Professor Abbe created some discussion. The point of the paper was, that, as the force of gravity varied from the equator to the poles, thirty inches of mercury in the barometer indicated a less gaseous pressure, and consequently less density of the atmosphere, at the equator than thirty inches at the poles, and hence a correction for latitude should be introduced in allowing for refraction. He showed that, for the difference of latitude of Pulkowa and Washington, it would make 0″.1 difference in the refraction at 45° of zenith-distance. and might be sufficient partly to account for differences in systems of star declinations which depended upon observations at great zenith-distances.

The most important paper in the section, and the one that attracted the most attention and discussion, was by Mr. Chandler, of Cambridge, upon 'A comparative estimate of methods and results in stellar photometry.' We have not space to do justice to this valuable and rather revolutionary paper, but we will try briefly to give its gist. Prefacing his remarks with the statement that it had long been known that small differences of stellar magnitude could be determined very accurately by Argelander's method of steps, by naked-eye estimates, but that it had been generally supposed that large differences could not be accurately so determined, and that the general idea had been that, as soon as photometry came generally into use, and so-called measurement took the place of estimation, a much more accurate scale of magnitudes, depending upon a true geometric light-ratio, would at once take the place of the old, the latter becoming obsolete, Mr. Chandler took for his text the general statement that instrumental photometry had thus far proved a failure; that is, it had not developed a more uniform scale of magnitudes than Argelander's, nor had the accuracy of individual determinations been increased, but they were, on the contrary, far more uncertain than the old differential naked-eye estimates. These statements he proceeded to back up with a convincing array of well-digested results, of which we can only give the briefest summary: 1°. For stars of Argelander's scale between magnitudes 2 and 6, the photometric catalogues of Seidel, Peirce, Wolf, Pickering, and Pritchard differed among themselves as much (or more) in their measures of what Argelander called a difference of one magnitude, as they did in their measures of his successive magnitudes. 2°. Their average values of the logarithm of the light-ratio (we will call it simply light-ratio hereafter, for brevity) for one of Argelander's magnitudes between 2 and 6, ranged between .30 and .38, about .35 for the mean of all the above-mentioned catalogues. 3°. Between magnitudes 6 and 9 of Argelander, the catalogues of Rosén and Ceraski averaged about .35 for the light-ratio, while Pickering's late results with his large meridian-photometer gave (between magnitudes 6 and 8.5) .48 instead of .35 for this ratio. 4°. To show the discrepancies in another way, assume a common light-ratio of .35 for all the photometers, and that their scales agree at magnitude 6. Then, for stars of the second magnitude, they will differ by 0.8 of a magnitude. That is, at a distance of four magnitudes away from where they agree, one photometer will say that the same star is twice as bright as another will. 5°. To test the uniformity of the different scales, all were referred to the average scale of all the photometers, and it was shown that Argelander's scale in the 'Durchmusterung' was just as close to this as that of any single one of the photometers. 6°. Coming to accidental errors, Mr. Chandler showed that, from a full discussion of the naked-eye estimates of Gould, Sawyer, and himself, the probable error of a single estimate was a little over ±.06 of a magnitude when the stars were at considerable distances from each other, and about ±.05 of a magnitude when near; while the probable error of a single measure in the 'Harvard photometry' was ±.17 of a magnitude, and in the 'Uranometria Oxoniensis' about ±.10 of a magnitude, thus showing that the eye-estimates were from two to three times as accurate as the photometric. 7°. Discussing the cause of the large residuals in the 'Harvard photometry,' Mr. Chandler showed the strong probability of wrong identification of stars in many cases, citing one case where no bright star existed in or near the place called for by the observing-list, on account of a misprint in the 'Durchmusterung,' and yet some neighboring star was observed on several nights for it. 8°. Also the method of applying a correction for the mean value of the atmospheric absorption was very questionable, since overwhelming evidence pointed to an enormous difference in this absorption from night to night. 9°. The author pointed out that we must obtain better results from photometers if we ever expect to use their results for the detection or measurement of variable stars, since several variables have been detected, and their periods and light-curves well determined, by careful eye-estimates, whose whole range of brightness is no greater, or even less than, the range of error in the photometric observations upon a single star with the meridian photometer.

In a discussion of a paper by Mr. Barnard upon 'Telescopic observations of meteor-trains,' Professor Newton pointed out that the study of their drift was the only method we have of studying the upper currents of our atmosphere, except such rare catastrophes as the Krakatoa explosion.

The closing paper was by Mr. Chandler, 'On the use of the zenith-telescope for latitude.'

PROCEEDINGS OF THE SECTION OF BIOLOGY.

The regular work of the biological section began on Thursday, and a partial classification of the papers into botanical and zoölogical added considerably to the interest and convenience of those present. Some have proposed a divison of the section of biology into botanical and zoölogical sections, but this, with a small meeting, seems hardly desirable, as there are apt to be only enough papers to occupy the time.

Among the first of the botanical papers was one by Prof. W. J. Beal, giving a comparison between the hygroscopic cells of grasses and sedges. In both grasses and sedges, as has long been known, there are one or more longitudinal rows of cells on each leaf, the function of which is to fold or close the blade in times of drought, and thus prevent too rapid evaporation of moisture from the surface. These rows of cells, as well as the cells themselves, vary in shape, size, and distribution in the different genera and species, and may have some value in the discrimination of critical species. The most interesting point brought out was, that many parallels exist between the genera of grasses and sedges in the arrangement of these hygroscopic, or, — as Professor Beal chooses to term them, — bulliform cells.

The paper of Messrs. J. M. Coulter and J. N. Rose, giving a synopsis of the North American pines, based on leaf-structure, had some points in common with the one just mentioned, and was of especial value from a systematic stand-point, from the fact that any species in this somewhat difficult group can at once be distinguished by the peculiarities of its minute leaf-structure; and the results of the author's observations are shown to be worthy of attention from the fact that a classification based on these characters is, in its broader features, closely like that of the late Dr. Engelmann, which, as is well known, took into consideration the whole tree.

The relations of germs to disease naturally occupied a prominent place in the proceedings of the section, and the presence of over half a dozen investigators in this line made the discussions interesting. Dr. D. E. Salmon read two papers bearing on the causes of immunity from a second attact of germ diseases. There are three possible explanations: 1°, something is deposited in the body during the attack which is unfavorable to the germ; 2°, something has been withdrawn which is necessary to its development; 3°, the tissues have acquired such a tolerance for the germ or for an accompanying poison that they are no longer affected by it. Dr. Salmon favored the last view, and gave details of a large number of experiments to substantiate his opinion. He said that Metchinkoff's phagocyte theory was not wholly satisfactory, and that large doses of the germs were more powerful than small ones. He attributed their action to a poison which was a result of their growth, and thought that a large dose had a greater effect because the poisons benumbed or killed the cells, thus giving the bacteria a better chance to grow and to thus produce more poison.

Dr. Joseph Jastrow gave an account of some physiological observations on ants, in which he was able, by simple but ingenious means, to study the rate of walk of these insects, and stated that his results, so far as they went, confirmed the opinions of others that the smaller the animal the more rapid the step, and also the more quickly fatigue was produced. Dr. Jastrow also had some observations on the dreams of the blind, taken mostly from persons who had lost the sense of sight before the age of five. In these cases the dreams were all in terms of hearing. In the case of Laura Bridgeman, the dreams were apparently based on touch. In persons who become blind between five and seven, sight terms played an important part in dreams. The relation of these facts to the development of the sight centres was pointed out.

A short paper by S. H. Gage and Seth E. Meek, on the lampreys of Cayuga Lake, stated that the large lamprey, heretofore regarded as sub-specifically distinct, was identical with the well-known sea-lamprey of the Atlantic coast, the characters separating it being of a sexual nature and assumed at the breeding season. The existence of a second species in Cayuga Lake, hitherto not known east of Indiana, was mentioned. The authors described the method of nest-building, stating that the lampreys seek out a spot in the still water above the ripples, and then, by means of their sucking mouths, remove the stones until a nest from four to eight inches deep is made. In the sand in the bottom of this nest the eggs are laid. The time of oviposition was from June 9 to July 6 during the present year. The pile of gravel thrown up in making the excavation is not the nest, but later it is found to be occupied by the ammocoete larva.

The most important feature of Dr. Kingsley's account of the embryology of the shrimp (Crangon) related to the development of the compound eye. Locy was the only previous observer of the early stages of the eye of anthropods, and Dr. Kingsley's observations confirmed his results as well as going more into detail.

Dr. C. S. Minot, in his paper on the segmentation of the vertebrate ovum, reduced all types of segmentation to a common basis, and clearly pointed out the homologies. The most important point was that which showed that the majority of authors had confused the germ-layers in the mammalian ovum, and have termed the entoderm, ectoderm, and *vice versa*. On Dr. Minot's showing, the difficulties encountered in mammalian embryology are largely those of misconception and misinterpretation.

Dr. Merriam, after mentioning the fact that bats might be divided into tree-dwelling and cave-dwelling forms, presented evidence, of a negative character, which goes to show that the tree-inhabiting bats migrate. No woodsmen have found bats in hollow trees in winter, and there is no evidence that any forms hibernate. In a second paper the same gentleman gave an outline of the work being done in the department of agriculture, on economic ornithology and mammalogy, in which he pointed out, in most vigorous language, the immense damage done the agricultural interests by the bobolinks and English sparrows. One South Carolina planter with rice-fields of twelve hundred acres employed each year a hundred persons to kill the birds, at a total expense for ammunition, etc., of $4,500.

Among the papers read were the following: 'Culture experiments showing accidental relations between Gymnosporangia and Rolstelia,' by Dr. W. G. Farlow; 'Insect diseases,' by Prof. S. A. Forbes; 'Areas of form and color perception of the human retina,' by Prof. J. H. Pillsbury; 'Development of the human chorion,' by Dr. C. S. Minot; and, 'The auditory bones in the lower vertebrates,' by Prof. E. D. Cope.

MUSK is an animal substance, obtained from an abdominal sac of the male of the Moschus moschatus, a small hornless deer inhabiting the higher mountains of central Asia, ranging from Thibet to China, and into Asiatic Russia. The contents of the musk-sac are a solid, brownish, granulated, ovoid mass, exceedingly strong and tenacious in odor, and varying in size from that of a walnut to that of a hen's egg. There are four varieties of musk, viz.: Tonquin, from China, regarded as the best, and which is looked upon as the most recherché; Yunnan, from the frontiers of Indo-China; Assam, or Bengalee; and, least valued of all, Kabartin, from Tartary and Siberia. Musk is very expensive, the price at present ranging from eight to twenty dollars per ounce, in the pods or bags, according to grade. This high price is the cause of much adulteration, in this country as well as at the place of production; so that there is very little in the market that can be considered pure. The principal adulterants are lead, iron, coagulated blood, leather, stones, and even paper and rags. The adulterant is inserted in the bag, and the opening closed in such a manner as to defy detection. About five hundred pounds of musk are used annually in the United States, of which ninety-five per cent goes into toilet soaps and perfumery, the rest being used for medicinal purposes.

— PROF. JOHN DICKINSON, a brother of Miss Anna Dickinson, has accepted the chair of geology and mineralogy in the University of Southern California at Los Angeles.

SCIENCE.

FRIDAY, SEPTEMBER 10, 1886.

COMMENT AND CRITICISM.

The Smithsonian report for 1885, which we may hope will be issued with less delay than its predecessors have been, will contain an account of the progress in astronomy for that year, by Mr. William C. Winlock of Washington, which has already appeared with sufficient promptness as a separatum. Mr. Winlock forestalls at once any criticism we might otherwise like to make by pleading the brief time necessarily available as an excuse for any shortcomings that may be found, and remarks that his record is intended primarily for the large and increasing class of those who have a general rather than a special interest in the progress of astronomy, while it may be of use to the professional astronomer also, as a convenient collection of reviews and notes. Abstracts of the most important papers are given, while other papers appear by title only, and free use has been made of reviews in such periodicals as *Science, The athenaeum, The observatory,* and *Bulletin astronomique.* Comets, a specialty of Mr. Winlock's, are very fully and accurately dealt with; and his method of indicating the names of all these objects, now become so numerous with every year, is an important advance.

Independently of the excellences or shortcomings of the present work, we think the question may fairly be raised whether these annual reports are worthy of continuance or not. They are, through no fault of the author, rather tame reading for those having only a general interest in astronomy, being largely a mere recital of the new facts of the year's finding out, with no connecting-link to the astronomy of the past. To be sure, the developments of astronomy within a twelvemonth are rarely sufficiently far-reaching for even the practical astronomer to keep in mind the precise relations of past and present research. Again, if these reports are prepared for the convenience of the professional astronomer, it may well be doubted whether they are worth what they cost the astronomer who undertakes to prepare them; for the work is no approach, in point of serviceableness, to a complete bibliography for the year, such, in fact, as Mr. Winlock himself broaches the preparation of, perhaps through the co-operation of astronomers. If this is found practicable, then the editor of the Smithsonian report might well confine himself to the presentation of a quinquennial history of astronomical progress, to be prepared by the ablest astronomer who would undertake the task, and who would be expected to indicate clearly the bearings of recent research upon that of previous years, and weld the scattering links into a continuous chain. It is easy to see that the work executed in this manner would have an important bearing upon 'the diffusion of knowledge among men,' which, in its present form, it does not possess.

Judging by the scientific agitation which has shaken England for so many years, one would hardly credit the statement made by Sir John Lubbock in his address at the unveiling of the statue of the founder of the Mason science college, that, in 54 of 240 endowed schools for boys which have reported, no science whatever is taught; in 50, one hour is devoted to it per week; in 76, less than three hours; while only 56 devoted as many as six hours to it. According to the report of the Technical commission last year, there were only three schools in Great Britain in which science is fully and adequately taught. In urging the benefits of science, Sir John Lubbock says, "In the first place, science adds immensely to the interest and happiness of life. It is altogether a mistake to regard science as dry or prosaic. The technical works, descriptions of species, etc., bear the same relations to science as dictionaries to literature. . . . Occasionally, indeed, it may destroy some poetical myth of antiquity, such as the ancient Hindoo explanation of rivers, that 'Indra dug out their beds with his thunderbolts, and sent them forth by long continuous paths.' But the real causes of natural phenomena are far more striking, and contain more real poetry, than those which have occurred to the untrained imagination of mankind."

Dr. Thomas Taylor's microscopic method for detecting the adulteration of butter with foreign fats seems destined to assume as many shapes as Proteus. At first the globose forms, obtained by the boiling and subsequent slow cooling of butter, and exhibiting the Saint Andrew's cross under polarized light, were brought prominently forward as distinguishing marks of pure butter. Prof. H. H. Weber, however, upon testing the method as described by Dr. Taylor, found, that, although the so-called butter crystals could be readily prepared from butter, they could be as readily prepared from beef-fat, or mixtures of beef-fat and lard, under like conditions. The necessary conditions are, the slow cooling of the melted fat in the presence of minute solid particles about which the fat may crystallize, the so-called 'butter crystals' being aggregations of minute crystals radiating from a centre. In the test as described by Dr. Taylor, the butter is boiled for one minute, and then slowly cooled. During the boiling, some of the water of the butter evaporates, and a corresponding portion of its salt solidifies, and the minute crystals thus formed serve as centres of crystallization for the fat during the subsequent cooling.

After the publication of these results, the 'butter crystal' and its Saint Andrew's cross were relegated to a subordinate position, and in several publications Dr. Taylor insisted that his most important test had been neglected, viz., the appearance of the unboiled material under polarized light with a selenite plate. According to Dr. Taylor, butter shows a uniform tint, while lard and tallow show prismatic colors. Here, again, however, he has been pursued by Professor Weber, who shows that either butter-fat or lard or tallow, when cooled quickly, will show a uniform tint, while if cooled slowly, so as to admit of the formation of larger crystals, prismatic tints are shown by both. Since imitation butter is cooled rapidly when made, and since both genuine and imitation butter are liable to undergo sufficient changes of temperature after manufacture to allow of a partial re-crystallization, the test is plainly fallacious. Apparently, Dr. Taylor prepared his annual report with these results in mind, for there, and in his paper before the annual meeting of the American society of microscopists at Chautauqua, Aug. 10–16, he gives his method a still different exposition.

Dr. Taylor's first step is now to search for fat crystals in the test sample by plain transmitted light. By the application of polarized light, 'amorphous crystals,' whatever these may be, may be detected. To determine whether these 'amorphous crystals' are of beef-fat or lard, the sample is boiled and slowly cooled, as already described, and mounted in oil. Under these conditions, he now finds, in accordance with Professor Weber, that butter, lard, and beef-fat all give globular crystalline bodies which (apparently with the exception of lard) show the Saint Andrew's cross. These bodies are to be distinguished by their forms, lard giving a stellar form, butter the well-known 'butter crystals,' and beef-fat a stellar form with biserrated spines. Dr. Taylor has also discovered the noteworthy fact that Tennessee butter of a certain grade yields globules which are flattened or indented on one side! The above account of Dr. Taylor's method, as at present described by him, is drawn mainly from his last annual report to the commissioner of agriculture, —his Chautauqua paper, to judge from the published abstract, having been chiefly a criticism on Professor Weber's experiments. We shall endeavor to keep our readers informed of the changes which the method undergoes in the future.

THE EARTHQUAKE OF AUG. 31, 1886.

THE accompanying map has been hastily compiled from the great mass of conflicting data from all sources now available, and probably gives a fair general idea of the origin of the shock, the limits of the area disturbed, and the intensity at many points within this area (plotted on the American scale of intensity, 1 to 5). It will be readily appreciated by every one that in this preliminary report all that is or can be arrived at is to give a general outline, as determined by the most probable evidence at hand, to serve as a good working hypothesis: to attempt any thing further at present would be to make a mere pretence at accuracy.

A line of weakness in the earth's crust extends from Troy, N.Y., south-westward, along the line of tidewater, past Baltimore, Washington, and Richmond, losing itself in a broad flexure south of Raleigh. The cause of the shock seems to have been a renewed faulting or displacement along the line where it crosses the Carolinas. This severe shock appears to have had its origin along this line in central North Carolina and eastern South Carolina, at 9.49 P.M. (75th meridian time), Aug. 31. It was not without warning. For a long time slight shocks have been occasionally felt in North Carolina, and only a few

THE CHARLESTON EARTHQUAKE.

SCIENCE, *September* 10, 1886.

The co-seismal lines give the even minutes after 9 P.M. (75th meridian time).

Scale of intensity, 1 to 5.

+ indicates that the shock was unimportant, or not felt.

Diameter of circles (in ½ mm.) gives American scale of intensity (1 to 5).

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days previously moderate shocks were felt near Charleston. From the Carolinas it radiated with great rapidity (from 20 to 60 miles a minute) throughout the great area bounded on the south by the Gulf of Mexico; on the north by Michigan, the province of Ontario, New York, and southern New England; on the east by the Atlantic ocean, where it was probably felt nearly 500 miles at sea; and on the west by the central Mississippi valley. The limits are, so far as now known, as follows: central Florida; eastern Louisiana, Arkansas, Missouri, and Iowa; southern Michigan and province of Ontario; northern New York; and southern New England. It was not felt at Bermuda. The limits of the shock, as here stated and as indicated in the accompanying map, it is particularly desirable to verify, as well as the correct time at which the shock was first felt at all points within the disturbed area. It often happens that there are places within an earthquake area where the shock is not perceptible, owing probably to some local peculiarity in the geological formation, although decidedly noticeable at places not far away. There are already points of this kind mentioned, — in Florida, Indiana, and Connecticut, for instance, — and such information is very interesting.

The hypothesis has been advanced by Perrey that earthquakes are connected with subterranean tides due to the combined influence of the sun and moon, and analogous to those in the ocean. At a given point the earth's strata are under the accumulated tension of centuries, and this pressure is slowly but steadily increasing, until it reaches a point when fracture is imminent. Twice a day the great oceanic tidal waves sweep along the coast, the tremendous changes of pressure due to them being possibly augmented by analogous movements beneath the crust; and at a critical moment they add 'the last straw' that determines the fracture. It is very interesting to notice in this connection that at the time of the severe shock at Charleston this tidal influence was at its maximum. The moon was in perigee at 2 A.M., Aug. 29; new moon at 8 A.M. the same day, acting in a direct line with the sun (the eclipse of the sun occurred at 5 A.M., Aug. 29): extremely high tides occurred, therefore, for several days following. The moon's upper transit at Charleston occurred at 2.22 P.M., on Aug. 31. The high tide following (the higher of the two daily tides) was at 9.35 P.M., just twenty minutes before the shock occurred. This remarkable coincidence is of course extremely interesting.

It seems remarkable that no sea-wave followed the shock; and indeed it was providential that it did not, as the resulting destruction and loss of life would have been a hundredfold greater. A sea-wave (often very incorrectly called a tidal wave) of greater or less size is the almost invariable accompaniment of a severe shock occurring near the seacoast.

It is unnecessary to enlarge here and now upon the general effects of this severe earthquake, or to theorize upon the causes of earthquakes in general or of this one in particular, more than has already been done. Such a study, to be of any value, must await the compilation and elaboration of a vast amount of material, and the final reports of the geologists who are now at work in the region of greatest disturbance.

STUDY OF THE EARTHQUAKE.

THE U. S. geological survey has undertaken to make a study of the severe earthquake of Aug. 31, which caused such great destruction and loss of life at Charleston, S.C. It was the most severe on record in the United States, both as to the effects produced and the area disturbed.

The study of phenomena of this kind is of the greatest value to science as a guide to the knowledge of the nature of the interior of the globe, and in its bearing upon every branch of physics and geology. In it there is needed a vast amount of reliable information, not only from points within the disturbed area, but also from adjacent points, in order to accurately define its limits; and it is not only skilled observers who can furnish such information, but almost every one can contribute valuable facts. It is therefore confidently hoped that facts of interest will be sent in at once to the U. S. geological survey at Washington while they are still fresh in the memory. Newspapers can render great assistance by giving wide publicity to this call, and by sending copies of their issues containing information about the local effects of the shock. Attention to the points mentioned below will add greatly to the value of the information, and facilitate its elaboration and study.

Write on one side only of the paper. After dating the letter as usual (giving also the locality where the observation was made, if not the same), write 'Answers to circular No. 2.' State the observer's situation (whether in the house or out of doors, up stairs or down, sitting, standing, walking, reading, etc.); also, if possible, the character of the ground (whether rocky, earthy, sandy, etc.) Then answer the following questions, referring to them by number only: —

1. Was an earthquake felt at your place the evening of Aug. 31, 1886, or within a few days of that time? Negative answers to this will be of great

interest from any points within the disturbed area, and especially from points near its limits: that is, southern Florida; central Mississippi, Arkansas, Missouri, and Iowa; south-eastern Minnesota and Wisconsin; central Michigan; southern portion of the province of Ontario; northern New York; southern Vermont and New Hampshire; and eastern Massachusetts; also from the western part of the Atlantic and northern part of the Gulf.

2. At what hour, minute, and second of standard time was it felt? When this can be accurately given, it is of the very greatest importance. Be particularly careful to state whether it is standard (railway) time or local time; whether the watch or clock was compared with some standard clock at a railway-station or elsewhere, how soon, what the error was, and whether you corrected your observation by this comparison or not.

3. How long did its perceptible motion continue?

4. Was it accompanied by any unusual noise? If so, describe it.

5. Was there more than one shock felt? If so, how many? Where several were felt, give accurately, or even roughly, the number, duration, and character of each, and the interval between them.

6. Which of the following measures of intensity would best describe what happened in your vicinity? — No. 1. Very light; noticed by a few persons; not generally felt. No. 2. Light; felt by the majority of persons; rattling of windows and crockery. No. 3. Moderate; sufficient to set suspended objects, chandeliers, etc., swinging, or to overthrow light objects. No. 4. Strong; sufficient to crack the plaster in houses or to throw down some bricks from chimneys. No. 5. Severe; overthrowing chimneys, and injuring the walls of houses.

7. Do you know of any other cause for what happened than an earthquake? Give also any further particulars of interest, stating whether they are from observation or hearsay: for instance, whether the shock seemed like a tremor or jar, or an undulatory movement; and whether it seemed to come horizontally or vertically; whether any idea of direction of shock was formed, and if people agreed in their idea as to such direction. Mention any unusual condition of the atmosphere; any strange effects on animals (it is often said that they will feel the first tremors of a shock some time before people notice it at all); character of damage to buildings; general direction in which walls, chimneys, etc., were overthrown. Springs, rivers, and wells are often noticeably affected by even slight shocks, and such facts are especially interesting. If a clock was stopped, give the time it indicated, and some idea as to how fast or how slow it was, its position, the direction in which it was standing or facing, and the approximate weight and length of the pendulum. If a chandelier was noticed to swing decidedly, describe it and state direction of swing. If pictures swung, state direction of wall, and whether pictures on the wall at right angles to it were also put in motion. If doors were closed or opened, state the direction of the wall in which they were set. All such little facts, if only noticed, remembered, and recorded, are of great value.

At end of letter give name of the observer, if other than the writer. A moment's thought will show the impossibility of an immediate acknowledgment of every letter received, although each one will have its share in contributing to the value of the result, as it finally appears in the public press and the official publications of the survey.

Address simply, Division of volcanic geology, U. S. geological survey, Washington, D.C.

Everett Hayden, *Assistant Geologist.*

THE FRENCH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The French association for the advancement of science held its fifteenth annual meeting in Nancy, the 12th of August and the week following. Nancy, one of the frontier towns, near the German limit, is a very handsome and pleasant city. It is very prettily built, and contains old monuments of a striking effect. It is also a scientific and literary town, and many able *savants* or writers hold a position in the university. The meeting was a very successful one, in that a large number of members were present, and the papers submitted were numerous and satisfactory. The president was M. Friedel, the well-known chemist, the successor of Würtz in the Sorbonne, and one of his best and most affectionate pupils. In his address to the meeting the first day, he made it known that the Association scientifique, founded by Leverrier, is to be soon combined with the French association under the name of the latter. The greater part of M. Friedel's address was concerning recent progress in chemistry and mineralogy. After having recalled M. Moissan's successful experiment, by which fluor has been isolated for the first time, and M. Lecoq de Boisbaudran's interesting researches concerning two new metals, he spoke at length on the artificial synthesis of different compounds, such as those of felspars and some precious stones. After M. Friedel's address, M. Collignon, the secretary-general, briefly recalled the principal points of the association's history for the past year, alluding to the Grenoble meeting and the excursions made in the neighborhood, mentioning the names of deceased members: Bouquet, Bonley, Jamin, Robin, Dechambre, Courty, and others. M. A. Volland, mayor of Nancy, greeted the association with heartfelt words. M. E. Galante spoke on the financial state of the association, which is very satisfactory. The expenses are for the publication of the yearly volume recording the acts of the association and the different works submitted; many grants for scientific researches are also included.

Some interesting discussions have been held in the meetings of the different sections. One of the best took place in the agricultural section, and the topic was wheat-production. Many experimenters and able specialists took part in this discussion, such as Frederic Passy, Levasseur, Alglave, Dehérain, Grandeau, Raffalovich, etc. M. Dehérain spoke on the best manner of getting the most wheat at least cost price, which is, I think, the universal desideratum, applying not only to wheat, but to all that can be manufactured or grown. M. Dehérain said that the great objection to the use of a large amount of manure is the 'laying' which usually occurs. But the 'laying' can very well be avoided if some trouble is taken in selecting the wheat species. According to M. Dehérain's experiments, the Scotch red wheat, the Shirley, and the Browick are not subject to 'laying,' and the crop is a very fine one when manure is liberally used; 35 or 40 *quintaux* of wheat, and 60 or 80 of straw, sometimes bringing more than 500 francs per hectare. M. Porion has even been able, in the Pas-de-Calais, to obtain crops four times more abundant than the mean average of French crops. M. Sagnier spoke of Indian wheat, the hero of the day, but a very unwelcome one. It seems that India is growing wheat very successfully, and the increased extension of railways helps this production in a marked manner. In 1876, ten years ago, India had twelve thousand kilometres of railway, and one and a half million hectares planted with wheat. At present there are thirty thousand kilometres of the former, and twelve million hectares of the latter. In ten years the wheat-crop has increased eightfold: it has doubled in the last three years. But this cannot be all, and the wheat-crop must certainly become greater still. M. Sagnier believes it may certainly become double what it is at present, and four times as large as that of France at this time. M. Alglave agrees with M. Sagnier, because, he says, although the inhabitants of North India have taken to using wheat for their food, those of the south keep eating rice, which does not sell so easily; and all their wheat they willingly sell, inasmuch as rice-culture does not interfere with wheat. Rice requires a watery soil, which does not suit wheat; so that they will continue growing rice in the valleys, and wheat on the hillsides. At all events, the enormous extension of wheat-culture in India is a matter of no little anxiety to European agriculturists.

In the anthropological section, M. Cartailhac read a paper concerning primitive burial rites. In 1830 some Danish anthropologists, Bruzelius, Boye, and Hildebrand, believed that in many cases primitive men were accustomed to bury only the bones, after the flesh had disappeared. M. Cartailhac, following up this idea, remarked that in many savage countries the fact is quite true. In the Andaman Islands, for instance, as E. H. Man has recently noticed, the body is buried for a time only, then unearthed when the flesh has been decomposed; and a similar custom is met with in many instances. M. Cartailhac proves that this fact is also established in regard to primitive mankind, and that at the *age du Reune* — nothing being known of the burial rites of the stone age — the real burial was performed only when the body was deprived of flesh. In the Menton caves, for instance, the bodies were certainly buried in the skeleton state. The same is true of the *age de la pierre polie*. Upon the whole, M. Cartailhac believes that the custom of letting corpses putrefy before giving them a definitive burial has been a very prevalent one. It is curious enough to notice that in Spain no king is laid in his burial-ground before the death of his successor: the dead king remains in the *Putrido*, as it is called, till his successor comes to take his place.

In the medical section I notice no very interesting papers yet, that is, none of general interest. There have been no general meetings at this session, as there usually are, — none save the general assembly of the first day. Some interesting excursions have been made in the neighborhood. One had been projected to Mount Douon, a mountain on the German territory; but the German authorities, not knowing the nature of the French association, had asked that no excursion should be made: so it was deemed better to abandon the project. Only two or three persons went up, and found a small body of troops and some local German authorities. But it was ascertained that the intentions of the association had been entirely misunderstood, the German authorities knowing nothing of the association, and believing it to have political objects. The absurdity of the notion was ridiculed, and no more was thought about it.

The next meeting will take place in Toulouse, and the following one, for 1888, in Oran (Algeria).

LONDON LETTER.

ANOTHER of the veteran English naturalists has just passed away, after a long illness, in the person of Mr. George Busk, F.R.S., F.G.S., etc. By profession a medical man, and for many years consulting surgeon to the Seamen's hospital at Greenwich, he was one of those who sacrificed his professional prospects to a love of science for its own sake, and made his reputation chiefly as a teacher and examiner in the subjects of comparative anatomy and histology, in connection with the Royal college of surgeons and the University of London. He was one of the translators and editors of Kölliker's 'Manual of human histology,' and sole editor of Wedl's 'Rudiments of pathological histology.' In 1872–73 he was vice-president of the Royal society, and for about ten years was the secretary of the Linnean society. When an inspector of physiological laboratories was needed under the vivisection act, Mr. George Busk was appointed to the post, which he held, with great advantage to science, up to the time of his death.

A severe colliery explosion has just taken place in one of the deep pits (1,410 feet) of the Lancashire coal-fields, by which nearly forty lives were sacrificed; but one of the few survivors is able to give most important evidence on the behavior of the Davy lamp, and its share in causing this particular explosion. From the heaving of the coal, a sudden rush of gas came out upon his partner's lamp, the flame rapidly elongated inside, and in a very short time the gauze was seen to burst, and the explosion took place. This danger was not unknown to Davy, but it has hitherto been considered that the elongation of the flame gave sufficient warning to enable the miner to escape to a place of safety. In the present instance it seems clear that the three stages followed each other too quickly, the result being a lamentable sacrifice of life.

Considerable attention has been directed of late to the performances of the Marchant engine, for which it is claimed that the difficult problem of the return to the boiler of steam which would otherwise be wasted has now been practically solved by it. Several stringent tests have been made of this engine under the superintendence of responsible engineers previously unacquainted with it, and the result of one of the most recent may be here given. "The stated effective horse-power of the engine (93.3) was therefore obtained at the expenditure of 0.803 pounds Welsh coal per horse-power per hour, and we hereby certify to such ascertained result." The boiler pressure was 241 pounds per square inch; the average vacuum in the condenser, 17 inches; and the speed, 125 revolutions per minute. The results thus obtained work out to a fraction over half a pound per indicated horse-power per hour. The economy in coal is such, that it is calculated that the Peninsular and oriental steamship company would save £1,000 ($5,000) per day by the use of such engines. As the condenser occupies only a sixteenth of the space of an ordinary water-condenser, it is adaptable to locomotives, which might, says Mr. Marchant, the inventor, be built to run 1,000 miles without a fresh supply of water.

The season of annual congresses has now well begun. Allusion was recently made in this correspondence to that of the naval architects in Liverpool, a concise summary of whose work appears in *Nature* for Aug. 12, and will well repay careful perusal. The mechanical engineers hold theirs in London during the present week. The controversy upon women's education, revived by Dr. Withers Moore in his presidential address at the British medical association last week, has already received contributions by cable from the United States, and has attracted much attention here. The educated layman's view of it is forcibly set forth in an article headed 'A plea for silly mothers' in the *Pall Mall gazette*, from which the following sentences may be quoted. "Where Dr. Moore has gone astray is, that while he wants to prove that the higher education unfits women to be mothers, all he does is, that overpressure does so: of course it does. Overpressure is bad for women; so it is for men. Some women are not fit for professional careers; neither are some men. . . . We no longer aspire to shut women out of the world in mediaeval seclusion; our aim is rather to keep them among its stir and strife in protected and shepherded peace, and in that work there is as much call upon the new chivalry as ever was made in an earlier civilization upon the knights of the lance and spear."

Dr. J. S. Billings's address on the position and prospects of the medical profession in America excited very great interest, as did the invitations from the American representatives to attend the International medical congress to be held next year in Washington. The present meeting has been more cosmopolitan than any former one, a hundred members coming from the continent, United States, or colonies, while there were members from Costa Rica, Calcutta, Japan, and South Africa.

A very interesting discussion, which has a scientific side to it, is going on with reference to the permanency of water-color pictures; and so much public interest has been aroused, that a committee has been appointed by the 'lords of the committee of council on education' to investigate and report on the matter. The advocates of the permanency of water as a medium for color-painting cite in support of their views the fact that the ancient Egyptians, whose pictures in some cases are apparently as fresh and bright to-day as when first executed two or three thousand years ago, used water-colors. Old manuscripts, illuminated in water-colors several centuries ago, do not appear to have diminished in brilliancy. On the other hand, there are undoubted cases of fading of pictures by Turner and others, owing to prolonged exposure to sunlight. A comparison of collections of oil and water color pictures of equal age, however, seems to show that the former are at least as liable to fade as the latter. Such colors as ochres and siennas are permanent in both mediums, while lakes are fugitive in both, and the madder colors are generally considered lasting. A few years ago, Mr. Holman Hunt took much trouble to investigate the purity of artists' colors, which, he found, were frequently adulterated. The results he communicated at the time to the Society of arts. It is now suggested that a more extended official investigation should be made of the whole subject, on the lines which he then indicated, including in the research the action of the electric light, as well as that of sunlight, upon pure and adulterated pigments, and mixtures thereof. W.

London, Aug. 15.

NOTES AND NEWS.

THE two hundred and fiftieth anniversary of the foundation of Harvard university will be celebrated on the sixth, seventh, and eighth days of November next. On Saturday, the 6th, undergraduates day, the students of the university will celebrate the event by literary exercises in the morning, athletic sports in the afternoon, and a torchlight procession in the evening. On Sunday, the 7th, foundation day, the anniversary of the passage by the general court of the colony of Massachusetts Bay, of the memorable vote, "The court agree to give four hundred pounds towards a school or college, whereof two hundred pounds shall be paid the next year, and two hundred pounds when the work is finished, and the next court to appoint where and what building," there will be commemorative exercises, under the direction of the college authorities, in Appleton chapel, conducted in the morning by Rev. Francis G. Peabody, and in the evening by the Rev. Phillips Brooks. On this day clerical graduates of the university are requested to refer in their pulpits, if the circumstances permit, to this act of the infant colony, and the benefits which have followed from it. On Monday, Nov. 8, alumni day, the graduates of all departments of the university, and guests, will meet in Massachusetts hall, at 10 A.M., and proceed thence to Sanders' theatre, under escort of the undergraduates, where an address will be made by James Russell Lowell, and a poem delivered by Oliver Wendell Holmes, and honorary degrees will be conferred by the university. In the afternoon the association of the alumni, composed of all graduates of the college, with their invited guests, will have a collation in Memorial hall. It is suggested that the members of Harvard clubs in the various cities of the United States who are unable to attend the celebration at Cambridge should commemorate the day.

— The American public health association will convene at Toronto, Canada, Tuesday, Oct. 5, and continue four days. The executive committee have selected the following topics for consideration at said meeting: the disposal of the refuse matters of cities and towns; the condition of stored water-supplies, and their relation to the public health; the best methods and the apparatus necessary for the teaching of hygiene in the public schools, as well as the means for securing uniformity in such instruction; recent sanitary experiences in connection with the exclusion and suppression of epidemic disease; the sanitary conditions and necessities of school-houses and school-life; the preventable causes of disease, injury, and death in American manufactories and workshops, and the best means and appliances for preventing and avoiding them; plans for dwelling-houses. At the last annual meeting of the association, a resolution creating a section of state boards of health was adopted. A meeting of the representatives of the state boards of health has been called by the secretary of the Conference of state boards of health, on Monday, Oct. 4, and it is expected that the said representatives will on that day organize the section.

— The hydrographic office has received the following note: Aug. 31, at 9.45 P.M., the steamer City of Palatka, Captain Voegel, when a mile and a half north of Martin's industry light ship (off the coast, south of Charleston), in eight and a half fathoms of water, experienced a terrible rumbling sensation, lasting a minute and a half. There was quite a heavy sea from the south-east after leaving Charleston bar at 5.30 P.M. When this rumbling sensation took place, the wave-motion ceased. It was a perfect calm during the rumbling: after that, the usual motion of the south-east swell took place. The wind at the time was south-west, light, weather cloudy, barometer 30° 01′, thermometer 80°. The sensation resembled a ship scraping a pebbly bottom, and the vibration of the ship was very great.

— A very interesting account of an epidemic of malaria in eastern Massachusetts is given by Dr. L. B. Adams in the *Boston medical and surgical journal.* This epidemic of intermittent fever occurred in the summer of 1885, and its chief force was felt at South Framingham. The infected district contains one-third of the area and one-fifth of the population of the village. Five-sevenths of the houses had cases in them. In some instances every occupant was attacked. A few scattered cases were seen in June and July. At the close of July there was a change of weather and a heavy fall of rain. This was immediately followed by the appearance of many cases. August was colder than it had been for fifteen years, and the rainfall great, more than seven inches. Between the end of July and the latter part of September, when the disease began to decline, more than two hundred cases were seen and reported by the physicians. It was thought by some that the disease was attributable to the drinking-water. The full history of this epidemic, and the views of Dr. Adams, will doubtless be given in the future, and we shall then refer to this subject again.

— Special attention should be paid by bathers to the exclusion of salt water from the mouth and ears. Many cases of inflammation of the ear, followed by severe and lasting trouble, even to deafness, are chargeable to the neglect of this precaution. Incoming waves should never be received in the face or the ears, and the sea-water which enters the ears when floating or diving should be wiped out by soft cotton : indeed, the best plan is to plug the openings of the ears with cotton, which is to be kept there during the bath.

— The new State board of health of Massachusetts is composed of seven gentlemen, two of whom are physicians, — one a regular, Dr. H. P. Walcott, who is president of the board ; and the other, Dr. E. U. Jones, a homoeopathist. Dr. S. W. Abbott, a well-known sanitarian, has been appointed secretary.

— Profs. von Frisch and Ullman of Vienna, after careful and exhaustive study, confirm the views of Pasteur as to the possibility of preventing the development of rabies by inoculations with the virus obtained from rabbits, and are now prepared to treat the victims of rabid dogs.

— Sea-bathing is now so generally practised, and death by drowning so common, that every person should familiarize himself with some method of resuscitation ; and if each community living upon the seashore or upon the banks of rivers or bays would organize a life-saving service, or obtain instruction in this important subject, many lives which are now sacrificed would undoubtedly be saved. One of the simplest methods of artificial respiration is that which Mr. J. A. Francis has described in the *British medical journal.* The body of the patient is laid on the back, with clothes loosened, and the mouth and nose wiped ; two bystanders pass their right hands under the body at the level of the waist, and grasp each other's hand, then raise the body until the tips of the fingers and the toes of the subject alone touch the ground ; count fifteen rapidly ; then lower the body flat to the ground, and press the elbows to the side hard ; count fifteen again ; then raise the body again for the same length of time ; and so on, alternately raising and lowering. The head, arms, and legs are to be allowed to dangle down freely when the body is raised.

— Two more persons inoculated by Pasteur for the prevention of rabies, after having been bitten by rabid dogs, have died. Of fifty-four persons bitten by mad wolves, fourteen have died.

— One of the leading men of Edgefield county, S.C., is reported to have died this week from rabies, after an illness of but twelve hours. The bite was received in May from a rabid dog, and produced no trouble until the day before his death.

— In a little pamphlet, under date of Aug. 22, the Hon. W. E. Gladstone has given his views on ' The Irish question ' as it now stands, with a history of the movement for self-government and an indication of the lessons taught by the recent election. This has been published on this side by Charles Scribner's Sons, New York.

— ' A catalogue of minerals,' by Albert H. Chester (New York, *Wiley,* 1886), is intended to embrace all English names now in use in the nomenclature of mineralogy. It includes species, varieties, and synonymes. Dead and useless names have been omitted, so that the catalogue can be conveniently used as a check-list and in cataloguing collections.

— The weather report for August, from observations taken at Lawrence, Kan., shows that the month was one of the three hottest Augusts on record. There were eleven days with temperature below the average for the season, but the remaining twenty days were excessively hot ; and the week from the 11th to the 17th surpassed any week since August, 1874. The July drought was broken on the 1st by a copious shower. There were seven other serviceable rains during the month, but no rain sufficiently heavy to wet the ground to a greater depth than two inches.

— Glanders is said to be quite prevalent among horses at the present time. The New York state board of health has discovered six cases at Middletown.

— The Paris *Conseil municipal* has ceded to the Society of the *Institut Pasteur* for ninety-nine years the ground upon which the institute is built. The following official statement has just been made: The whole number of persons treated by Pasteur is 1,656 (of these, 15 have died); 1,009 of these were French (3 of them died); 182, including 50 bitten by rabid wolves, were Russians (3 of these bitten by dogs, and 8 by wolves, have died); 20 were from Roumania, with one death; of the others, 59 were from England, 17 from Austria, 74 from Algeria, 18 from America, 2 from Brazil, 42 from Belgium, 58 from Spain, 7 from Greece, 8 from Holland, 25 from Hungary, 105 from Italy, 20 from Portugal, 2 from Turkey, and 2 from Switzerland (of all these, not one has as yet died: the total mortality, therefore, is less than one per cent, — a most striking commentary upon the views of those who declare Pasteur's methods a failure).

— At the last meeting of the American association, Eugene Michel Chevreul, on the motion of the section of chemistry, was elected an honorary fellow, the second only on the rolls of the association.

LETTERS TO THE EDITOR.

****Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Dynamite explosions.

IN its issue of the first inst., referring to the recent Chicago explosion, the New York *Herald* publishes, under the heading 'Teachings of the explosion,' an article containing 'some things' claimed to be 'instructive and important,' but which are so incorrect as to be neither. In this article it says, "But we know now, happily at the cost so far of but two human lives, some things that are instructive and important. One is, that a huge mass of dynamite, say ten tons, even when blended with five times its weight of gunpowder, expends its main force downward, thus verifying, on a vast scale, a fact known of the explosion of much smaller quantities of dynamite. Another fact is, that dynamite, even in huge volumes, is less likely to ignite neighboring masses of explosives in such a casualty than an unmixed mass of gunpowder would be. There were ten large magazines close to the Laflin & Rand, and all escaped ignition."

The above statement, that 'a huge mass of dynamite,' in exploding, 'expends its main force downward,' and the deduction that this verifies, "on a vast scale, a fact known of the explosions of much smaller quantities of dynamite," are so scientifically inaccurate as to need correction. The fact is, dynamite explodes with equal force in all directions, and that, at whatever point it meets with the greatest resistance, at that point it is most destructive, whether it is upward, downward, or laterally.

It is a common error, however, that dynamite always 'expends its main force downward,' which arises, probably, from the fact that, in the majority of reported dynamite explosions, it has met with the greatest resistance from the earth, and therefore has exhibited its 'main force' in that direction.

Mr. G. M. Roberts, manager of the Nobel's explosives company, London, writes as follows to the London *Times*: "Nitroglycerine and dynamite do not, when exploded, exert such a force as is popularly believed. To speak precisely, the power developed by the explosion of a ton of dynamite is equal to 45,675 tons raised one foot, or 45,675 foot tons. One ton of nitroglycerine similarly exploded will exert a power of 64,452 foot tons; and one ton of blasting gelatine, similarly exploded, 71,050 foot tons. These figures, although large, are not enormous, and need not excite terror. Seventy-one thousand tons of ordinary building-stone, if arranged in the form of a cube, would measure only 90 feet on the side, and, if it were possible to concentrate the whole force of a ton of blasting gelatine at the moment of explosion on such a mass, the only effect would be to lift it to the height of a foot. The foregoing figures are derived from experiments made at Ardeer with an instrument which gives accurate results in measuring the force of explosives."

Supposing these data to be reliable, and in view of the fact that the buildings which stood on the great excavation in Chicago have disappeared entirely, is it not reasonable to suppose that fully as much force was required to lift, splinter, and distribute, in every direction, the materials composing those buildings, overcoming the attraction of gravitation in the act, as was necessary to make the great excavation in the earth, by the expenditure of 'its main force downward'?

This fact of the elimination of the buildings seems to have escaped the notice of the writer of this article.

In verification of our statement that it explodes with equal force in all directions, the following extract from the above quoted authority, Mr. Roberts, is cited: "I have often, by way of experiment, exploded a pound of dynamite suspended from the end of a fishing-rod by a string about six feet long, holding the rod in my hand the while. As there was no solid matter to project, I received no injury, and the end of the fishing-rod was not even scratched. About three feet of the string at the end of the rod was always left uninjured."

Meeting, in the above experiment, with no resistance other than the air at any point, there was consequently no destructive power shown in any direction; but, had there been solid matter above or below or on either side, the 'main force' would have been expended upward or sideways, and not 'downward.'

This experiment illustrates another remarkable feature in dynamite, peculiar to itself, — that of its concentrated or local effects, compared with the more diffused effects of gunpowder explosions.

Quoting again from Mr. Roberts, he says, "The power exerted by an explosion on surrounding objects is in the inverse ratio of the cube of the distance from the point of explosion. Thus, at 100 feet from the exact point of an explosion, the power is only the cube of 1-100 or 1-1,000,000 part of what it is at a distance of only one foot from that point, or, in other words, if the power at one foot from the spot be represented by 1,000,000, at the distance of 100 feet it will be but 1. It is thus seen that the effects are intensely local, and but comparatively trifling at even short distance."

The wide-spread damage in the Chicago explosion was undoubtedly due, in a much larger degree, to the gunpowder than to the dynamite exploded.

Another fact and deduction relating to the escape of several magazines near the great explosion are quite as misleading, if not as erroneous, as the former ones.

If we are correctly informed, most, if not all, of the magazines nearest the exploded buildings, contained dynamite. Now, it is a fact well known to experts that this material is non-explosive by shock or by fire applied separately, but requires some fulminate combining both concussion and combustion, acting simultaneously, to explode it. Hence, being protected from the fire or combustion of the explosion by the walls of the magazines, and being unsusceptible to the force of the concussion, there is nothing remarkable in the salvation of the adjacent magazines. Even those, if any, which contained gunpowder (that explosive being protected from contact with fire, and remaining inactive) were uninjured for equally scientific reasons.

The article concludes, referring to its statements and deductions, by saying, "These are facts which could not have been exemplified save at much cost and risk, and our government officers and other men of science will, we may be sure, bear them carefully in mind hereafter."

Now, as we have shown that the above statements are not facts, but that the contrary is the real truth, and as the actual facts have been ascertained as well by many of our government officers as by a large number of experts all over the world, we would respectfully suggest to the *Herald*, when it intends to publish another scientific dynamite article, that it secure the services of, or at least submit its facts to, some such expert as General Abbott or Gen. John Newton, both of the U. S. army, whose experience with explosives of every kind has been exhaustive, and thus obtain information that the public can rely on.

A. W. G.

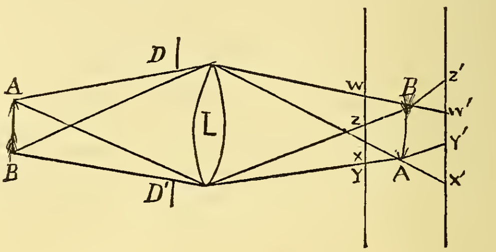
New York, Sept. 1.

On a means of determining the limits of distinct vision.

If an image ($A'B'$) of an object (A B) be thrown on a screen by means of a lens (L, for simplicity supposed free from spherical aberration), and the screen moved forward or backward, the image will be blurred. If part of the rays be stopped by a diaphragm (D D'), this blurring will be less as the aperture of D D' diminishes, for this lessens the spaces (WZ, etc.) over which the rays from any one point of the object are spread on the screen. Now, let the rays be cut off from one side alone; let a curtain (D) descend from above. The upper boundaries (W, X, etc.) of the spaces WZ, XY, etc., will descend, while the lower ones remain stationary. If the object be dark against a brilliant background, the light from above A will be cut off as B descends, and the blurred edge (XY) of the image becomes dark; so that, in the limit, instead of a blurred image (WY), there would be a distinct one (Z Y), or, as the image of D ascends, the image of A B appears to move to meet it, the part near D leading the way, since D intercepts the extreme ray from A before that from B.

If the object be light on a dark ground, the effect will be most apparent on the boundary farthest from D, since the blurred edge that changes to dark is more noticeable than that which changes to light. If the image be formed in front of the screen, making the blurred image Z' X', a little consideration will show that the apparent motion of the image will always be away from the image of D.

These results may be verified with any lens, but are most strikingly shown with the eye, using a sheet



of paper close to the eye as curtain, and any object,— as a pin, pencil, or ruler,— seen against a window or lamp as background. A slit in a piece of paper held against a lamp serves as light object on a dark ground. It is, of course, easy to hold the object so near that it will be blurred; but special effort may be required to blur a distant object, except with near-sighted persons. The applicability of this in making a test of the limits of distinct vision is now apparent. Let a ruler lean against the shade of a lamp; place the eye so near that the image is necessarily blurred, and, moving the edge of a sheet of paper back and forth before the eye, step slowly backward till apparent motion of the object ceases; continue the backward movement until the object begins to recede slightly from the screen: the space where there was no motion is that in which alone distinct vision is possible. Of course, every effort must be made to accommodate the focus of the eye to the object during the whole experiment.

It is a more difficult task than one thinks, to decide by simple judgment whether an object is seen distinctly or not, except it be much blurred. If the image is fairly distinct, most people will suppose it to be perfectly so. The test described above never fails to show whether or not the judgment is correct.

The effect noticed above also adds to the appearance seen when two networks of thread or wire not in the same plane are held before the eye. The watered appearance is of course due to curves which are the loci of the intersections of one set of wires with the other; but these intersections are made noticeable by the fact, that, when two wires not in the same plane and making an acute angle are held before the eye, the nearer acts the part of the curtain D in the above demonstration, and an irregular dark spot is seen about the point where the wires cross. The writer hopes to make a series of experiments as to the limits of distinct vision in different persons, using the test suggested above. Its simplicity, and the absence of any judgment on the part of the person experimented upon, other than as to the direction of motion of the object, commends it to the investigator.

ARTHUR E. BOSTWICK.

Montclair, N. J., Aug. 30.

Cause of a recent period of cool weather in New England.

From Aug. 15 to Aug. 23 the weather in New England was quite cool and pleasant. This cool period culminated on the night of the 22d, when the temperature at the Boston signal office sank as low as 49°. On the signal service weather-chart of the morning of Aug. 23, it is found that the temperature was higher all around New England (north, east, south, and west) than in New England itself. Over New England the sky was clear, and the air was blowing out from this region in every direction, on the east side toward a storm which is central on the ocean, and on the west side toward a storm which is central in the lake region. Whence, then, came this cool air? for it had previously been quite warm. It evidently could not have been imported from abroad: was it, then, due to a descent of cool air from above? This is hardly possible, since it was found, at 11 P.M. of the 22d, that the temperature on Mount Washington was 51°, while at the nearest lower stations — Portland and Boston — the temperature was 56°, and on top of Blue Hill 51°. At 7 A.M. of the 23d the conditions of temperature were almost the same, except that the temperature had risen slightly at every station but Boston. If the air had descended from the height of Mount Washington, it is well known that its compression would have heated it much higher than the temperature was found to be at lower stations, unless this heating had been counteracted by some other cause. On top of Blue Hill the lowest temperature recorded by a self-registering minimum thermometer on the night of Aug. 22 was only 50.5°; while, at a base station four hundred feet lower, the temperature fell to 44°; and in Boston, nearly six hundred feet lower and ten miles distant, the temperature fell to 49°. The thermometers were alike, and exposed in the same manner. The air evidently descended over New England from above, otherwise the wind could not have blown out in every direction; but the statistics above show that its coolness could not have been due to this cause, since it was cooler at the earth's surface than a little distance above it. The air, as was to be expected on account of its descent from above, was clear and dry, the absolute humidity being lower than at any time during the month except on the night of Aug. 15, when almost identical conditions prevailed. Here we no doubt find the cause of the coolness. Tyndall's experiments on the effect of aqueous vapor in intercepting radiation from bodies of low temperature like the earth led him to assert, that, if the blanket of aqueous vapor over England were removed for one summer's night, the whole island would by morning be held in the iron grip of frost, on account of the rapid radiation from the earth's surface which such conditions would permit. Even the more intense insolation by day at such time would be counteracted by the rapid radiation into space, as shown at elevated parts of the earth's surface. This serves to explain the cool period lasting several days in New England; and this cool period seems to substantiate the view recently advanced, that the cold in anticyclones (or areas of high pressure) is due to radiation from the earth's surface, which is favored by the clear, dry atmosphere accompanying these areas. Tyndall, Hann, and Woeikof have adduced evidence of this in Europe, and Mr. Dewey in this country (*see Amer. met. journ.*, May, 1886).

H. HELM CLAYTON.

Blue Hill meteor. observ., Aug. 30.

Dr. Orton's Ohio gas and oil report.

I have been carefully studying my friend Dr. Orton's admirable and most valuable report on the Findlay, Bowling Green, and Lima wells, an advanced summary of which you published in the issue of *Science* for June 25. Having been absent from my office, I am ignorant as to whether your subsequent issues contain notices or criticisms of Dr. Orton's facts and views, which I esteem not only historical, but marking an era in our knowledge of the subject. I run some risk, therefore, of offering considerations which others may have anticipated; but two or three of these considerations deserve attention in the present stage of our investigations.

I trust that all geologists will sympathize with me in heartily cheering Dr. Orton's skilful insertion of the long-waited for keystone in the arch of the demonstration of the origin of oil. I am ashamed of my own stupidity in not finding and fixing in its place this keystone myself. I have been seeking it for years, asking myself continually how the decomposing organic matter of the seashores and marshes could be retained by the sands and shales until sufficiently protected from complete oxidation. I have repeatedly put this question to other geologists, but never received an answer of any kind; apparently because so few of them accepted the *in situ* origin of rock-oil, and therefore seeing no value in the question, and no need for an answer to it. Dr. Orton is the first geologist to appreciate the value of Dr. Leidy's observation of the petroleum-mud-layer at the mouth of the Schuylkill River; and his generalization from it is one of the best and broadest ever made in our branch of science. It accounts satisfactorily for the preservation of rock-oils in every formation, of every geological age, all over the world; subject, however, locally or regionally, to subsequent change or destruction. The eruptive rocks (lavas proper) are the only formations not charged with organic matter. Even the tufas, swept by the wind into the sea, must hold the remains of animal air-life and plant pollen. The winds are forever transferring dead and living organisms from place to place, and every rain washes them to the surface of the land and sea to be locked up in clay formations. However different the regional conditions, the process is continual and the results identical everywhere. Compare the Levant with the Red Sea. Each is as large as our Appalachian belt from Canada to the Gulf of Mexico. The one, however, is a reservoir of Nile deposits, — an extension of the Delta under sea-level, — replete with the original stuff of rock-oil. The other is a reservoir of incalculable quantities of wind-deposits, mixed with equally incalculable quantities of tropical animal and vegetable organic stuff. If any one still doubts the *in situ* theory, let him try to invent any other for the vast expanse of petroleum ground on both sides of the Caspian, and of course including the bed of that sea. There, also, we see going on at present the slow process of the loss of rock-oil from a formation which was originally charged with it; and that without any great structural disturbance. In Galicia, in Lombardy, on the other hand, we see the process of loss nearly finished under conditions of structural disturbance so great as to make the dips vertical. If Oken had been a geologist, and were living now, he would probably assert in his next treatise — and with a certain magnificent truthfulness — that the whole crust of the globe consists only of oiled clay, whether siliceous, ferruginous, or calcareous, — here, in its original condition; there, oxidized and dried; in another place, crystallized and cleansed. Fortunately the Okens are not all dead; but their generalizations are restrained by a wise caution as to the genuineness of facts, and regulated by measurements. Dr. Orton's report proves this in a most satisfactory manner — if it needed proof.

The difference between the Pennsylvania and north-west Ohio oil and gas regions is fourfold: 1°, one is Devonian, the other Silurian; 2°, one is sandstone, the other limestone; 3°, one is decidedly waved, the other almost on a dead level; 4° (and this is what I wish specially to discuss), the one is non-cavernous, the other cavernous.

Thirty years ago I began to insist upon the geological (especially the topographical) importance of the underground chemical and mechanical erosion of the limestone formations of the world. I was led to this by my first field-work in the Silurian valleys of Pennsylvania and my early study of the blue-grass country of Kentucky. I saw that the eastern and western coal-fields had been separated by the falling-in of the roofs of myriads of mammoth caves in the Trenton limestones, preceded by the same process at the outcrops of the cavernous subcarboniferous limestones. I have always opposed the notion of the early age of the Cincinnati uplift. The nonconformity in middle Ohio, and that around Nashville, are important facts, but merely mark two out of many local and temporary variations in the general downward movement, which was otherwise uninterrupted from Silurian times to the end of the coal-measure age. It was not until then that the great upward and plicating movement took place, which started the erosion of the United States area. The principal *rôle* in the erosion from that time until now has been played by the limestone formations, under the solvent action of drainage-waters acting everywhere through them, down to and for some depth below sea-level. Everybody knows the result in the great Appalachian valleys. Everybody knows how the Ohio valley region is undermined. I venture little in asserting that the new oil and gas region of north-western Ohio is thus undermined. This makes it essentially characteristically different from the Pennsylvania, West Virginia, and eastern Ohio oil and gas region. If the numerous wells bored at Findlay and in the twenty-seven counties of north-western Ohio have none of them struck through the roof of a mammoth cave, that negative argument is of no force when one calculates the chances of a well being drilled directly over such a cave. These caverns are the great underground drainage-channels. They correspond to the large streams on the earth's surface. What would be the chances for and against a man in a balloon at night dropping a bag of ballast into a river? A river, however, is a mile, half a mile, a furlong wide; a cavern cannot be more than fifty or one hundred feet wide. On the other hand, the caves are probably somewhat more numerous than the large surface-streams, but not much. Certainly no one will venture to deny the undermined condition of Ohio, until as many thousand wells have been bored into the Trenton formation as have been bored into the Pennsylvania Devonians.

But the underground drainage is only collected into and passed through the mammoth caves to some exit. Its collection takes place through the infinite multitude of vertical fissures which cut up the whole limestone formation into blocks; and these fissures are all widened by chemical solution. The whole Trenton underground of Ohio must be like the Roman arsenal works at Baix, — a sort of crypt, in which water stands now at a level in the caves and fissures, because it can find no rapid issue at sea-level. In central Kentucky the cave-waters flow, because they can issue in the bed of the Ohio River; but in north-western Ohio the top of the Trenton Dr. Orton shows to lie from three hundred to nine hundred feet below sea-level (i.e., in round numbers, from eight hundred and fifty feet to fourteen hundred and fifty feet below the surface of Lake Erie), and therefore no flow is possible. The water must be standing water: the oil will therefore rise to its surface, and the gas press upon the surface of the oil, and over the whole extent of communicating fissures and caves equally.

But how could caves be formed at such a depth beneath sea-level? Standing water may corrode, but cannot erode. No one dreams that our Silurian caves in Pennsylvania follow the limestone strata many thousands of feet beneath sea level under the great synclinals. No; but there are some wonderful facts for all that. There is a stream in Brush valley which sinks and flows under Nittany Mountain to rise in Nittany valley, where it drives a large mill. Sawdust and other things — a miller's hat among them — have made the underground voyage. The top of the limestone lies beneath the mountain two thousand feet lower than its outcrop and one thousand feet beneath ocean-level. It is an inverted siphon, with one mouth several hundred feet higher than the other; the confining top wall of the siphon being impervious Utica clay slate. At the Roman baths near Zurich (Baden in Aargau) river-water descends from a vertical outcrop to a depth of three thousand feet, and ascends, mineralized and heated, to the bath houses. The hot springs of Virginia are similar deep inverted limestone siphons.

In fact, there is no such thing as standing water anywhere. All water flows. Mere evaporation at one end of a canal will cause a current to set from the other end. Hydraulic pressure from the surface of middle Ohio will suffice to produce a universal lateral and upward water movement in northern Ohio, the Trenton sinking in that direction. If the currents thus induced be infinitely slow and gentle, nevertheless there has been an infinite amount of geological time (since the coal age) for them to effect their underground erosion in.

To all this must be added the great depth of the real rock-basin of Lake Erie. It is now only two hundred or three hundred feet deep; but who knows the thickness of its lining deposits? It has been receiving the inflow of Michigan, Indiana, Ohio, Pennsylvania, and the Canada peninsula for an unknown length of time, and, in addition to previous deposits, the glacial drift and modern river-muds. My belief is that its mother rock-bottom is excavated to a depth greater than the deepest wells of the new oil and gas region; and, if so, then the origin of the system of mammoth caves and fissures which hold the salt water, oil, and gas of north-western Ohio is relieved of difficulties. The water which is now nearly stagnant, flowed then freely to its natural outlets; the underground erosion which is now infinitesimally feeble, proceeded then energetically, at a rapid rate and on a grand scale.

What I wish to draw attention to is this: granting a cavernous condition of the Trenton in Ohio, then Dr. Orton's terrace structure of the top of the Trenton becomes of value as indicating slopes in the general plane of the cavernous part of the formation. By this I mean to indicate the probability that the whole formation is not cavernous to an equal extent throughout (from top to bottom), but that certain members of the mass are more soluble than the rest. In Pennsylvania the Trenton itself is not cavernous on a grand scale: our sinking springs are along the outcrop of the passage-beds at the bottom of the Trenton and Bird's-eye and top of the calciferous. The whole formation in front of the Alleghany Mountains is between six and seven thousand feet thick. The uppermost thousand feet is very compact and non-mangesian; the underlying mass is composed of alternate layers of limestone and dolomite, with some low-lying calcareous sandstone groups. Dr. Orton reports the formation in Ohio 'magnesian, of a fair character throughout most of its extent,' but 'somewhat siliceous in some of the drillings.' It will be an important item of investigation, how far the cavernous horizon in Ohio corresponds to that in Pennsylvania, where the formation is ten times as thick as in Ohio. Dr. Orton inadvertently remarks (p. 18) that 'there is no warrant for assuming its universality as a limestone' under the country between middle Ohio and middle Pennsylvania. But I am sure that he will revise the remark when he reflects that a formation which is 'universally limestone' from Tennessee to the Manitoulin Islands in a north and south direction, and is universally limestone along the whole Appalachian belt from Alabama to New York, cannot possibly be any thing else than limestone under the intermediate region of the bituminous coal-measures. If there is any reasoning from the exposed to the concealed in geology, all geologists must feel sure — quite sure — that the lower Silurian formation No. II. must underlie Wheeling and Pittsburgh as a limestone formation, non-magnesian at top, magnesian at middle and bottom, at least two thousand if not three thousand feet thick, and at a depth of, say, ten thousand feet beneath the present surface.

But I have been led on to a much greater length than I expected, by the importance of the subject, to the new gas and oil industry of Ohio. I cannot trespass longer on your space with the obvious applications of what I have adduced above to the vexed questions of local capriciousness, etc., in the new oil and gas field.

J. P. Lesley.

Philadelphia, Sept. 1.

The law of volumes in chemistry.

The questions regarding the so-called molecular weights and volumes of liquids and solids, which are now attracting the attention of chemists, can, I think, be better understood if we keep in mind the principles enunciated by the writer in 1853, that "the doctrine of chemical equivalents is that of the equivalency of volumes," and that "the simple relations of volumes which Gay-Lussac pointed out in the chemical changes of gases apply to all liquid and solid species;" so that "the application of the atomic hypothesis to explain the law of definite proportions becomes wholly unnecessary." In further illustration of this view, it was said in 1867 that "the gas or vapor of a volatile body constitutes a species distinct from the same body in a liquid or solid state; and the liquid and solid species themselves often [probably always] constitute two distinct species of different equivalent weights." From this it follows that freezing, melting, and vaporization are chemical changes. The union of many volumes of a vapor or gas in a single volume of a liquid or a solid is a process of chemical combination, while vaporization is chemical decomposition. Such decomposition is either with or without specific difference, and examples of these two modes are seen respectively in heterogeneous dissociation and in integral volatilization, which latter is the breaking-up or dissociation of a polymeric species into simpler forms having the same centesimal composition. Both of these processes are subordinated to the same laws of pressure and temperature, and involve similar thermic changes in the relations of the bodies concerned. In this enlarged conception of the chemical process we find a solution of the problems above named, and an explanation of the distinction which has been made between 'the chemical molecule' and 'the molecule of the physicist.' That the latter has a much less simple constitution than the former, as calculated from the results of chemical analysis and from vapor-density, has been long maintained alike on dynamical and chemical grounds. It is discussed by the writer in 1853 in the essay already quoted, entitled 'The theory of chemical changes and equivalent volumes,'[1] and again in the late paper of Spencer Pickering in the *Chemical news* for November, 1885.

If, then, as maintained by the writer, the law of volumes is universal, and if the production of liquids and solids by the condensation of vapors is a process of chemical union giving rise to polymerids, the equivalent weights of which are as much more elevated as their densities are greater than those of the vapors which combine to form them, the hypothesis of atoms and molecules, as applied to explain the law of definite proportions and the chemical process, is not only unnecessary, but misleading. According to this hypothesis, which supposes molecules to be built up of atoms, and masses of molecules, the different ratios in unlike species between the combining weight of the chemical unit or molecule (as deduced from analysis and from vapor-density; $H = 1.0$) and the specific gravity of the mass are supposed to represent the relative dimensions of the molecule. Hence the values got by dividing these combining weights by the specific gravity have been called 'molecular volumes.' The number of such molecules required to build up a physical molecule of constant volume would, according to this hypothesis, be inversely as their size. If, however, as all the phenomena of chemistry show, the formation of higher and more complex species is by condensation, or, in other words, by identification of volume, and not by juxtaposition, it follows that the so-called molecular volumes are really the numbers representing the relative amount of contraction of the respective substances in passing from the gaseous to the liquid or solid state, and are the reciprocals of the coefficient of condensation of the assumed chemical units. If steam at 100° C. and 760 millimetres pressure, with a formula as deduced from its density of H_2O, and a combining weight of 18, is converted into water at the same temperature, 1,628 volumes of it are condensed into a single volume, having a specific gravity of 0.9588, which at 4° C. becomes 1.0000. Water is

[1] See the author's 'Chemical and geological essays,' pp. 426–437, and, further, *ibid.*, pp. 453–458.

thus 1,628 (H_2O); and the weight of its volume at the temperature of formation, as compared with an equal volume of hydrogen gas or of steam, in other words, its equivalent weight, is $1,628 \times 18 = 30,304$, which thus corresponds to a specific gravity of 1.0000 : ice, at its temperature of formation, with a specific gravity of 0.9167, being 1,487 (H_2O) with an equivalent weight of 26,766. The hydrocarbon, $C_4H_{10} = 58$, condenses to a liquid having, according to Pelouze and Cahours, a specific gravity of 0.600, which corresponds to an equivalent weight, as compared with that of water, of 17,582, or approximately 303 (C_4H_{10}), with a calculated specific gravity of 0.5997. The reciprocal of the coefficient of condensation (or so-called molecular volume) of steam is 18, while that of the gaseous hydrocarbon is $600 : 1000 :: 58 : x = 96.66$.

The chemical unit for bodies, which, like these, volatilize integrally, is fixed by the density of their vapors; while for fixed species, like anhydrous oxides and silicates, or for those which by heat undergo heterogeneous dissociation, as for example calcite and hydrous silicates, the unit may be the simplest formula deduced from analysis, or, for greater convenience in calculation in the case of oxides and silicates, may have a value corresponding to $H = 1$, or $O = 8$. The unit for silica thus becomes $Si O_2 \div 4 = 15$; that for alumina, $Al_2O_3 \div 6 = 17$; and that for the magnesian silicate, $Si Mg_2O_4 \div 8 = 17.5$. Such unit-weights as these have been employed by the writer in his late essay on 'A natural system in mineralogy,' in the tables of which they are represented by P; while the values got by dividing these numbers by the specific gravity of the species have been designated unit-volumes, and represented by V. The writer of that essay, in deference to the general usage of chemists, therein adopted the received terminology of 'molecular weights' and 'molecular volumes,' and, failing at the time to grasp the full significance of his own earlier teachings as to the universality of the law of volumes, spoke of the so-called molecular weight as an unknown quantity, although in accordance with that principle this molecular weight, or, properly speaking, this equivalent weight, is simply deduced for any body the specific gravity of which is known.

T. STERRY HUNT.

Centre Harbor, N.H., Sept. 3.

The old gorge at Niagara.

The existence of a drift filled channel running from the west side of the whirlpool on the Niagara River, to the wide, open valley of St. David's on the north face of the Silurian escarpment, has been known to geologists ever since the publication of Sir C. Lyell's 'Principles of geology.' It was considered by him as an ancient channel of the river, and it has been so regarded by many geologists ever since. Arguments numerous and of no slight weight can be quoted in favor of this opinion. But of late years it has been somewhat modified, and a disposition has been manifested to regard this drift-filled valley of St. David's as consisting of two smaller valleys, one of which was excavated by a stream flowing into the place of the present whirlpool, and the other into the valley of St. David's. On the latter theory there may be a solid barrier of rock not far underground between the two valleys. In the latter no such bar can exist.

Into the discussion of this subject I will not now enter. It would require more time and space than can be afforded. I desire merely to mention a single fact. In the course of the arguments on this point it has been apparently taken for granted, if not asserted, that no rock can be seen in place along this gorge, but that it is filled deeply with drift almost from end to end. During the recent meeting of the American association I took an opportunity of going up the valley from the whirlpool, and was much surprised to find a ledge of limestone exposed at its bottom about a hundred feet above the river. On both sides it disappeared beneath the talus, but probability indicates its continuance from side to side, especially as a considerable surface is exposed. This point can only be decided by quarrying.

The importance of a bed of limestone so situated, on the discussion of this question, is obvious. It does not seriously affect the latter of the two hypotheses mentioned above, which is, however, beset by other grave difficulties. But in regard to the former it proves, that, if the Niagara River ever passed that way, its bed was far above the present level. No concealed side-channel can be admitted in this case. The space is too small. A line of drill-holes carried along the course of the valley can alone supply the evidence needed for a decision between the two rival theories.

It is scarcely necessary to point out the bearing of this fact on those calculations of the age of the great gorge which assumes that any part of it above the lower rapids was merely cleaned out and not excavated from solid rock since the end of the ice age.

E. W. CLAYPOLE.

Science for a livelihood.

Some time ago I read in your journal a stirring editorial, calling for young men to devote their energies and life to the cause of science, and deploring the lack of persons who were willing to encounter hard work and poor pay because of love for investigation and study.

Early this summer, after graduating from a first-class scientific school, I made application to four agricultural stations in this and other states for some position, pay no consideration whatever. Having been brought up on a farm, and having a first-rate scientific education, a love of the natural sciences (in which I have done a little practical work), and an excellent physique, I thought myself fitted for investigation in scientific fields, particularly as I love it above all else.

In every case I received answer, 'Places all full.' I have begun to doubt if investigators and workers are needed in the natural or experimental sciences, and think that a poor young man who cannot afford to give money to the work has no call in this field. Am I right? C. B.

Brooklyn, N.Y., Sept. 4.

Revivification.

In answer to your Paris correspondent, I would say that quite recently, a native of India, after his conversion to Christianity, gave an exhibition and full explanation of the trance, as I am informed by a missionary just returned from that country. Full particulars can be obtained by addressing Rev. S. Knowles, Gonda, Province of Oude, India.

E. T. NELSON.

Ohio Wesleyan university, Sept. 6.

SCIENCE.—SUPPLEMENT.

FRIDAY, SEPTEMBER 10, 1886.

AN EASY METHOD OF MEASURING THE TIME OF MENTAL PROCESSES.

It is justly considered one of the triumphs of physiological psychology to have made the elementary processes involved in perceiving and thinking more real and better known, by comparing the times necessary for their performance. It has made the connection between mental action and the function of the brain closer, by showing that all processes take time, and that this time is varied by abnormal conditions of the brain. These psychometrical observations, though of but recent date, form one of the favorite fields of present psychological research.

The usual method of measuring one's reaction time is somewhat as follows: The subject is seated with his hand in contact with an electric key: his attention is to be directed, we will say, to a flash of light electrically produced before him. The operator controls the appearance of the spark by simply breaking an electric connection: at the same instant he sets in motion (by the same current) a Hipp chronoscope,[1] which in turn is stopped immediately on the closure of the key by the subject. The interval during which the clock was recording will then be the time necessary for the subject to perceive the light. But in this time several elements are involved. These can be separately investigated by other means. We have, 1°, a series of afferent processes, such as the time necessary for the sense-organ (in this case the retina[2]) to be affected, the time necessary for the impulse to travel along the sensory nerves to the brain; 2°, the reception of the sensation in the brain (plus, perhaps, the generation of the will); and, 3°, a series of afferent phenomena, including the transmission of the impulse from the brain to the spinal cord, down the cord to the anterior nerve-roots, thence along the afferent nerves to the muscles, the latent time of the muscles, and, finally, the contraction of the muscles closing the key. The phenomenon in which the psychologist is interested is included under 2°. But to determine that, he must eliminate 1° and 3°. And here we see how essentially physiological a real psychology is: it has need of facts which none but a physiologist would undertake to discover. We want to know the rate at which the nervous impulse travels. This Helmholtz measured in 1850, only a few years after Johannes Müller despaired of our ever ascertaining it, and found to be about 33 metres (108 feet) per second for both motor and sensory nerves. The travelling along the cord is much slower, — about 10 metres (33 feet) per second. The very minute times involved in the delay in the sense-organ, ganglion of the spinal nerves, and muscle, have also been accurately determined. The whole operation, i.e., the complete reaction time, takes about $\frac{1}{7}$ of a second, of which the process included under 2° consumes a share subject to great variation according to the conditions of the experiment, but always small.

Let the operation be somewhat more complex. Say that the light shall not always be of the same kind, but that at times it shall be red, and at times blue. The subject is not to react until he has perceived the blueness or redness of the light. If we subtract the simple reaction time from the total time intervening between the appearance of the colored light and the closing of the key after the subject has seen whether it is a red or a blue light, we shall have the time required to distinguish red from blue. This we will call the 'distinction' time. We can evidently make the distinction more difficult by having three, four, or more colors. The average distinction time between two sensations, though largely variable, is about from $\frac{1}{17}$ to $\frac{1}{25}$ of a second, or less.

In the above experiment it has been assumed that the nature of the reaction has remained unaltered; that is, in each case the subject closed the one key before him. This, too, is capable of complication. We can agree that the subject is to react by a key on his right hand if a red light appears, and by one on his left if a blue light appears. If we subtract the time necessary for all the processes up to the color distinction from the time required to close the appropriate key, we shall obtain the time necessary for making a choice between two reactions. While before we were testing the readiness of the subject's sensibility and of his judgment, we are now testing the alertness of his will. That time necessary for this new process we will call the 'choice' time. According to

[1] This is an instrument which, by a clock-work arrangement, records to the thousandth of a second. It is set in motion electrically by the release of a magnet, and stopped by the closure of the same. A tuning-fork recording on a revolving drum, or similar arrangement, is often used in its place.

[2] If the stimulus excited the touch, we should also have the time for transmission along the nerve to the spinal cord, and the slow travelling up the cord.

Wundt, it is a little longer than the distinction time, and, like it, is very much affected by different conditions of mind, and varies largely in different individuals. It, too, can be complicated by making the choice between three, four, or several modes of reaction.

Only one more type of reaction time will be here mentioned. It is called an 'association time,' and is measured as follows : A word is called, and simultaneous with the call the clock-work is set in motion. As soon as possible after the word is heard, the subject answers by uttering the first word associated with the call-word that suggests itself to him. By subtracting from this time the time necessary for the hearing of the first word and the utterance of the second, we have the time involved in the process of association, or the 'association time.' This is a very much more complicated process, and naturally occupies a longer time, — about $\frac{3}{4}$ of a second. It differs largely in different states of mind and in individuals. It can be complicated by restricting the kind of words allowable as associations. For example, only words related to the call-word as part to whole may be allowed. We thus test what may be termed the 'suggestiveness,' or co-ordination, of one's mental furniture.

All these reaction times have been measured in laboratories under somewhat artificial conditions, and with the aid of more or less elaborate apparatus. It has long been desirable to avoid this artificiality, and thus make the inferences from such experiments to similar processes in our daily thought more certain and immediate, and to simplify the apparatus so that the demonstration of these mental times may be easy and inexpensive. It is to describe an attempt at solving these difficulties with reference to a few types of reaction times, that I devote this article.

My method is a very simple one. We require delicate apparatus, because we have to measure very small fractions of a second ; and this, in turn, is necessary, because we measure but a single reaction time at once. By measuring a long series of successive reactions we can dispense with delicate time apparatus ; for the error involved by such neglect will be divided among the whole series, and will thus not appreciably affect the value of the average reaction time. For our purposes a small clock or a watch beating quarter-seconds, as a rule, is sufficiently accurate. One can readily count four to the second, and the process can be made still easier by tallying off the 'tens' by pencil-marks or on one's fingers. It is advisable, in counting, to emphasize alternate numbers ; thus, one, *two*, three, *four*, five, *six*, etc. We shall find incidentally that the conditions suitable for such experimentation are unconstrained and natural. The method is applicable to all the kinds of reaction times above described.

1. *Simple reaction times.* — Here I have but a single experiment to offer. On one occasion I imposed sufficiently on the good nature of an evening company of about eighteen persons to ask them to arrange themselves in a circle, each one standing with the forefinger of one hand resting upon the shoulder of the person before him. At a given signal, one of the party gently pressed with his finger upon his neighbor's shoulder, who in turn communicated the impression as soon as he felt it to the shoulder of the one before him ; and so on around the circle. The impression made four or five complete revolutions, and the time was taken to the nearest quarter of a second. By dividing the time by the product of the number of revolutions of the impression into the number of persons, one obtains the average simple reaction time for a touch impression. A little drill would be necessary before the time would be constant, inasmuch as a miscellaneous set of persons do not readily act together without rehearsals. My time was about $\frac{1}{5}$ of a second, but it would evidently have been shorter could I have repeated the experiment. It is recommended as a useful evening amusement. There is one point more : if the reaction time of any particular individual is desired, one has only to subtract from the average time of one revolution of a circle in which he forms a member, the time of a revolution of the impression in which he is absent.

2. *Distinction time.* — The apparatus consists of a clock ticking quarter-seconds (a stop-watch is much more convenient), and several packs of ordinary playing-cards. To begin with a very simple case : Take a single pack of cards ; throw out all the face cards, and you have forty cards left, of which twenty are red, and twenty black. Shuffle these well together. Let the assistant be ready with the clock close to his ear to give you a signal when to begin, and to count the ticks. The 'one' by which he begins his counting is a good signal.[1] The moment you hear the word 'one,' you throw the first of the forty cards upon the table, and continue to do so with the rest, distributing them into two heaps. As you throw the last card, you call 'Done!' whereupon the assistant closes his counting. The cards must be divided without any plan between the two heaps — about as a chance arrangement would divide them. The time consumed in this operation divided by the number of cards will be spoken of as the 'throwing time.'

What naturally suggests itself as the next opera-

[1] It is advisable to prepare the subject for the signal by previously calling, 'Ready!'

tion is to repeat the process by which the throwing time was obtained, with the difference that the card is not to be deposited before the thrower has appreciated the color, whether red or black, of each card to be thrown. The time necessary for this process, minus the throwing time, would be the time which it took the person to distinguish red from black. But this method is really not valid at all, and for the following reason. While throwing one card, one can in the indirect field of attention, so to say, be preparing to decide or already deciding what the color of the following card is; so that the two operations of throwing and distinguishing partly overlap. A distinction time gotten by such a proceeding would be entirely too short. Several ways of avoiding this difficulty were suggested, of which I used the following one. The cards were held with the backs towards the thrower. The operation consisted, first in simply turning the card with its face upward, and depositing it on a heap; and, second, in not depositing it before its color has been seen. In this way the person cannot see the following card, because it has its back towards him; and all the cards may be placed on a single heap. The average difference between the time required for the first operation and that for the second, divided by the number of cards, will give the distinction time for distinguishing red from black.[1]

I have described the simplest type of a distinction time. The process can be indefinitely complicated by having three, four, or more colors to distinguish, using the backs of variously colored cards, or by distinguishing the four suits of one pack. By having several packs of cards, one can vary the experiments in very many ways. One can distinguish as many of the spot-cards as one pleases, from two to ten; can, in addition to this distinction, distinguish between the suits; and so on. Before giving the results I have obtained in this way, I will anticipate the question whether the number of cards used will not affect the result. It probably will; for the mind, being once set on the habit of making these distinctions, can keep up the process with less energy, and thus with greater rapidity. This question I hope to solve by a special set of experiments. From what I have done I am able to say that the variation will be extremely slight. It is recommended to use forty or sixty cards, as it is easy to hold that number in one's hand, and these numbers are divisible by 2, 3, 4, 5, and the latter by 6. Moreover, $\frac{1}{40}$ or $\frac{1}{60}$ of the error involved in neglecting fractions of a second less than a quarter is a small error indeed.

The persons whose reaction times were taken were, I., a girl of ten years; II., a young lady and, III., myself. In all the experiments in which II. and III. took part sixty cards, and in all in which I. was the subject forty cards, were used. In the following table the time is always given in seconds.

Subject.	5's f'm 9's 2's " 4's etc	2's, 4's, 6's.	2's, 4's, 6's, 8's.	2's, 4's, 6's, 8's, 10's.	1's, 2's, 4's, 6's, 8's, 10's.	Green from blue.
I.	.058	.097	.159	.250	—	.036
II.	.045	.073	.078	.089	.110	.037
III.	.043	.054	.061	.068	.074	.021

The column headed 5's from 9's, 2's from 4's, etc., indicates that the pack of cards was divided equally between two-spots and four-spots, or five-spots and nine-spots, or some similar combination of two kinds of cards; and that the subject had to distinguish by the method above described the denomination of each card. It thus appears that it took I. .058 of a second to make this distinction, and II. and III. .045 and .043 of a second respectively. In other words, it takes $\frac{1}{23}$ of a second to tell whether a card is a five-spot or a nine-spot, or to make any similar distinction. The only experiment performed by the usual laboratory methods, which I could find, comparable with this, was one by Professor Wundt, undertaken in his psychological laboratory at Leipzig, in which the distinction was made between a black cross on a white background, and a white cross on a black background. He gives .0485 of a second as the distinction time, which agrees well with .044, the average of the times of the two adults in the above table. The distinction between the green and blue backs of cards, as is shown by the last column of the table, is more rapidly made. Perhaps part of the difference is due to the fact that the card did not need to to be turned so completely around to see the color as to see the denomination.

In the other columns of the table is shown the result of a series of experiments in which the cards were divided among three, four, five, or six kinds, as indicated in the heading. It is seen, that though the thing to be done remains the same,

[1] In another method the forty cards are spread out upon a table, say, in five rows of eight each. The subject first runs his eye along each row, going forward on one row and backward on the next, dwelling on each card only long enough to bring it into distinct vision. The operation is very rapid (being faster than counting), but is rather uncertain. Next, he 'reads' the color of each card in the same manner. The difference between the times necessary for these operations evidently, again, gives the distinction time. Here, too, reading ahead in indirect vision is possible, but not to any great extent. The method is of value only as a means of checking the results of the first method, but is inferior to it. Doubtless some of my readers will invent a method better than this or the one described in the text.

namely, to read the denomination of each card, yet it takes longer to do so the greater the number of denominations to which it may belong.[1] One must take a longer look at a card to tell that it is a four-spot, for instance, where it may be a one, two, four, six, eight, or ten, than when it may be a two, four, or six. This difference was most marked with me in passing from two to three kinds. The increasing number of possibilities is more puzzling to the little girl than to the others; for it takes her as much as $\frac{1}{4}$ of a second to tell the cards when five denominations are used, whereas it takes the others only about $\frac{1}{13}$ of a second.

A few words of caution must be added for those who intend to repeat the experiments. Do not expect very constant results at first; the familiarity which one acquires after the second or third trial very much reduces the time; after this there is a more gradual reduction, due to practice. The numbers in the table are regular only because founded on many sets of experiments, and the first few records of each kind of reaction are omitted in a few cases.

3. *Choice time.* — This time is obtained by an indirect process. We have already become acquainted with the 'throwing time.' This time has no particular psychological interest, as it simply tells how long it takes one to throw out cards. This time will differ very largely in different persons, and is much reduced by practice. It took I. $\frac{2}{5}$ of a second, II. $\frac{3}{10}$ of a second, and III. $\frac{11}{40}$ of a second, to throw a card upon one of two heaps. It takes longer to distribute the cards, the more numerous the heaps among which they are to be divided; but the increase in time is slight. It took I. less than $\frac{1}{2}$ of a second to place a card in one of five heaps, and II. and III. $\frac{3}{8}$ and $\frac{1}{3}$ of a second respectively when six heaps were used. Of course, the time refers to the simple operation of placing the cards, without reference to their denomination, in one of a certain number of heaps. Each of these counts has a different mode of reaction.

Having gotten the throwing time, the next step is to distribute the cards among the heaps in such a way that each heap will contain but one kind of cards. If we are throwing five-spots and nine-spots, then all the five-spots must be put on one heap, and all the nine-spots on the other. If we are using two, four, six, and eight spots, then there will be four heaps, each containing all the cards of one denomination. In addition to the time consumed by the manual operation of taking the card and placing it on the pack, part of the time is consumed in recognizing the denomination of the card, and the rest in placing it on its appropriate pack. In other words, if from the time occupied by this operation we subtract the throwing time, we have left the distinction time together with the choice time. But we know the value of the distinction time by our previous experiments. Simple subtraction yields the choice time. I will again put the results in the form of a table.

Subject.	5's f'm 9's 2's " 4's etc.	2's, 4's, 6's.	2's, 4's, 6's, 8's.	2's, 4's, 6's, 8's, 10's.	1's, 2's, 4's, 6's, 8's, 10's.	Green from blue.
I.	.062	.100	.193	.353	—	.058
II.	.045	.117	.144	.162	.169	.050
III.	.029	.089	.095	.098	.100	.032

If we compare this table with the former one, we see at once that, as before, the time increases with the complexity of the operation; but the increase is more rapid in this table than in the former one. This is just what we should expect; for in the former case it was the same process to be done under different conditions, while here the nature of the reaction is changed with each additional kind of card. When we deal with but two kinds of cards, the choice time and the distinction time are about equal. This agrees well with Professor Wundt's results.[1] The process readily becomes at least partly automatic. But as we pass to a choice between three kinds of reactions, it would seem that a distinct exertion of the will is necessary in each case. The time undergoes a marked increase. From that point on, the increase in time with the complexity of the operation is more gradual. But, as before, the little girl finds great difficulty in distributing the cards appropriately when many kinds are used. It takes her over $\frac{1}{3}$ of a second to determine upon which of five heaps to put a card after she knows its denomination, while it only takes the others $\frac{1}{6}$ and $\frac{1}{10}$ of a second to perform the same operation with six heaps.

A comparison of the first and last columns of the table shows the regularity of the phenomena we are studying. The choice time ought not, of course, to be affected by the nature of the distinction upon which it is founded; and the choice time for five-spots and nine-spots and that for green and blue ought to be and are (approximately)

[1] The only comparable experiment (and the similarity is not very close) I can find is one recently published by Dr. Cattell, in which he finds that it takes only about 1-160 of a second longer to distinguish one out of ten than one out of two colors.

[1] It is again difficult to find comparable results. But the distinction plus choice time can be compared with similar results of Dr. Cattell. His figure is .078; mine is 0.81.

alike. We thus have a means of varying one without the other. The independence of the two processes (distinction and choice) is further shown by the fact that II. is the quickest distinguisher, while III. is the most ready chooser. III. is slowest in both operations, but differs less in the readiness of her sensibility and judgment than in the alertness of her will. Perhaps an educational truth with regard to the development of the mental powers is hinted at here.

4. *Association time.* — Here our apparatus reduces itself to a clock and some slips of paper; but the number of persons involved in the experiments must be increased from two to three. Let each of the three write on the slips of paper ten or twenty words, say, of one syllable each, and the names of concrete things. Avoid any natural connection between the words by not writing them in the order in which they were thought of. Now let I. and II. be the subjects of the experiment, while III. records the time. 1°. Let I. begin by calling, as soon as he hears the signal, the first word on his list: hereupon II. answers by the first word which he can associate with the call-word, and immediately upon this calls his first word to I., who in turn performs the association and calls his second word; and so on to the end. If there are ten words on the list of each, then each person has called ten words, has answered ten words, and has performed ten associations. 2°. Now let I. and II. each have twenty words before him, and let each call a word as soon as he hears the answer of the other.[1] This operation will differ from the former only by the fact that the association has been omitted. The difference in time between 2° and 1° divided by 10, will give the sum of the association times of I. and II.

Now let I. and III. be the subjects, and II. take the time, and the sum of the association times of I. and III. will be obtained. Then get the sum of the times for II. and III., and the solution of a very simple algebraic equation will give the value of the association time of each.

I have also used another, perhaps somewhat simpler method. It differs only in that in each operation one person acts as caller, and the other as associater, throughout. In this way the values of six equations are gotten: i. e., I. (caller) + II. (associater) = ?; II. (caller) + I. (associater) = ?; and so with each pair. We then eliminate the value of 'I. (caller),' 'II. (caller),' etc., by getting the value of the three equations, — 'I (caller) + II. (caller),' 'I. (caller) + III. (caller),' etc., just as before. The results of the two methods agree very well, and one may be used as a check upon the results of the other. The effect of practice in reducing the time is at first very considerable.

[1] The words should be pronounced distinctly, and no more rapidly than in the first operation.

It remains to be noted, that after I have ascertained my own association time and my own calling time, and know it to be fairly constant, the work of finding the reaction time of a fourth person is much reduced. We have simply to get the sum of our association times and of our calling times, and subtract from these my own association and my own calling time.

I will give the results of the first method, because here alone is the effect of practice (in two of the subjects) eliminated. The subjects are the II. and III. of our former experiments, and the times are .803 and .872 of a second respectively, which agrees very well with .764 of a second, which is the time found by Professor Wundt by the more elaborate methods. The great difference between this time and that necessary for a distinction or a choice, shows how much more elaborate the former process is.

The methods above described leave much to be desired; but the principle upon which they depend (namely, of substituting a series of reactions for a single one, and of arranging the apparatus so that the subject himself produces the sensations upon which the distinction and choice is made) seems to be the one by which the desired simplification can be best accomplished. If the above account shall be the means of setting others to work at the same problem, and of popularizing to any extent the study of experimental psychology, its object will be more than fulfilled. Joseph Jastrow.

THE HYGIENE OF THE VOCAL ORGANS.

The experience which Dr. Mackenzie has had for the past twenty-five years, as a specialist in the treatment of diseases of the throat, renders him thoroughly competent to advise on the important subject of which he treats in the volume before us. Additional interest attaches to his utterances for the reason that during this active career, the most famous singers have come under his professional care and observation, including Nilsson, Albani, Vallina, Patti, and a host of others.

Dr. Mackenzie well says that hygiene has a positive as well as a negative side. The preservation of health means not only that actual mischief is avoided, but that the body is kept in the best working order. The hygiene of the voice, therefore, must include a consideration of the best methods of developing its powers to the highest

The hygiene of the vocal organs; a practical handbook for singers and speakers. By Morell Mackenzie, M.D. London, *Macmillan*, 1886. 12°.

pitch as well as protecting it from injury or decay.

After describing the anatomy of the vocal organs, the author passes to a consideration of the uses of the laryngoscope. Although this instrument is of inestimable value in the recognition and treatment of disease, it has, nevertheless, added very little to the knowledge of the physiology of the larynx. This is accounted for by the greater amount of skill required for the examination of the larynx in the act of singing than for ordinary medical purposes, and also by the fact that but few throats are sufficiently tolerant to permit of such a prolonged examination as is necessary to obtain results of much value.

The development of the voice receives considerable attention in the author's methods. Many children can be taught to sing little airs when they are between three and four years old. From the age of six until that of fourteen or sixteen the voice undergoes but little change except in the way of gaining power. At this time a marked change occurs, more noticeable in boys than girls, that is, 'the changing of the voice.' This is due to an increase in the size of the larnyx in all its dimensions, enlargement and consolidation of the cartilages, and an increase in length and thickness of the vocal cords.

In speaking of the training of the singing voice, Dr. Mackenzie recommends vocal gymnastics and a development of the breathing capacity, by walking, hill-climbing, running, fencing, and swimming, and in a chapter devoted to the care of the formed voice directs the avoidance of strain and complete inaction of the vocal organs when out of order. The influence of the general health upon the voice is very marked. Whatever is good for the singer's general health is *pro tanto* beneficial to his voice. Alcohol and tobacco should not be used. The hoarse tones of the confirmed votary of Bacchus are due to chronic inflammation of the lining membrane of the larnyx: the originally smooth surface being roughened and thickened by the irritation of alcohol, the vocal cords have less freedom of movement, and their vibrations are blurred, or rather muffled, by the unevenness of their contiguous edges.

In discussing the speaking voice, its compass, mechanism, and defects are fully considered. The various diseases of the larynx, paralysis, and abnormal growths are not overlooked, and a special chapter treats of the training of the voice for speaking in public. The importance of early training is dwelt upon, and the improvement which is possible to a poor voice by proper methods of culture.

In concluding the volume, Dr. Mackenzie desires it to be understood that he speaks as a physician, rather than as a singing-master or an elocutionist, and that his aim is to furnish the vocalist and public speaker with a guide to the diseases of the voice, and the best means of avoiding them. He has accomplished his object in a manner which is no surprise to those who know his skill and acquirements.

RECENT EARTHQUAKE LITERATURE.

Report on the East Anglian earthquake of April 22, 1884. By R. MELDOLA and WILLIAM WHITE. London, 1885.

THE Essex field-club of England has devoted vol. i. of its 'Special memoirs' to the Essex earthquake of April 22, 1884, which has already been the subject of sundry articles in scientific periodicals and society transactions. This publication is much the most extended discussion of the phenomena which has appeared, and its authors have here given us an excellent example of the thorough presentation and discussion of the facts observed. It forms a volume of two hundred and twenty-three pages, with four maps and numerous illustrations in the text. It begins by giving a list of nearly sixty previous British earthquakes which had caused structural damage, the records being drawn from various sources, and including some that are not mentioned in Mallet's 'British association catalogue.'

After describing the careful methods of collecting and sifting the data in regard to the present shock, some twenty pages are devoted to its general character. It is regarded as the most serious seismic disturbance that has affected Great Britain for four centuries, extended over fully five thousand square miles, and in intensity is estimated as about one-twentieth of the great Lisbon earthquake of 1755. Pages 44 to 155 are given up to a detailed description of the phenomena at various places, the accounts being in many cases in the original language of the reporter, and in many more giving the result of personal examination of the localities, immediately after the occurrence, by the authors themselves or by competent persons authorized by them. No one who has not himself engaged in similar work can understand the labor involved in the collection and arrangement of the materials here presented. They are accompanied by numerous wood-cuts illustrating the damage done to particular buildings, and the general impression produced by their perusal is that the shock was much more severe and destructive than the accounts published at the time had led us to suppose. Many instances are given of buildings so wrecked as to be uninhabitable, and in some towns the injured buildings are numbered by hundreds. The whole number of buildings damaged was estimated between twelve hundred and thirteen hundred, including twenty churches and eleven chapels. The area of structural damage was confined to fifty or sixty square miles in north-east Essex, having its main axis in a direction north-east and south-west from Wivenhoe to Peldon.

In considering the connection of the shock with surface geology, the chief damage is found to have been upon the London clay; but some evidence was found that the shock was spread widely, especially toward the north and north-west, by the better conducting older rocks which lie underneath. The excessive damage at Wivenhoe, as well as its comparatively sudden decrease to the north-east of that place, is attributed to reflection of the earth-wave at that place by the valley of the Colne River.

Attempts to estimate the velocity of propagation, the exact location of the centrum, etc., are admitted by the authors to be of little value as to results, owing to the uncertainty of the data available in a country where earthquakes are rare, and therefore find no one prepared for careful observation, and where also seismographs are practically unknown; but they furnish further evidence of the care with which this report has been prepared.

Alphabetical catalogue of the earthquakes recorded as having occurred in Europe and adjacent countries. By J. P. O'REILLY. Dublin, 1886.

The second memoir named aboved forms a part of vol. xxviii. of the Transactions of the Royal Irish academy. It is arranged on the same plan as the similar catalogue of British earthquakes published in 1884, by the same author, and which forms an earlier part of the same volume of Transactions. The present list is based mainly upon those of Mallet, Perrey, and Fuchs, and aims to give, for each of the localities arranged in alphabetical order, the number of recorded earthquake shocks, with their dates and condensed indications of the extent of the area affected. It forms a volume of two hundred and twenty quarto pages.

As it is very difficult, even where all the facts are known, to make any numerical estimate of intensity (and, moreover, for the vast majority of recorded shocks no sufficient details are now available on which to base such estimate), the element of intensity has been omitted in preparing this list, and it represents only the number of recorded earthquakes, the unit adopted being the shock. When several or many or continuous shocks are recorded, these are interpreted as meaning two or three or four shocks,— estimates which are certainly usually within the truth. It is also recognized that in the earlier centuries many earthquakes must have passed entirely unrecorded, and that the list is necessarily in so far an incomplete record of the true number of earthquakes that have occurred.

In Professor O'Reilly's former memoir concerning British earthquakes, an earthquake map of the islands was presented. The present list is not accompanied by a corresponding map of Europe, the preparation of which will necessarily involve considerable time and trouble, and which, we hope and expect, will in due time appear. In these days when the graphical representation of all physical phenomena has become so common, it is certainly an important advance in seismology to be able to apply the same methods to the study of earthquake frequency in various parts of the world; and we anticipate the day when a similar map of the United States may be available for American seismologists. Indeed, some progress has already been made by the present writer in the preparation of such a map.

Statistik der erdbeben von 1865–85. Von C. W. C. FUCHS. Vienna, 1886.

Dr. Fuchs's memoir is from the ninety-second volume (1885) of the Sitzungsberichte of the Vienna academy. In it he has collected the records of earthquakes from his various annual reports, and arranged them according to countries; so that the statistics for any particular locality for the whole twenty years are now easily available to the student. It forms another chapter in the general earthquake catalogue which Mallet brought down to 1843, and which Perrey continued for the later years. It would be a desirable thing if Perrey's lists for the years from 1843 to 1865, which are scattered in numerous separate memoirs, could be collected and collated in a similar way. In order that the lists for different countries may be comparable one with another, Dr. Fuchs has included in his present lists only those shocks which were sensible without instruments; that is, those which correspond to the numbers III to X in the Rossi-Forel scale. The lists proper occupy about four hundred octavo pages, and are preceded by a brief separate notice of the more important earthquakes. It would have increased somewhat the usefulness of Dr. Fuchs's book if he had added an index of the countries; but, as they are arranged geographically, the deficiency is not a serious one.

Transactions of the Seismological society of Japan. Vol. ix. part 1. Tokio, 1886.

Vol. ix. of the Transactions of the Japanese society opens with a paper occupying twenty-three pages, by Dr. C. G. Knott, on earthquake frequency. After a discussion of the probable length of any periodicity which might be due to the gravitational action of the sun or moon, with the result that the periods most likely to be discoverable are semi-annual and annual, he gives a method of combining the monthly numbers so as to eliminate any shorter periods. The author then applies these methods to Mallet's list of European earthquakes, to New Zealand earthquakes (1869–79), to the East Indian Archipelago (1873–81), to Chili earthquakes (1873–81), and to the Grecian Archipelago (1859–73). The resulting numbers are plotted in two sets of curves: the one showing the annual period, the other the semi-annual period if there be one. The curves, excepting that for the East Indies, show clear indication of a semi-annual period, but the author finds reason to doubt whether it is to be attributed to the gravitational cause which suggested the search for it. In considering the possible effect of atmospheric changes, it is suggested that earthquakes, frequently at least, are not local phenomena, and their causes may be sought at a considerable distance from the place where they occur; as, for instance, changes of pressure over the continent of Asia or over the Pacific Ocean might cause variations in the strains along the littoral line between them, and so might be a determining cause of earthquakes in the Japanese area. Pursuing this idea, Dr. Knott finds a possible or probable cause of the winter earthquake maximum (which his annual curves show in both the northern and southern regions) in the accumulations of snow over continental areas and in the annual change of barometric gradients.

The remainder of part i. is occupied by Prof. R. Shida, with two papers, entitled 'Automatic current recorder,' and 'On earth-currents.' In the former he has described and figured an instrument for automatically recording the strength and direction of a varying electric current. In the latter he has collected a brief account of what has been done in the way of observing earth-currents, adding observations of his own which seem to indicate, that, while the magnetic declination and earth-currents vary in a similar way, the latter changes are not the cause of the former, inasmuch as an increase of western declination corresponds to an increase of current flowing from north to south along a telegraph-wire, not to a decrease, as should be the case if the connection were causal. The author also discusses the possible connection of earth-currents with earthquakes.

Transactions of the Seismological society of Japan. Vol. ix. part 2. Yokohama, 1886.

The second part of this vol. ix., separately bound, is entirely occupied by John Milne with an account of the volcanoes of Japan, mainly historical and descriptive. The author gives a list of over forty works which have been consulted in its preparation, of which twenty-six are in Japanese, a considerable proportion being in manuscript. The information thus gathered from previous writers is supplemented by extended personal observations by the author in frequent journeys made for the purpose during his residence for a dozen years or more in Japan; and it is these accounts of his own explorations that the ordinary reader will find most interesting. Among them may be especially mentioned his visit to Oshima (p. 78 ff.), where he had an opportunity of looking down into the open crater of an active volcano, which was at the time belching forth masses of molten lava to a height far above the point where he stood. It must certainly have been, as he says, 'a sight of extraordinary grandeur.' A map is given on which are marked 129 mountains of volcanic origin, 23 being in the Kurile Islands. Of these, 51 are active, 16 being in the Kuriles, and 11 in Yezo. Of the whole number, 39 are symmetrically formed cones, showing a more or less close approximation to the theoretical outline deduced by Milne in the *Geological magazine*, and by Becker in the *American journal of science*, and again discussed by Milne in this paper. From several considerations the author infers that the volcanoes of the Kuriles are of more recent formation than those of Japan.

This part, ii., of vol. ix., is issued from the office of the Japan *Mail* in Yokohama, instead of from Tokio as heretofore, and there is also an entire change in its outside appearance. There are numerous errors, which show that the English proof-readers in that office are not yet quite perfect. The word 'ejectamenta' has proved especially puzzling to them, being misprinted in six of the nine places where it occurs.

The Japanese Transactions of this society have reached vol. iii., which contains papers on 'Earth tremors,' by Milne; on the 'Earthquake of Oct. 15, 1884,' by Sekiya; and on 'Air-waves and sea-waves,' by Wada.

The volume recently issued in the International scientific series, on 'Earthquakes,' by John Milne, is also before us; but this article has already reached such a length, that its consideration must be postponed to another time.

C. G. ROCKWOOD, Jr.

FROM *Nature* we learn that Japan has thirty-seven periodicals devoted to education; seven of these are medical, with a monthly circulation of 13,514; nine treat of sanitary matters, and two of pharmacy; twenty-nine are what might be termed popular scientific journals, and have a circulation of 70,000.

SCIENCE.

FRIDAY, SEPTEMBER 17, 1886.

COMMENT AND CRITICISM.

ALTHOUGH THE GENERAL PUBLIC has ceased to be interested in the subject of cholera, which two years ago was the engrossing topic of daily conversation, the medical profession has not ceased to investigate its methods of growth and propagation whenever the opportunity has offered. A most important contribution has been made by Macleod and Miller, as a result of their labors in Shanghai during the past year. They found Koch's comma bacillus in twenty-five out of twenty-seven cases, and satisfactorily account for its absence in these two cases. In cases of diarrhoea and dysentery the bacillus was absent. The germ was destroyed on drying, but when kept moist was capable of growth after four months. Experiments are now being made upon guinea-pigs with a view of producing the disease in them if possible. Emmerich and Buchner, who have been studying cholera in Sicily, are of the opinion that the cholera germ finds its way into the body by means of the inspired air. The opinion commonly held, and among those of this opinion is Koch himself, is that it is through the mouth and stomach that the germs find their entrance.

THE FAITH CURE has succeeded in drawing to its ranks many individuals who, afflicted with incurable or imaginary diseases, have consulted regular physicians without obtaining any thing more than temporary benefit. From time immemorial this class has been a large one, and as a consequence the weapon ointment of Hildanus, the tar-water of Bishop Berkeley, the metallic tractors of Perkins, and the magnetic belts of Wilson, have, each in its turn, had their devotees and enthusiastic advocates. Rev. Dr. Buckley, editor of the *Christian advocate*, in an article contributed to the *Century*, declares that the tendency of faith-healing is to produce an effeminate type of character which shrinks from pain, and concentrates itself upon self and its sensations. He thinks that it destroys the ascendency of reason in the soul, and that it tends to mental derangement. It might also be added, that such a belief, if generally accepted, would at once put a stop to all study and scientific investigation, and relegate us to the dark ages. The law which is from time to time enforced against the medical pretender and charlatan should be invoked to aid in the expulsion from the state of all, by whatever name they are known, who for mercenary purposes traffic in the innocence and simple-mindedness of the weak and the sick.

THE HIGHER EDUCATION of women was discussed by Dr. Withers Moore in his recent address to the British medical association. Inasmuch as his hearers were physicians, Dr. Moore wasted no time with an introduction, but at once went to the root of the matter by stating that the proper function of woman was to act as a producer of men, for she is the only means by which man can be brought into the world. The functions of gestation and maternity require a great outlay of physiological force, and, if this force is used up in other work, the offspring of the world must suffer, as must also the woman herself. There are two channels of expenditure of physiological force of the woman, — the terrible strain of higher and professional education, the training for competition with men in the most severe exercises of the intellect; and the expense of being properly trained for motherhood.

The saying, 'Educate a woman and you educate a race,' is full of promise if rightly interpreted; full of dire disaster, if it be applied to the mind to the exclusion of the body. Excessive mental labor is a cause of sterility; and whatever does, or tends to, render women infertile is prejudicial to a nation. Young women at the present time think that they must do men's work, though there is no necessity for it, and when they have not the constitution to do a woman's proper work. If girls were more properly taught at school the true physiology of woman, this would be in a great measure stopped. We cannot turn man into a woman, nor fit him to perform a woman's duties; no more can we fit woman to perform the work and duties of a man. Dr. Moore's address deals with this all-important question from an exceedingly practical stand-point, and is singularly free from abstractions and generalities; and, if his views are to be controverted, they must be met with correspondingly practical objections. His treatment of the subject shows a large experience with the every-day life of the women of the present time, and will well repay most thorough and careful perusal.

Writer's cramp is an affection which, until a very recent date, has been looked upon as in most cases incurable. Fortunately, however, for those who suffer from this disease, means are now known to exist not only for its amelioration, but for its permanent cure. The difficulty is one which is not, as its name implies, confined to writers. It may occur in any individual whose occupation brings into constant play one set of muscles: thus the pianist, the telegrapher, and the ballet-dancer may suffer from these cramps or from an inability to perform the acts peculiar to his occupation. The cramps are merely symptoms of a diseased condition, the exact seat of which is a matter of dispute; some locating it iu the brain, others in the spinal cord, while there are those who regard the nerve-centres as in no wise affected, but trace the source of the affection to the nerves themselves. The method of treatment which has been found most successful consists in the application of gymnastics, combined with massage, to the affected muscles. The rubbing, and sometimes a gentle striking of the muscles with a wooden bar, together with regular movements of the fingers or other defective part, are continued for several weeks, during which time not more than one hour daily is devoted to these exercises. During five years, Wolff, who has given special attention to this affection, has treated 277 patients. Of this number, 245 were writers; 32 were pianists, violinists, telegraphers, and painters. 157 were cured, 22 improved, and 98 not cured.

Dr. S. W. Abbott, of the state board of health of Massachusetts, in the Boston *Medical and surgical journal*, Aug. 12, describes the method employed by Professor Walpert in testing the air of inhabited apartments to ascertain the amount of carbonic acid present. The air-tester of Walpert consists of a simple rubber bulb, of known capacity, connected with a glass tube, which is constricted at its further end. The bulb is filled with the air to be examined, and this air is then forced through a measured quantity of lime-water until the opacity produced by the formation of lime-carbonate is so great as to obscure a black mark upon the bottom of the test-tube containing the lime-water. With very foul air, the bulb having a capacity of twenty-eight cubic centimetres, and the quantity of lime-water being three cubic centimetres, the mark is obscured after filling the bulb ten or fifteen times; while, if the air is as pure as it should be, the lime-water will become turbid only after the bulb has been filled thirty or forty times. Professor Walpert has prepared a table which indicates approximately the amount of carbonic acid present when the bulb has been filled from one to sixty times.

The principle upon which this tester is based is, of course, not new. It is, however, a much more convenient method than that recommended by Angus Smith, in which bottles containing lime-water were employed. All these methods are defective, necessarily so perhaps, for the reason that they all take it for granted that the amount of carbonic acid is a true exponent of the degree of purity of the air. This is, of course, erroneous. An air containing no more carbonic acid than that of the Alps, may, on account of organic impurities, be much more deleterious than one holding a large amount of carbonic acid, but without the organic contamination. There is much reason to hope that biological methods, with plate and other cultures, will help to solve this difficult question of practically ascertaining whether a given atmosphere is or is not contaminated to such a degree as to be prejudicial to health, and in what the danger consists. While the chemists and biologists are at work upon this problem, we shall still be confined to the estimation of carbonic acid present in the air, as an indication of its purity, and are glad to learn that Dr. Abbott has found Walpert's air-tester convenient in form and size, portable, and sufficiently accurate to meet the wants of the sanitarian.

THE CHARLESTON EARTHQUAKE: SOME FURTHER OBSERVATIONS.

Further and more reliable observations and reports seem to confirm the substantial accuracy of the coseismal lines given in the map issued with the last number of *Science* to an even greater extent than could have been reasonably expected. The most disturbing element in compiling that map was the time of the earthquake at Charleston, as given by all the press reports and the signal-service observer at that city, 9.54 p.m. The most accurate time found by Professor Mendenhall during his visit, however, was 9.51, which agrees very much better with all other accurate observations from adjoining localities. This and other reports might allow of shifting the central ellipse a little farther south; and this, of course, agrees better with the fact that the greatest destruction was caused at Charleston. Still, all reports agree that the shock was more nearly vertical at points to the north-west of that city, and even at Augusta, nearly due west.

Among all the recorded times, up to date, the following seem most worthy of mention at present: Charleston, 9.51, from very reliable data obtained by Professor Mendenhall; Washington, D.C., 9.53.30, the mean of observations by Professors Newcomb and McGee; Baltimore, 9.54, Richard Randolph, civil engineer; New York, 9.54, Western union telegraph operator; New Haven, Conn., 9.55.30, signal-service observer; Toronto, Ontario, 9.55, Professor Charles Carpmael, director of the Meteorological service of Canada; Mount Sterling, east central Kentucky, 9.53.15, I. J. Evans, watchmaker; Newport, Ky., 9.54.15, S. P. Newman, attorney; Portsmouth, southern Ohio, 9.55.57, signal-service observer, corrected by telegram to Columbus; Dubuque, Io., 9.58, as given in associated press despatches; Jacksonville, Fla., 9.54, associated press. If we take the centre of disturbance at a point about 50 miles north-west of Charleston, at 9.51 P.M., these figures give velocities about as follows: to Washington, D.C., 144 miles a minute; to Baltimore, 130; to Newport, Ky., 92; to Dubuque, Io., 103; to Jacksonville, Fla., 63. These seem to indicate that the origin was along a north and south line rather than at a point. If we take the origin at about the middle of the line joining Charleston and Raleigh, at 9.50 P.M., we get velocities as follows: to Washington, 76; to Dubuque, Io., 87; to Newport, Ky., 84; to Jacksonville, Fla., 71.

The area as stated in the last number of this paper is also about the same according to the latest observations. No reports of any disturbance are yet at hand from any point in southern Florida south of Tampa. It was felt very slightly at Boston, Mass., in northern Vermont, and New York; in Ontario it was very perceptible at Toronto and a number of points; and it extended into southern Michigan, eastern Iowa, Missouri, Arkansas, and Louisiana.

It is reported by Captain Boutelle that the water on the bar at Charleston has deepened since the shock from six inches to a foot. The character of the shock is reported from almost all points as decidedly undulatory, rather than vibratory, in character, which perhaps explains the fact that there was generally formed a very fair idea as to the direction of the motion. Published requests for information have been very generously responded to; and although some letters are amusing, and even absurd, a large proportion of them give valuable and interesting data. The following extract from a letter received from Mr. Richard Randolph, civil engineer, Baltimore, Md., is such an excellent example of clearness of statement combined with accuracy of observation, that its perusal cannot fail to be both interesting and instructive: —

"I was reading in my front room, third story, east side of the street, about the middle of the block; was sitting with one leg thrown over and resting upon the knee of the other, so that the position of my body was nearly north and south, pointing with the foot about 15° west of north. While in this position, so sensitive to lateral oscillations, I experienced a sensation which I at first ascribed to a violent palpitation of the heart; but the absence of all uncomfortable feeling, and the great amplitude of the oscillations, quickly drove that idea from my mind. At the same time I was satisfied that such a motion could not be due to what I supposed to be a passing baggage-wagon loaded with trunks, the sound being exactly that of such a wagon, which frequently, during the last month, has passed over the cobble-stone pavement of the street. I did not look to see if there really was a wagon passing, and, although the sound began and ended with my observation of the telluric movement, I still assume it to have been caused by a wagon. After noticing for a few seconds my suspended foot swinging at right angles with the position of my body with the regularity of a pendulum, and feeling a general movement in the same direction, and hearing a sonorous beating of some object in my bedroom adjoining keeping time with these oscillations, I arose and walked across the room to my watch, and, upon inspection, saw that the minute-hand was exactly halfway between 9.53 and 9.54, i.e., 9.53½. My watch has, for the last two months, coincided precisely with the chronometers exposed for public reference in the windows of the principal dealers; and I had made a comparison only the day before. These chronometers keep the standard time of the Philadelphia meridian.

"While in this standing position, I no longer felt the vibration; but the sounds in the adjoining room continued at the same rate, but ceased, as did all perceptible vibration, by the time I resumed my seat, when I recorded on the blank leaf of a book I was reading, '6½ minutes of 10 P.M.'

"In order to form an estimate of the duration of the phenomenon, I held my watch before me, and noticed the time required to repeat from memory the observations I had just made; and this indicated 45 seconds, and 10 seconds from the first sensation to the time of observation. In the same way I counted the number of beats per minute of the sounding body in the adjoining room, which indicated 110. As I have an ear for music and time, I have much confidence in this method of estimating.

"I then went into the other room to examine the object which caused the sounds, and found, that upon oscillating my wardrobe, which was backed against the north-and-south partition wall of the room, the sounds were produced by one of the doors tapping the partition between the two compartments of the wardrobe, giving out a not unmusical sound, and one that could not be evoked from any other object, and could only be produced by an east-and-west oscillation. To reproduce them with the intensity and periods during the earth movement required a movement of ½ an inch at 6½ feet from the floor, for a complete oscillation."

If many observers had the self-possession and skill to make such reports, the results would be valuable indeed. EVERETT HAYDEN.

CHEVREUL'S CENTENNIAL FESTIVAL.

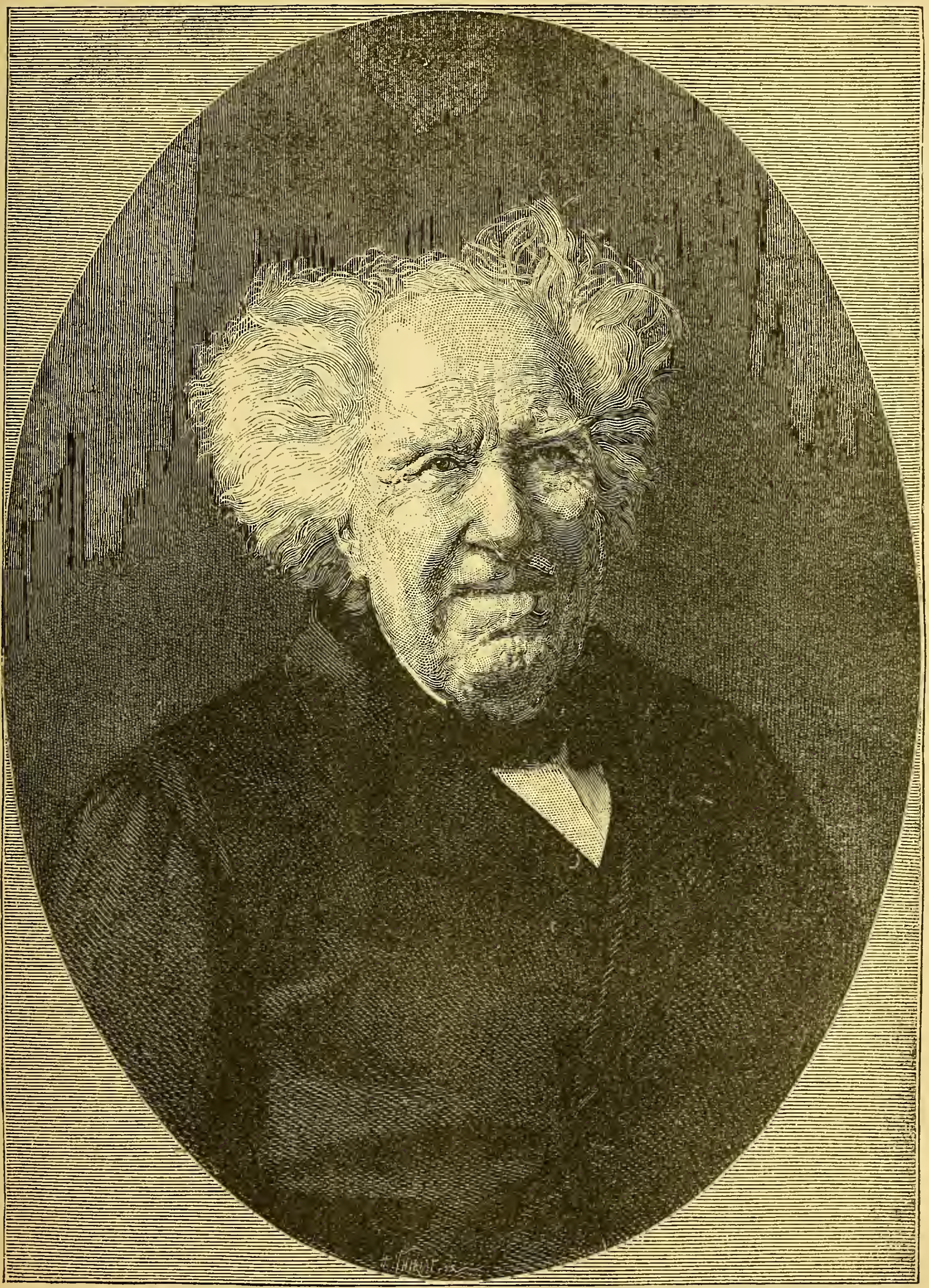
DURING the last two days, Paris has celebrated with unprecedented demonstrations of joy and respectful sympathy the centennial anniversary of the venerable *savant* Chevreul, unprecedented and unrivalled, because he is the only great scientist of our times who has attained the late hour of life he has entered this morning, Aug. 31, and because his life has been one of labor and hard work from the beginning. Chevreul's life is easily and shortly written. Like happy men and happy nations, he has no history, no adventures, no romance of any sort, but a simple, honest, straightforward, and manly life, given entirely to work, — to serious work, seriously conducted.

Michel Eugène Chevreul was born Aug. 31, 1786, in Angers. His father was a well-to-do physician in Angers, professor in the medical faculty, and a talented writer. Old age seems to be hereditary in the family; Chevreul's father having died at ninety-one, and his mother at ninety-three years. Chevreul is yet a very tall man, square in the shoulders, and walks quite erect and straight.

After the revolution the University of Angers was disestablished, a school for chemical and physical studies being put in its place; which school Chevreul attended between the ages of eleven and seventeen. In 1803, Chevreul went to Paris, after having been taught the elements of chemistry by a professor named Héron. Chemistry was taught in Paris at that time by men of great science, Vauquelin and Fourcroy. Thenard was assistant to the former. Chevreul entered Vauquelin's laboratory, and set to work immediately. He was there with Orfila, Payen, Bouchardat, and Frémy, of which only one survives, Frémy, the present director of the Museum of natural history, on whose arm Chevreul leaned to-day when coming to the festival given in his honor. Chevreul's aptitudes were quickly noticed. In 1806 he was appointed director of Vauquelin's laboratory, and professor in the Lycée Charlemagne, and during the same year he published the results of his first experiments. In 1806 seven papers came from his pen, of which three were on coloring-matters (indigo and Brazilian wood). Four years later he was appointed *aide-naturaliste* in the Museum of natural history, then examiner for the Ecole polytechnique; and at thirty he was professor of chemistry in the Gobelins, the world-known manufactory of tapestry, and director of the department of tinctorial baths. In 1826, after the death of Proust, Chevreul was appointed member of the Academy of sciences, to which he has belonged ever since. Not one of his colleagues of that time is yet living. In 1830 he became professor in the museum, and some time after director, holding the former position till the present day, though not so actively the last two years, and the latter till 1883. He is a member of a great number of foreign scientific societies, and since 1875 has attained the highest dignity in the order of the *Légion d'honneur*. He never misses a meeting of the Academy of sciences, and it is not long since one could meet him in the Rue des ecoles, walking to the institute, hat in hand, and hands behind the back. He seems to have an aversion to hats, and dispenses with them a great deal.

During the war of 1870 he remained in Paris the whole time of the investment, and lived in the museum, notwithstanding eighty German bombs scattered to pieces the magnificent hothouses of the Jardin des plantes, and one fell quite close to his own laboratory. It was in a letter written during January, 1871, to Abbé Lamazon, in answer to a note of the latter, that Chevreul used for the first time the expression he prefers when speaking of himself, — 'the dean of French students.'

Chevreul married early, but his wife died more than twenty years ago. His conjugal life was a very quiet and happy one. Chevreul has only one son, who lives in Dijon, and is a retired magistrate. He himself lives alone in Paris, devoted to his books and laboratory, both of which



E. CHEVREUL.

take all his time. He is very fond of fine books and rare editions.

As a man, Chevreul has a very pleasant expression, and always greets strangers or friends in a very hearty fashion. There is nothing pedantic in the man: he is amiable, kind-hearted, and good-natured. He is also a very just man and a stanch friend, which is shown by an incident that occurred in 1874. At that time, M. de Cumont, one of the most incompetent and unpopular ministers of public instruction that we have had of late, had made up a list of persons upon whom he wished to confer the distinction of the *Légion d'honneur;* but these persons, belonging to the museum, Chevreul found, with good reason, rather unripe for the much coveted distinction, while persons who were quite worthy of it were not put down on the list. Minister and director disagreed, and the director sent in his resignation. This created quite a sensation, and the minister had to abandon his project to induce Chevreul to withdraw his decision.

Upon the whole, Chevreul's life has been a very quiet one, devoted wholly to work and study. He is a rich man, as he spends very little, and his income exceeds by a great deal his expenses. He is a society man, and has very refined and pleasant manners. A few years ago he sometimes went to balls, and was a favorite with many ladies, who had great pleasure in listening to his conversation. He has a humorous turn of mind. Recently, when accepting a new assistant, he exclaimed, "Well, you must be plucky to become my assistant: I have already killed four!" 'Killed' is a metaphor, but no more so than it is when used in speaking of a commander who has killed two or three horses, that is, has had them killed under him.

Chevreul's material life is very simple: he eats little. Two eggs and a slice of patty are enough for the morning, with some milk and coffee; in the evening, a full plate of soup, a cutlet, and some fruit, some cheese, and only water or beer, no wine at all.

A catalogue of Chevreul's works would be a work in itself. The two most important branches of science studied and developed by Chevreul are the chemistry of fat substances, and the theory of complementary colors. By his researches in the former of these, Chevreul has given methods for obtaining a number of very important and useful substances, such as stearin, glycerine, etc. Millions have been earned by the application of his methods.

The centennial anniversary of Chevreul was celebrated by various ceremonies. The Société d'agriculture, of which he has been a member for more than fifty years, and president for thirty-seven years, gave him, during the meeting of Aug. 30, a handsome present, the 'Penseur' of Chapu, a very fine bas-relief, and a medal. After the meeting of the Agricultural society came that of the Academy of sciences. Chevreul went, as usual, and was greeted with great sympathy by his colleagues. The same evening Chevreul was invited to the opera, where he had not been for a very long time; and he assisted at the whole play, gotten up in honor of his first century. He had received before, the visit of the Chinese ambassador, Tcheou-Meow-Ki, who came to congratulate him; he had received a delegation from the inhabitants of the Rue Chevreul, who sent him a fine nosegay; he had received also the visit of MM. Alcan and Ch. Richet, who brought him a volume especially published for the occasion, 'Hommage à Chevreul,' and written by Berthelot, Gautier, Grimaux, Ponchet, and others, — a sort of *livre jubilaire,* as is often published in Germany when some important date in the life of a professor or scientist is celebrated.

Notwithstanding all these speeches and ceremonies, Chevreul slept very well, and was quite fresh the next day, when took place the ceremony of the unveiling of Chevreul's statue in the new gallery of the museum, which was hung with Gobelin tapestries of splendid hues and dimensions. Although a great many persons of scientific pursuits are still out of Paris, the room was full, and the heat was awful. A large crowd gathered in the Jardin des plantes to witness the passage of those invited. When Chevreul came in, leaning on Professor Frémy's arm and on that of an old soldier ninety-four years of age, unanimous applause went up, with many cheers for the hearty old *savant.* Chevreul was quite astonished at the sensation he created, and murmured, 'What a fine crowning-point for a *savant's* life!' The statue was due to Guillaume, and is a very fine one. It does not resemble much the Chevreul of to-day, but is so well arranged, and with so much taste and art, that the effect is excellent. This will be one of Guillaume's masterpieces.

But now began the unpleasant part of the day. It was half-past two, and the heat was terrific. One required rain, or hail, or snow, any thing that could refresh the air: nothing poured but speeches and large drops of perspiration. After one speech, another: one man went down the tribune one side, another got up the other side. They were audible only in a very small part of the building. The gallery was intended to receive specimens of natural history, and the skeletons of all creatures that had one, and was very well designed; but it was not intended for speeches. The consequence was that very little of them was heard. One of those which was received with most enthusiasm was that of Nadault de Buffon, a descendant of our great naturalist, an old man already, and quite blind, but possessed with a strong voice, a fine appearance, and very enthusiastic feelings.

After this avalanche of speeches, which was certainly enough to fatigue one, M. Chevreul answered some words in reply, and the delegations defiled before him. The number of them was very considerable, but he witnessed the whole proceeding nevertheless. All saluted him with utmost respect and demonstrations of great joy. He was presented with a nosegay — I know not by which delegation — that was a masterpiece of art in the choice and distribution of colors. No more delicate allusion could be made to the venerable master's theory of complementary colors; and it was understood by the whole crowd, being exemplified in an unparalleled manner.

The ceremony was over at four o'clock. There were crowds of people around the monument, awaiting the passage of the centenarian, and progress was difficult and trying. However, all went very well, and Chevreul was received by the crowd with deafening applause.

It is likely that our readers would have been tired after all this ordeal: Chevreul was not. The same evening he was present at a great banquet given in the Hotel de Ville, and he even drank some champagne when his health was proposed, — a somewhat superfluous motion, it seems. During the night a torchlight procession paraded the streets; but this popular demonstration had nothing interesting in it, and no *savants* were concerned in this masquerade, which certainly originated in the brains of some alderman desirous of more votes at the next election.

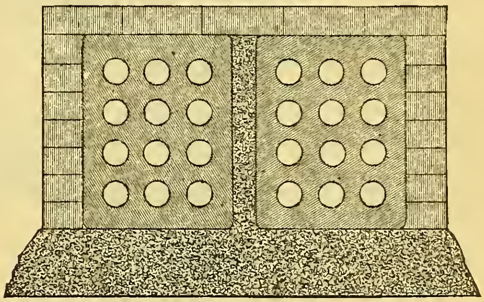
Upon the whole, Chevreul's centennial anniversary was celebrated as it ought to have been, and as becomes, at the same time, a man of high scientific standing, and a city which always appreciates great thoughts and a noble life.

H. DE VARIGNY.

BURYING THE WIRES.

THE actual work of preparing subways or underground conduits to receive the telegraph and telephone wires, in this city, was begun on Aug. 30. Numerous experiments and tests were made, and many projected methods considered, before the commissioners having the matter in charge decided upon a plan which seemed to them satisfactory. The system finally selected appears to fulfil all the requirements of the case, and the work of 'burying the wires,' so long discussed by the daily papers, will now proceed as rapidly as the conduits can be placed in position.

The subway, as now being constructed in Sixth Avenue, consists of a double row of conduit-blocks, laid in a trench five or six feet deep, with man-holes at every cross-street, for the insertion of wires and making connections. Each block is 42 inches long, $17\frac{1}{2}$ inches deep, $13\frac{1}{2}$ inches wide, weighs about 450 pounds, and is pierced by twelve $2\frac{1}{2}$-inch holes. The material of which the blocks are made is a concrete composed of 80 per cent clean, sharp sand, $19\frac{1}{2}$ per cent coal-tar pitch, and $\frac{1}{2}$ per cent oil and black oxide of manganese. These are thoroughly worked together in a tank at a high temperature. The mixture is then forced into moulds of proper size and shape, subjected to heavy pressure, and deposited to cool in tanks of water. At a public test conducted by Mr. Albert R. Ledoux, chemical expert to the subway commission, the crushing resistance of this concrete was found to be 4,591 pounds to



the square inch, and the crushing resistance of a conduit section was 59,210 pounds. This concrete deteriorates and disintegrates in a few years where exposed to great changes of temperature, so that it is not adapted for use in pavements, or where exposed to the heat of the sun and the action of snow and frost; but the experience of several years proves that it undergoes no appreciable change when used under ground. As a material for sewer and drain pipe, etc., it has been found satisfactory.

The conduits are being laid in a manner that ought to insure their stability. At the bottom of the trench is laid a bed of cement concrete six inches in thickness. This is allowed to harden, after which the sections are placed in position, in two rows, leaving a space of two inches between the rows, to be afterwards filled with hydraulic cement. The method adopted to insure the continuity of the 'ducts,' or holes, through which the wires will run, is simple but effectual. The holes are moulded with a slight enlargement at the ends, sufficient to admit a short tube or ferrule of the same inside diameter as the hole. As each block is lowered into the trench, and placed in position, a large plate of iron, previously heated, is held between one end of it and the end of the block it is to join. The heat softens the pitch, and removes any oil which may have been left by the mould. The iron is then removed, the block drawn back a few inches, and the ferrules are put in place. These ferrules are of such length, that, when pushed firmly into place against the shoulders of the enlargement, the blocks remain about an inch apart. The block, with ferrules inserted, being in position, a round wooden bar, split lengthwise into two long wedges, is inserted into each hole or duct, running back through the ferrules into the other block. One part of each bar is then slid upon the other, until they fill the hole snugly, the result being that the blocks are brought into practically exact alignment. Next, iron plates, embracing the joined ends of the blocks, are clamped in position, and the space between the blocks and surrounding the ferrules is filled with hot pitch concrete solidly rammed. Then the aligning bars are removed, and the operation is repeated with each subsequent block. The space between the conduits is filled with hydraulic cement, and the double conduit enclosed in brick-work, the completed subway presenting the appearance shown in section in the accompanying diagram.

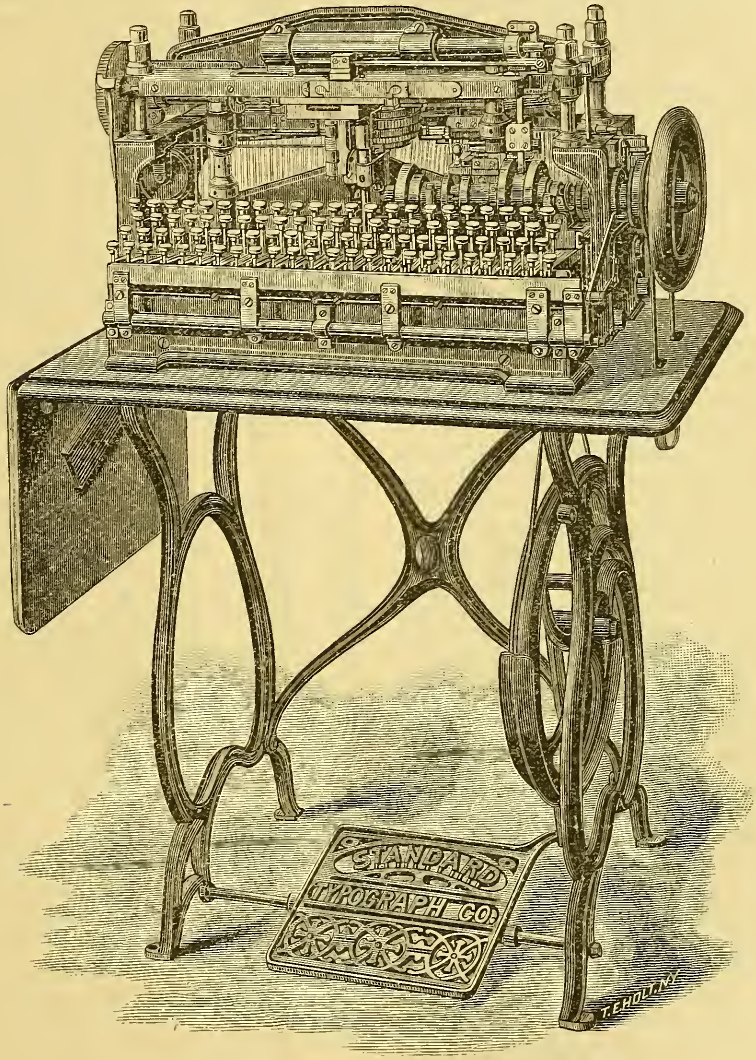
THE STANDARD TYPOGRAPH.

There is now being perfected in this city a machine intended to dispense with type and type-setters in certain kinds of printing. The 'standard typograph' is the name selected for it by its inventors, though the term 'matrix puncher' would be a more fitting title. A good idea of its general appearance may be gathered from the accompanying illustration. At first glance, it seems to be a combination of an enlarged type-writer and a sewing-machine, possessing the key-board of the former and the stand and operating mechanism of the latter. The typograph is in reality a kind of type-writer, but, instead of printing upon paper, it produces indented or depressed characters upon a sheet of soft metal, from which an electrotype may be made, as from the wax matrix taken from type, in the usual electrotyping process.

The principal parts of the machine are, the key-board, resembling that of the Remington type-writer; the type-wheel, which revolves in a horizontal plane; and the matrix carriage, immediately above the type-wheel. Part of the last is shown in the engraving, above the key-board, about the middle of the machine. Fitted in vertical grooves in the periphery of the type-wheel are a number of steel types, one for each character used in ordinary printing, the face of the type being upward, toward the matrix carriage. Two small lugs or stops project from the wheel at diametrically opposite points. Arranged in a semicircle at the rear of the wheel are two rows of detent levers, the outer end of each lever being connected by a link with a finger-bar of the key-board, much as the type-bar of a type-writer is connected with its key. The detent levers are pivoted near the inner end, so that the depression of a finger-bar, or key, as it may be called, raises the inner end of its connected lever into the plane of revolution of one of the stops of the type-wheel, each stop being located on the wheel slightly above its corresponding semicircle of levers.

The matrix carriage, one end of which is shown in the engraving, above and to the left of the type-wheel, has movement in two directions in a horizontal plane. The side movement, from left to right or *vice versa*, is communicated to the carriage by the return of a key to its normal position after being depressed to form a character in the matrix. This side movement, or letter-spacing, is variable, and is governed by the key depressed, so that the carriage is moved each time a space equal to the exact width of face of the type impressed in the matrix. Thus, for the letter *h* or *g*, the carriage would move twice as far as for *i* or *l*. By a simple adjusting device, this movement may be changed so as to leave a space between the letters, as shown in the concluding line of the sample paragraph given farther along. The other movement of the carriage, that required to bring the matrix into position for a new line, is produced by depressing a key provided for that purpose. This movement also may be varied so as to leave greater or less space between the lines.

The manner of operating the machine is as follows: the matrix, which, as at present used, is a sheet of lead about one thirty-second of an inch thick, is secured firmly to the carriage, and adjusted, face downward, in its place above the type-wheel. The operator, having his 'copy' within easy reading distance, puts the type-wheel in motion by means of the treadle, and depresses the keys one after another, according to the word or space desired, as in the ordinary type-writing machine. As each key is struck, the end of its detent lever, by contact with the projection on the wheel, stops the revolution of the latter, holding it in such a position that the type desired is in place for striking the matrix at the proper point. At the same instant the type is forced upward by a revolving cam, producing an impression of its face in the matrix. The cam continues to revolve, the type drops back into place, the wheel is released and continues its rapid motion, and the carriage moves into position for the next letter, the whole operation being practically instantaneous, and the rapidity of working being limited only by the skill and the last letter is struck. The 'feed' of the carriage is then reversed, and the rest of the line filled in backward. This is done so that the ends of the lines may be even, as the spacing between the words is not automatic, but depends altogether upon the skill and accuracy of eye of the



THE STANDARD TYPOGRAPH.

of the operator and the speed of the treadle. The next letter is produced in the same way; and so on to the end of a word. Then the carriage is moved ahead sufficiently for the space desired by touching an appropriate space-key. This is continued until within two or three words of the end of the line, when the carriage is run on to the end, operator. One line finished, the carriage is returned to the starting-point, the line-spacing key is struck, bringing the matrix into position for the next line, and the various operations are repeated. When the matrix is completed, it is removed from the carriage, and an electrotype taken; and this electrotype is supposed to take the place of type on the printing-press. The following short paragraph is printed from an electrotype made direct from a leaden matrix produced upon the typograph: —

Although more than four hundred years have elapsed since the art was invented, it is a singular fact that the bulk of the world's printing to-day is done with movable types "set up" on the same plan adopted originally.

To the eye of the practical printer there are several defects in the above sample paragraph. The first word is not set in far enough from the end of the line. That is the fault of the operator, for which the machine cannot be held responsible. Some of the letters are too close together, and others too far apart; the letters do not range well, giving an irregular or 'squabbled' appearance to the line; some of the letters, notably the *e*, do not correspond in size with the others; and some, again, appear to be higher than the rest, giving a blacker impression. All these defects are doubtless due to imperfect workmanship on the part of machinists and type-cutters, and may easily be overcome in a more perfect machine. Another defect noticeable in the work of this machine is uneven spacing between the words. In the machine as at present constructed, this defect cannot be remedied except by almost superhuman skill on the part of the operator; but the inventors claim that in future machines, and with type cut on a 'unit' system (the width of face of each type being a known multiple of some unit taken as a standard), justification will be as easily accomplished as in ordinary type-setting. This remains to be seen. Still another defect, and a very grave one, is the difficulty of correcting errors. A wrong letter in a word, or a wrong word in a sentence, if about the same size as the right one, may be corrected by smoothing down the metal and re-punching over the smoothed surface. But the omission of one or more words, or their repetition, can be remedied only by a new matrix, whole or in part. Neither can changes be made in the wording of a sentence, something frequently desired by writers upon inspection of their proofs. With 'copy' prepared exactly as it should be printed, and an operator proof against error, this defect would not be conspicuous; but perfection is no more prevalent among writers and operators than among inventors and machinists.

But were the machine perfect in all other respects, there is still one defect which practical printers who have examined the typograph and its work consider fatal, and one which, in the opinion of experts, will be found extremely difficult if not impossible to overcome. When the steel type is forced into the soft metal of the matrix, it leaves a perfect impression; but, when the next type is forced in, the metal is pushed aside to a greater or less extent, thereby disturbing the previous impression, and preventing the full face of all the type from 'showing up' in print. This defect will be readily seen by comparing the sample paragraph with the contiguous paragraphs, which are printed from ordinary type. In the last three words of the sample paragraph, the metal has not been so much disturbed, as the letters are purposely set some distance apart, that there may be a protecting wall of metal left between them. Of course, it may be possible to discover some material for the matrix that will give better results in this respect, or some way may be devised to punch the metal without forcing it aside. These problems remain unsolved. In its present stage, the typograph shows an important advance in the direction of cheaper and more rapid book and newspaper work; but much yet remains to be done before the machine can be placed upon the market as a commercial and typographical success.

NOTES AND NEWS.

FROM a correspondent in Tokio we learn that on his return from America he presented a report on the resolutions of the Washington meridian and time congress. A committee was appointed by the proper authorities to discuss the matter, and on the 12th of July an imperial decree to the following purpose was issued: first, the meridian passing through Greenwich shall be the initial meridian for longitude; second, longitude shall be counted from this meridian in two directions up to 180°; third, the time of the meridian of 135° east shall be used as the standard time throughout Japan.

— A fireman on the steamer Alvo, which lately arrived in New York from Central America, was taken sick, and entered St. Vincent's hospital for treatment. The fever from which he suffered simulated yellow-fever to such a degree as to make his removal to the Reception hospital of the health department advisable. The attack proved fatal, and an autopsy revealed a yellow liver, a stomach filled with blood, and the other organs jaundiced. It was the unanimous opinion of the physicians present that yellow-fever was the cause of death. It is as yet unexplained how and where the disease was contracted, as it is reported that the health officer of the port never knew of yellow-fever existing at any port at which the Alvo had been.

— The report of F. H. Wines, special agent of the tenth census, on the defective, dependent, and delinquent classes, is full of interesting details. The number of males confined in prisons and workhouses in the United States in 1880 was 53,604, and of females, 5,005. The number of prisoners to each million of the population was 1,069: in 1870 it was but 853. There were 1,833 insane persons, 1,533 idiots, and 976 blind persons to each million inhabitants. There were 21,595 out-door paupers, and 66,203 inmates of almshouses, during the census year.

— A writer in the August number of the *Nineteenth century* begins an interesting discussion on the question, 'Are animals happy?' The view that the author takes practically amounts to saying that an animal with a less highly organized brain is more apt to be happy. While many of his inferences are suggestive, they are not founded on that broad knowledge of biological facts which the subject deserves. The article has been severely criticised in English periodicals.

— It has recently come to light that the state of New York, in 1806, paid to John M. Crous a thousand dollars for a remedy against hydrophobia which he considered infallible. The measure was advocated by DeWitt Clinton and Chancellor Kent. This remedy consisted of one ounce of the jaw-bone of a dog, burned and pulverized; the false tongue of a newly foaled colt, dried and pulverized; and 'a scruple of verdigreas,' raised on the surface of old copper by laying it in moist earth. The warrant of the comptroller on which the money was paid, and the receipt of Crous, are on file with other state papers at Albany.

— The submarine torpedo-boat briefly described in *Science* recently is having some changes made in its machinery and in details of construction. It will be equipped with horizontal rudders at the bow, in addition to those at the stern, so that it may be submerged with an 'even keel.'

— One of the amateur aeronauts whose experiences are recorded in the September number of the *Century* makes the interesting observation, that, immediately upon alighting, all remembrance of the events of the journey is gone, and only after several hours can he recall his experiences. He adds, that after a battle, soldiers have experienced the same phenomena.

— The temperature of August, 1886, was over four degrees above normal in Iowa, being the hottest on record for over twenty-five years, excepting August, 1881, which was one degree warmer still. The number of hot days on which the temperature reached or exceeded 86° was twenty-one, which is the highest ever recorded, being three in excess of August, 1881.

LETTERS TO THE EDITOR.

****Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Barometer exposure.

MR. CLAYTON'S last letter on the above subject shows that he has been considering all along the so-called 'serration effect.' It seems to me that this narrows down the problem very materially. Kindly allow me space to emphasize a point or two that I laid down in my previous letter, and to give a few facts regarding the above effect. I still think, that, if the wind has a tendency to diminish the pressure in a room by blowing across a chimney communicating with it, there will be a slight draught up the chimney, of the air forced into the room on the windward side. Mr. Clayton's theory of a smoky chimney is satisfactory only as a theory, but the facts are all against him. Any builder will tell him that a properly constructed chimney will draw under the conditions mentioned by him; namely, 'wind blowing across it' He will also find a large number of cases in Boston where chimneys have been built up in such a way as to make the effect suggested by him a maximum; and this, too, to obviate a lack of draught.

I have studied the above serration effect with some care, and have compared wind-velocity and barograph sheets for nearly two years. The barograph is enclosed in a rather tight case, and its sheet has a motion of about .75 of an inch per hour. The highest wind noted was 36 miles per hour, though there may have been momentary gusts reaching 50 miles per hour. The effect was noticed rather faint with a velocity of 4 miles per hour. Several times a velocity of 28 miles per hour produced no effect; and velocities of 20 miles per hour, with no effect, were quite frequent. Almost all the cases occurred with relatively low pressure, and they were often mixed up with the irregular fluctuations so often noticed at the centre of a cyclone. The maximum effect below the middle line was about .010 of an inch, with a mean value of about .005 of an inch. One singular fact noted was that often there would be a jump of .010 of an inch above the general trend of the line of pressure. A part of this might be caused by the momentum of the pencil, but this would be very slight. It would be very interesting to try the effect of opening a window to windward while the serration effect is taking place. I believe this has already been done to some extent, with the result that the serrations are not materially changed. At all events, I find that among those who have studied the problem in the light of these barograph sheets, there is a well-established belief, that while the wind has an influence in producing the serrations, yet just how it acts is problematical. Any such serration effect by the wind as .100 of an inch below the general pressure line is well-nigh incredible. I am so strongly convinced on this point, that I am perfectly willing, for the benefit of the readers of *Science*, to be at a little expense in order to enable us to see this effect for ourselves. If Mr. Clayton will make a tracing of one of his best effects, and send it to *Science*, I will furnish the editor with the funds necessary to reproduce it. I impose but two conditions, and will modify these if Mr. Clayton thinks them too severe. The conditions are, 1°, the chimneys or trap-doors of the house, or connecting with the room, where the barograph is, must be near the centre of a rather flat roof, that is, not at the edge or near the ridge-pole of a rather steep roof; 2°, the tracing must exhibit the serration effect for at least one hour, and must have in that hour not less than two downward motions of the pencil at least .050 of an inch below the general trace of the pressure at the time. Gan.

Sept. 10.

'Communistic leanings.'

In your reports of papers read at the Buffalo meeting of the American association for the advancement of science, you refer, in the following terms (*Science*, Sept. 3, p. 219), to a paper read by me before the section of political economy and statistics: "The theory of rent and its practical bearings was discussed by Edward T. Peters of Washington, and with such communistic leanings as to meet little approval."

This language is calculated to convey to the reader's mind an entirely erroneous idea of the paper referred to. That it is not based upon knowledge will appear from the fact that the title quoted is one which I submitted when my paper was only in part written, and for which I afterwards substituted a title better suited to the narrower ground to which, on the score of time, I found it necessary to confine myself. That title, as may be seen by referring to the programme of proceedings for Aug. 24, was 'Errors in the Ricardian theory of rent.' In the treatment of this subject I was not conscious of any 'leanings' except a leaning to scientific truth, my paper being simply an attempt to determine whether certain propositions embraced in the Ricardian doctrine logically flow from the assumptions upon which the doctrine is supposed to be founded, and also to compare them with certain very conspicuous economic phenomena, in order to ascertain how far the theory agrees with the facts of experience.

I will not ask space for a statement of my views on the general subject in question; but it would interest me to know whether *Science*, which may be supposed to appreciate the significance of words, and to use them responsibly, — which, moreover, has of late done itself honor by the breadth of its hospitality to various shades of economic thought, — would stigmatize as 'communistic' the proposal of John Stuart Mill "to intercept by taxation for the benefit of the state the unearned increase in the rent of land;" whether it would apply a like epithet to the proposal of Dr. Adolph Wagner, the distinguished professor of political economy in the University of Berlin, "that municipalities [I quote from 'Land and its rent,' by President Walker] should purchase all town property, in order to realize therefrom the progressive increase of values;" or, finally, whether the character of an opinion, and the epithets fitted to describe it, depend entirely on the degree of prominence of the person from whom it emanates.

I observe, in the first paragraph of your report of the proceedings of Section I, the statement that the section had, at the Buffalo meeting, "been comparatively free from the attacks of socialistic and economic cranks, to which it is especially subject." I trust it will always be successful in keeping off 'cranks' of every description; but I quite as earnestly hope that no sickly fear of giving audience to unpopular opinions will induce it to set up a narrow philistine standard of economic orthodoxy, and brand as 'communists' or 'cranks' all who fail to conform to it. The 'approval' of a body conducted upon such principles could be readily dispensed with.

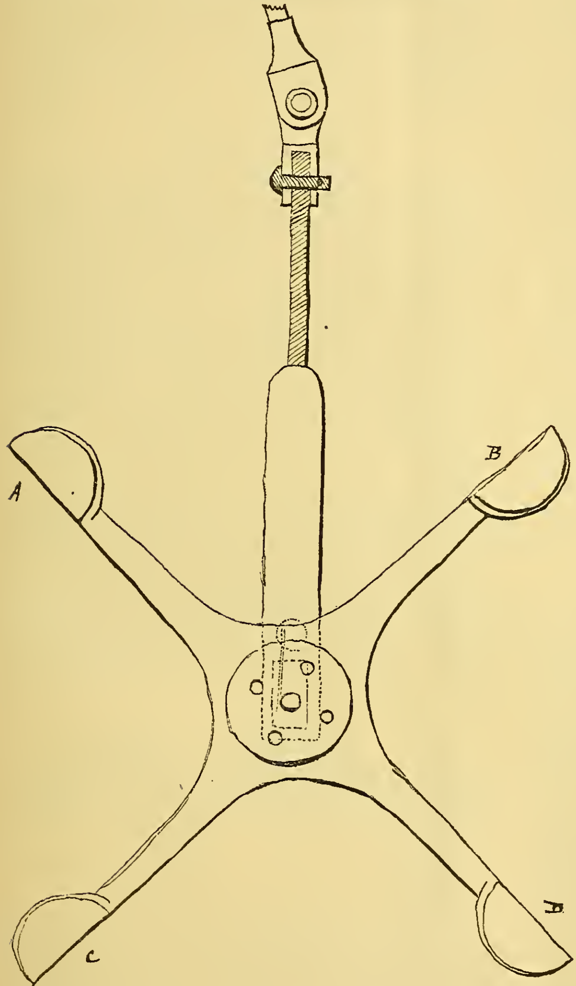
Political economy, as Prof. H. C. Adams, in one of the excellent economic papers recently published in *Science*, has well said, might be appropriately defined as the science which 'treats of industrial society.' Its especial province is, therefore, in a large degree, the arena of clashing interests; and unless Section I of the American association proposes, as a section of 'economic science,' to enact the play of Hamlet with the part of Hamlet left out, it must always, from the very nature of its functions, be 'especially subject' to the introduction of disturbing social questions, and must often hear views advanced which, however sound in themselves, and however disinterestedly scientific in their origin and spirit, will meet but 'little approval' from the men or classes whose interests or prejudices they may happen to antagonize.

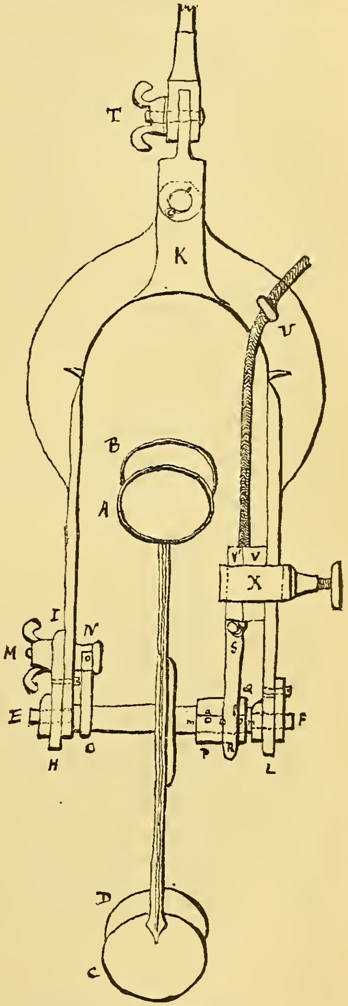
E. T. Peters.

Washington, D.C., Sept. 9.

An electric log.

In May, 1882, I sailed from Marseilles for the Piraeus on the steamship Ava; Capt. Aug. Bretel, of the Compagnie des messageries maritimes, commanding. A short time after going aboard, I noticed a small rope running through the saloon over the cabin doors to the after skylight, and thence along the side of the ship to the stern, where it was made fast. The next day I saw the captain and the first officer looking at a curious instrument, which looked something like an aerometer, except that the cups revolved in a vertical position. This instrument was fastened to the rope which I have mentioned, and thrown overboard, the captain meanwhile watching the revolutions of the wheel through a powerful field-glass. As it did not seem to work satisfactorily, it was hauled in; and I noticed that the captain, in making some repairs to the rope, used a stick of Chatterton's compound. This led me to believe that there was a copper conductor in it, and that electricity in some form was being employed. There was no opportunity at that time to make inquiries; but a few days later the captain kindly permitted me to see the instrument, which he called a 'loch-moulinet,' or 'electrical-mill-log.' After throwing it again into the water, he took me forward and showed me the earth connection, which was soldered fast to one of the iron beams of the ship. Thence the wire went through the chart-room to the wheel-house, where there was a telephone. This electric log, it seems, was the joint invention of Capts. G. Fleuriais and Bretel, and was so arranged, that, when connected with the cable, it formed part of an electric circuit, which was opened and closed with every revolution of the copper shaft to which the four cups or hemispheres were attached. The number of revolutions made by the shaft in a given time was of course dependent upon the speed with which the cups were dragged through the water; in other words, regulated by the rate of motion at which the ship was moving. A table had been prepared by the inventors, showing the number of knots per hour corresponding to the number of revolutions of the shaft in a half-minute. On placing the log and telephone, so arranged that it could be switched, in circuit, every revolution of the shaft, and consequent closing of the circuit, caused a click, plainly audible to any one listening at the telephone. The log having been allowed to run out to such a distance as to be practically free from the influence of the screw, I listened at the telephone. The sound, like a tapping on the diaphragm of the telephone, came clear and distinct; and, when the captain turned the half-minute glass, I had no difficulty in counting the revolutions of the shaft, seventy-four in number. On referring to the table, it appeared that we were making eight and five-tenths knots, which was the exact speed of the ship as shown also by the revolutions of the engine. The experiment was very satisfactory and extremely interesting. Captain Bretel wrote out a description





of his invention, with drawings, which he gave to me.

In the accompanying diagram, *A*, *B*, *C*, *D*, are four hemispherical cups on the ends of four arms affixed to a brass shaft, *E F*, which revolves freely in lignum-vitae bearings at the extremities of the jaw *H K L*. For convenience in removing the shaft, the bearing at *H* is detachable, being secured in place by the wing-nut *I*. At one end of the shaft is a small lignum-vitae pulley, *P Q*, having on one side a strip of copper, *mm'*, fastened in position by screws passing through the shaft, which screws make electrical connection between the copper strip and the shaft. An elastic tongue, *O*, on the screw *N*, bears upon the other end of the shaft, giving metallic contact between shaft and jaw. The log is towed some distance astern of the vessel by a log-rope, which is attached to the jaw by a copper shank and a clamping-screw, *T*. To this copper shank is secured a strip of zinc, thus forming a weak galvanic battery.

An insulated wire furnishes electrical connection between the commutator brush or tongue, *R S*, and a Bell telephone in the chart-room of the ship, the wire making several spiral turns around the log-rope to guard against snarling. With the log thus towing astern of the vessel, it is evident that at every revolution of the log-wheel *A B C D* an electric circuit between the telephone and the zinc and copper of the shank is made and broken by means of the copper strip *mm'* of the lignum-vitae roller coming into contact with the elastic tongue *R S*, each 'make and break' being signalled by a tick of the telephone. To find the speed of the ship at any time, it is only necessary to count the number of ticks to the half-minute, as measured by the sand-glass, and read off from a converting table the number of knots and fractions corresponding to that number.

Sam Hubbard.

Science for a livelihood.

I am interested in the communication from C. B., Brooklyn, N.Y., under the above caption in the issue of *Science* for Sept. 10. Like C. B., I graduated with a good scientific education, had done some practical work, and possessed a greater desire to labor in scientific fields than to do any thing else.

Instead of making application to only four schools, however, I applied to over sixty, and received a negative answer from all of them, and at the end of it was told by an eminent professor in Harvard university that there were at least fifteen applicants for every vacant place of the kind in the United States.

That was nine years ago, and my experience since confirms me in the belief, that if the student is without wealth, and has no friends who will forward him in his chosen field, he will do wisest, and be most independent, if he turns his attention to agricultural, mechanical, or any other honest occupation by which he can make some money; and then, after his money is his own, he can put as much of it as he sees fit into his scientific work. Such a course may be galling to pride, and a disappointment to friends, but, in all probability, there are few positions in this country where a student of small means can find sufficient work in the natural or experimental sciences to earn bread enough to keep the wolf from the door.

W. F. Flint.

Winchester, N.H., Sept. 13.

Sea-water in the ears.

Science for Sept. 10 has a paragraph on this subject, but omits to mention that the momentum of tidal waves as they break upon the beach in this locality is sufficient to drive the water through the bather's nostrils, and up along the eustachian tube to the ears. In no other way is greater damage done to the ear in sea-bathing than this, since one cannot voluntarily close both mouth and nose, like marine animals, while bathing. I once saw a person go into the water with his nose embraced by a clothes-pin, and the greater number of bathers now protect the ears with wool. As I very well know from personal experience, it is not always easy to keep water out of the ears in surf-bathing, but I believe accidents from this cause are less frequent than formerly.

Samuel Sexton.

New York, Sept. 11.

An easy method of measuring the time of mental processes.

Mr. Jastrow's method of measuring 'simple reaction time' by means of a circle of people, as described in *Science* of Sept. 10, was first used, as far as I know, by Dr. Holmes, who, as he said, "experimented with an apparatus more expensive than had ever before been used, and yet within the reach and means of everybody." The result obtained from this experiment depends largely on the experience of the operators, and it can easily be reduced to $\frac{1}{10}$ of a second.

If Mr. Jastrow will consult the *American journal of science* for September, 1871, he will find an account of some experiments on reaction and distinction time made by the writer, in which, in addition to color and form, the exercise of distinguishing tones of different pitch was introduced. The 'distinction times' given in that article are considerably greater than those obtained by Mr. Jastrow. The time of a single reaction only was measured, and I strongly suspect that in all cases the time obtained from measuring the duration of a series of reactions rapidly succeeding each other will be found to be shorter than that deduced from single measurements. The reason for this is obvious.

T. C. Mendenhall.

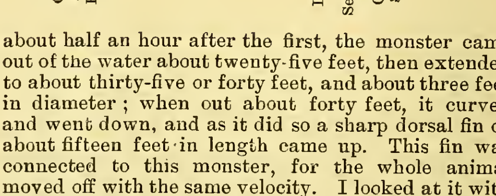
Washington, D.C., Sept. 13.

The sea-serpent.

With this please find an extract from an official report by Capt. Robert Platt, assistant coast and geodetic survey, with accompanying sketch of a 'sea-monster' seen by him near Cape Cod in October, 1878. Captain Platt is a trained observer, whose daily occupation at that time was to record just what he saw, and nothing more or less. I know Captain Platt so well that I have never doubted the existence of such a monster from the time his report was made known to me; and, if others have been sceptical, I hope that recent events have proven the matter beyond question.

[Extract from a report by Capt. Robert Platt, U. S. coast and geodetic survey, to the superintendent; written on board the U. S. coast-survey schooner Drift, Oct. 25, 1878.]

"I would also beg leave to state that Aug. 29, while becalmed off Race Point, Cape Cod, about four hundred yards from the vessel, we saw a sea-monster, or what I suppose has been called a sea-serpent. Its first appearance was that of a very large round spar two or three feet in diameter, from twelve to fifteen feet high, standing upright in the sea, but in a few minutes it made a curve and went down. It was visible about three minutes; the second appearance,



about half an hour after the first, the monster came out of the water about twenty-five feet, then extended to about thirty-five or forty feet, and about three feet in diameter; when out about forty feet, it curved and went down, and as it did so a sharp dorsal fin of about fifteen feet in length came up. This fin was connected to this monster, for the whole animal moved off with the same velocity. I looked at it with a good pair of glasses. I could not tell whether it had a mouth or eyes; it was of a brownish color. I enclose to you a rough sketch made by me, and submitted to all on board who saw the animal, and they all agree that it is a fair representation of the animal as it appeared."

B. A. Colonna.

U. S. coast survey, Sept. 4.

SCIENCE.—SUPPLEMENT.

FRIDAY, SEPTEMBER 17, 1886.

PSYCHOPHYSICS.

THIS is a comparatively new science, although its beginnings can be traced back into the last century. But until comparatively recent years it occupied a subordinate position in speculative psychology, and the phenomena constituting its province were not assumed to be distinct enough for separate investigation. At present, however, a certain class of students are endeavoring, by experiment, to give its method and results that exactness which is supposed to describe the function of science proper. The province of science has become more exactly defined in the course of its development until the proper criterion of its function is that measurement and demonstration of its results which takes its theories out of the reach of probabilities and conjecture and establishes them upon a basis of certainty. Introspective psychology has either presented unsatisfactory results, or the universal prepossession for experimental effects has desired to represent it so, and thereby contrast its uncertainty with the tangible and demonstrable products of exact science. However we may account for it, psychophysics has come in to dispute the territory of the older psychology, at least in the person of some of its admirers. It likes to speak of purely introspective psychology as out of date, and as if it were discredited merely because it is of the past. Innovation and change have predisposed inquirers to enthusiasm for the new, perhaps because all the great triumphs of modern science have been conquests over old views, or deviations from them ; the old has lost its prestige. Nothing has suffered more from this spirit than 'the old psychology,' as it is called by the admirers of psychophysics. The latter is taking rapid possession of scientific and philosophic interest, until students of the older philosophy are beginning to relax from their devotion, and to despair of retaining the homage which so many ages have paid to the idol of reflective thought.

Mr. Ribot's recent work on contemporary German psychology seeks to maintain and widen this breach between the two sciences : and we cannot but regret that it should be so ; for they are really distinct sciences, running parallel with each other, and have no more reason to come into conflict with each other than physics and chemistry. Their methods may be different, but are not on that account contradictory ; and the one should not be made all-absorbing to the prejudice of the other.

We frankly admit, however, that it is no wonder the scientist, accustomed as he is to experiment and definite results, feels a sense of dissatisfaction with the study against which psychophysics presents the charge of obscurity. Kantian and post-Kantian psychology has never been characterized by perspicuity ; and it is a natural revolt against it that even speculative Germany seems to have abandoned the popular gods of philosophy to find a new worship in experiments and facts quite in contrast with the genius of that people, disposed in so many particulars to take the high *a priori* road to truth, and to project every thing from consciousness, as it is accused of doing. Hence there is something of justice in the claim of psychophysics : it does tend to make its conclusions intelligible to experience ; and that is a very great gain. But, with these legitimate claims to our respect, it should not usurp the whole province of psychological experience, which it does not do, nor repudiate introspection as a proper source and method of knowledge, which it is too much disposed to do, forgetful of the fact that in so doing it really undermines the final test of its own results.

The field of psychophysics is much more limited than one would at first suspect. Its name might imply at least a partial combination of physiology and psychology : but its advocates exclude the main and distinctive features of both these sciences from it, and assign it a very limited territory ; as Dr. Wundt affirms, the field 'between inner and outer experience.' This means that it confines its investigations to phenomena which intermediate between purely mechanical events and purely reflective consciousness. Hence, on the one hand, such phenomena as circulation, assimilation, digestion, and on the other, such as perception, judgment, reasoning, memory, and imagination, are excluded from the field of its inquiries. Thus it is limited to the phenomena of sensation, which constitute the intermediate class spoken of. But even this class is not considered in its qualitative, but only its quantitative relations, hence it is still more limited. These quantitative characteristics consist of their intensity, psychic constancy, and reaction time. The last may be included under that of psychic constants, making two distinct problems for psychophysical investigation. That of the psychic constants is the more important of the two, as it has a bearing upon the speculative problems of psychology: it is concerned mostly with the measurements of time and space, or with those primitive experiences which determine the genesis of our empirical conceptions of them.

The quality of sensation is not a subject of experiment, but the characteristic of intensity gives rise to what is known as Weber's law, which designs to express the relation between stimulus and sensation in respect of their quantity. It is found that sensation does not increase in a direct ratio with the increase of stimulus: and hence the law is formulated to express a geometric ratio in the increase of stimulus, and an arithmetic ratio in the increased intensity of sensation; or, inasmuch as the absolute increase of stimulus is not always the same to increase sensation, it has been expressed to indicate that "sensation grows with equal increments when the excitation grows with *relatively* equal increments;" that is, the *ratio* between the quantities of stimulus is always the same, whatever the absolute quantities may be. This law is quite accurate within a certain range, but requires modification as we approach the maximum and the minimum of sensation. The ratio between stimuli is not the same for different forms of sensation, but varies within a large degree, although it still sustains its geometric relation. This fact, as well as something of the scientific accuracy claimed for the science, will be evident in the following table of measurements, giving the ratio between stimuli required for the several senses. The numbers indicate that any given stimulus must be increased by the amount of itself expressed by the fraction in order to produce a perceptible change in sensation. Nothing has been determined for taste and smell.

For touch	1-3
For muscular effort	1-17
For temperature	1-3
For sound	1 3
For light	1-100

Thus any given object or resistance must be increased by one-third of its force in order to produce a perceptible increase of sensation; and so on with the remaining senses. But the question arises, How far do such results give mathematical accuracy and exactness to the science of psychophysics? It is claimed that its accessibility to experiment gives it the proper exactness of a science, and that the old psychology is a mere jumble of verbal disputes. But the admirers of psychophysics forget both their own admissions and the ultimate court of appeal for their conclusions, as well as the nature of the phenomena to be measured.

We have only to consult the above table to discover that only the stimuli are expressed in distinct quantitative relations. It is true that these can be definitely measured, because they are objective quantities like all other commensurable forces. But it is very different with the intensity of sensation, although Weber and Fechner presumed to express its increase in an arithmetic ratio, with the geometric ratio of stimulus. As a matter of fact, the sensation and its increase are not measured in terms of the exciting cause: if they were, something of scientific accuracy would be given the results. But as it is, the only distinct knowledge we have when there is a definite increase of excitation, is, that there is a perceptible change in the intensity of sensation. All mathematical formulae to express one sensation in quantitative relation to another are purely gratuitous: whether one sensation is once, twice, or three times as intense as another, no one can presume to declare with mathematical definiteness, because there is only a subjective criterion for intensity of sensation, and such a criterion affords no commensurating unit for others. This is admitted by psychophysicists themselves in complete unconsciousness of its significance against the claims of mathematical and scientific accuracy for psychology.

"Doubtless," says Mr. Ribot, an enthusiastic defender of the new science, "our states of consciousness are undetermined magnitudes. But is it impossible to determine them, that is, to submit them to measure? The essential condition of measure is, that there be a fixed relation between the measure and that which is measured;" and he elsewhere observes that "there is no unit or common measure to which we can refer two sensations to determine their intensive magnitudes." A still more forcible statement and admission is the following: —

"We assert without hesitation that it is brighter at mid-day than by moonlight; that the firing of a cannon makes more noise than the firing of a pistol. There is, then, a quantitative comparison of sensations; but we can only say there is equality or inequality, never *how many times* one sensation is greater than another. Has the sun a hundred or a thousand times more brilliancy than the moon? Does a cannon make a hundred or a thousand times more noise than a pistol? It is impossible to answer this question. The natural measure of sensation that each man possesses reveals to him the more, the less, the equal, never the *quantum*. Our determinations are always vague and approximate."

Such admissions should certainly modify the pretensions of psychophysics to an accuracy not claimed or possessed by the old psychology, and they do prove fatal to the claim of any such exactness as is enjoyed by the physical sciences. The truth and importance of the law within the range of stimuli will not be denied; but as long as it is a mere assumption for purposes of definite expression that intensities of sensation are mathematical multiples of each other, there will be no reason for supposing one ratio rather than another, and hence the law proves absolutely useless for determining any exactness in psychology. In any case it could reach it only by the introspective method, which psychophysicists are so disposed to disparage, and yet only a little reflection is required to observe that introspection in one of its phases is the only valid testimony to the results already obtained and formulated. The truth is, there is no intelligible reason for setting up an opposition between introspection and experiment in order to place psychophysics in the rank of exact sciences. The question should not be as to its exactness or mathematical expression, but it should be the truth of its facts and conclusions. Conformity with mathematical laws and expression is not the sole criterion of truth or science, and hence by insinuating it the investigator but declares the transient and ephemeral nature of his speculations.

The problems and phenomena of psychic constants are much more interesting and important. They are welcome also as giving much more definiteness and intelligibility to some of the questions of transcendentalism, and, far from contradicting it, they seem to confirm it. The illusions producible in our conceptions of time and space under various circumstances stimulated inquirers to experiment for some constant in our various space determinations, and to measure the duration of psychic phenomena, or the intervals between stimulus and sensation, in order to find some constant for time. The time was when these two data of intelligence were supposed to be fixed and invariable, but further observations show them exposed to all the illusions belonging to perception in general, and hence the question arose both as to their origin and their nature. Transcendental philosophy anticipated experiment in making them ideal, but it was more successful in talking about them than it was in making its views clear and intelligible. Experimental psychology has come in to furnish us with definite data for reconsidering our empirical conceptions of them.

The nervous organization exhibits very different susceptibilities in different parts of the body: in some portions of the sensorium distinct and coexistent sensations are more nearly related in space than at others. In some cases it is also difficult to distinguish direction in the moving cause of sensation. Thus in different stages of maturity and development, space relations vary in definiteness. The sensibility of different parts of the body has been accurately measured and tabulated, so as to show the different ranges of experience in sensation. For the palm of the hand, the finger-tips, the back of the hand, the arms, the shoulder-blade, the back, different parts of the face, the soles of the feet, etc., sensibility varies, both in respect to the threshold of sensation and the determination of separate excitations. In some cases there is only consciousness of affection, and no distinct knowledge of location. And in the case of vision the illusions respecting geometrical dimensions are indefinitely numerous; so that serious doubt may be raised as to the correctness of our ordinary spacial judgments, and some other constant must be demanded for theoretical purposes than is found in practical experience.

Hence the problem has been to find whether vision or muscular effort was the more accurate in the determination of space. But experiment has succeeded only in showing the corrective influence of one sense upon another without discovering any fixed conception to serve as an invariable measure for space. And so with the experience of time. Innumerable experiments show that our conception of duration can be varied with all sorts of circumstances: sometimes it appears indefinitely long, and at others incredibly short, while other facts go to prove that there was no difference in the two instances. Now moments may seem an age, and again there seems no interval of time between the beginning and the end of hours. And again our conception of time is influenced by the period required to realize an event or experience: it may be lengthened or shortened by the state of vitality, or the state of attention and application. The time between stimulus and sensation is different in different individuals, and yet it cannot be determined by subjective measurement; so that some other constant must be assumed to prove variability in any case. Hence there is a resort to heart-beats, or to certain forms of rhythm, as the better representatives of our definite conceptions for time, and perhaps to certain forms of co-existence as criteria for definable space. Thus space and time do not appear as absolute and simple as supposed in the older philosophy, but relative and complex, at least in experience. Other mental phenomena must be considered in our notion of them.

The attainment of such conclusions is due entirely to the experimental method, which has insisted upon actual demonstration of all speculations regarding ultimate conceptions. This scientific spirit has added new interest to a study which was threatened with neglect, because it was too content with mere assertion, and presumed upon the self-evidence of words to communicate its wisdom. Although it may determine nothing as to the quality of sensation and consciousness, it will do much to drive away the mist that has ever hovered over many psychological speculations.

Still experiments have not yet demonstrated the derivative nature of time and space, although they have gone far to make them a matter of intelligible consideration and discussion. They have shown the variability of our empirical conceptions of them, but have not destroyed their validity as postulates of experience, because no special sense-perception may be constant enough to supply a criterion of their fixity. Indefinite conceptions of them at least are always assumed. However we may seek for some regular and uniform experiences within the ken of consciousness to serve as constants for them, or as the phenomena which determine and represent our conceptions of them, we shall find by closer scrutiny that some notion of time and space is already postulated in the very phenomena supposed to give the psychic constants for them ; that is, we shall in vain endeavor to go outside of time and space to discover events which will account for them, or present their genesis from non-spacial and non-temporal relations. But at the same time experiment is providing data to render them clearer and more tangible to ordinary reflection than older speculations. For space the theory of 'local signs,' both tactual and visual, is taking the place of transcendental conceptions ; and for time, the theory of discontinuous states of consciousness that may be objectively regular and uniform in their causes.

Among the most important contributions, however, which psychophysics has given to science, are the results showing the differential functions of the nervous system. The sense of temperature has been shown to be as distinct from touch as that is from vision, and even a different nerve is required to perceive cold from that which perceives heat. How far this differentiation of the sensorium may be carried, no one can predict. But even the established conclusions of the present will exert a far-reaching influence upon psychological speculations, and none more than the fact that distinct nervous organisms are required to receive representations once supposed to be connected with the same sense. It is too soon to predict what influence it will have in modifying older views : it will certainly modify them, but there is always a truth, even in the past, that avails to survive the mortality of language ; and, although psychophysics may compel us to reconstruct some theories, it will not wholly do away with the intellectual conquests of history, or oblige us to cast dust in the face of introspective methods, merely to gratify and strengthen an unnecessary prejudice against older opinions.

J. H. HYSLOP.

ANATOMICAL AND MEDICAL KNOWLEDGE OF ANCIENT EGYPT.

IN a paper read at a recent meeting of the Royal institution of Great Britain, Prof. A. Macalister gave an account of the ancient anatomical and medical knowledge of Egypt, of which the following is a summary from the *Lancet*.

The surviving fragments of the early literature of Egypt are mainly of a religious character ; but this is not to be wondered at, for the genius of the people was essentially religious, and their doctrine of the future state leavened their national life in almost every particular. To them the body was an integral part of the immortal humanity : therefore it could not be permitted to turn to decay, but had to be preserved from corruption that it might be a fit receptacle for the soul to dwell in through eternity. Their treatment of the body was thus dependent on their belief of its relation to the soul, and this, we learn from their religious writings, was a relationship of eternal independence. To secure perpetual preservation, the body had to be properly embalmed, the cavities opened and subjected to the action of antiseptics. Although the body was sacred, under the special protection of the god Thoth, though each part was under the guardianship of a special divinity, yet this sacredness did not preclude careful inspection and the processes necessary for preservation, for all parts had to be perpetuated.

Embalming was a religious rite, to be performed by the priests of the Cultus ; and the historian Herodotus has preserved for us what is doubtless a substantially accurate account of the different methods whereby it was done in the later times in which he lived. The organs removed from the bodies of persons of the better classes were not returned into the body, but were preserved in vases of alabaster or stone, surmounted by the heads of the four divinities of Hades, the sons of Horus and Isis.

During the ascendency of Greek influence in Egypt, Alexandria earned the reputation of being the chief school of anatomy and medicine in the world. Erasistratus, who lived in the days of Ptolemy Soter, B.C. 285, was an anatomist of such enthusiasm, that he and his disciples received from the king criminals condemned to death.

But this Alexandrian school, although upon Egyptian soil, was essentially Greek in spirit : even Herophilus had learned some of his anatomy from Praxagoras of Cos, although, as the anatomy of the earlier Greek school had been derived from Egypt, it was but returning to the mother-country the traditions of culture derived therefrom. It was in Egypt Democritus of Abdera studied, and so was fitted to teach anatomy to Hippocrates, the father of medicine. The three pithy and graphic letters on anatomy (which are extant), which it is supposed Democritus sent to Hippocrates, may well have been the result of his Egyptian training. At a later period it was at Alexandria that Galen pursued his study of anatomy under Heraclianus, and the anatomical school of Alexandria survived until the Mohammedan invasion of Amru in A.D. 640.

That much even of the earlier Greek medicine, anatomy, and pathology was derived from Egypt, we learn both directly and indirectly. Most of the vegetable drugs in use in Greece were natives of Egypt; and Galen, speaking of one prescription called 'epigonos,' tells us that it was obtained from the adytum of the temple of Ptah, at Memphis. He quotes it, and other Egyptian prescriptions, from the book Narthex, written by Hera of Kappadokia.

Medical colleges of far greater antiquity than that of Alexandria existed in the priestly schools of Memphis, Heliopolis, Sais, and Thebes. These were much more faithful exponents of the purely Egyptian system of the art of physic.

Of the ancient medical literature of Egypt, two nearly complete treatises are still extant, and six or seven fragments of others. These vary in date and in perfection. The most complete are the Papyrus Ebers and the Medical papyrus of Berlin. The fragments which are noteworthy are, the British museum papyrus, formerly the property of the Royal institution, the Papyrus VI. of Boulaq, the Magical papyri of Turin and Paris, the Coptic medical manuscript in the Borgia library, and the Greek papyri 383 and 384 of Leyden.

ECONOMIC STATISTICS.

THIS volume is another of the *handbuchs* which the Germans of this generation are diligent in compiling. Encyclopedic in character, it deals with the statistics of production and consumption of economic goods in all countries where numerical data can be obtained. The germ of the work is discovered in a volume published by the same author in 1867, which presented certain commercial statistics collected during an extensive voyage around the earth. Since then two similar world-tours have been undertaken, while official reports have been ransacked to yield up their treasures. The result is this book, containing a mass of statistical information in regard to almost every conceivable commodity which nourishes man, or which enters into manufactures as raw material. The scope of the work embraces the statistics of minerals, mechanical forces, machinery, steam-power, electricity, money (both paper and metal), waterways, railroads, postal service, telegraphs, marine cables, and telephones.

To illustrate the plan pursued, the section treating of grains is here analyzed. At the outset is given the proportion of the area of Europe which is devoted to the culture of the several cereals during successive decades in different countries. The condensed tables reveal the wheat situation at once. Unfortunately, however, in such a work as this the picture cannot be a late one, and is useful in large part only for purposes of comparison.

No figures are apparently given for any year since 1883; but the author, in arriving at averages, has been careful to choose periods of legitimate length to be used in such comparison. The tables are re-enforced not only by summaries of the crops produced, the exports and imports, and the consumption, both total and per capita, but also by historical and descriptive matter. One table shows us the source of English wheat in successive years. Five pages are set apart to the statistics of the United States, while the South American grains receive their share of attention. This is finally all summarized in one short tabulation, presenting the total world-production of wheat, rye, barley, oats, and corn, in hectolitres and centimetres.

There is little attempt to generalize from these census wastes of figures; but no one can pick his way through this interlacing of exports and imports, as here interwoven, without reflecting upon the immense fact of the internationalism of trade. But a century ago the total of the world's export trade in corn was but eleven million hectolitres, while now it annually reaches five hundred and fifty millions.

The fortunes of some comparatively insignificant commodities are tracked from country to country. Neither pork-packing in Chicago nor the trade in human hair is neglected; and no fact is too minute for this fact-hunter, who carefully informs us that the skilful hair-trader distinguishes between French and German hair by the sense of smell. One of the most valuable tabulations is that on p. 640, summarizing the present condition of the world's trade. Naturally the grand total values of imports and exports do not exactly balance, the former being about ten per cent in excess

Das wirthschaftliche leben der völker. Ein handbuch über production und consum. Von Dr. KARL VON SCHERZER. Leipzig, *Dürr*, 1885. 8°.

of the latter: these are 35,691, and 32,645 million marks respectively. Of this amount, our own country, fourth in the race, furnishes about one-tenth; Great Britain leads with one-fifth; while France and Germany hold the intermediate positions. By such tables the work supplements and often corrects Mulhall's statistical volumes, and is more satisfactory in so far as Dr. Scherzer is more generous in stating his authority for statistics, which are necessarily more or less a matter of dispute. This literary accomplishment is one not yet acquired by Mr. Mulhall. Especially desirable are such references when the statistics of gold and silver are given. Not a little of the confusion of the present discussion concerning the merits of bimetallism is due to the conflicting statistics of gold and silver production; and all writers on the subject should be careful to state their authority when using such figures as a basis for argument. Here Dr. Scherzer follows Neuman-Spallart and Soetbeer. The work is scholarly and painstaking, and will be of service to all students desirous of new statistical conclusions or verification of others' work.

CONN'S EVOLUTION OF TO-DAY.

This book is defined by the author as "a summary of the theory of evolution as held by scientists at the present time, and an account of the progress made by the discussions and investigations of a quarter of a century." The book, however, deals chiefly with the evolution of animals. Inorganic evolution is dismissed with some few words about the nebular hypothesis, and, partly in statement and partly by implication, the author expresses the view that inorganic evolution is scarcely worthy of treatment by scientific methods and by scientific men. In so doing, he ignores the entire field of geology. In a manner equally curt, the subject of vegetal evolution is passed over, and the author begins his theme proper, which is a discussion of the nature of the evidence for and against the doctrines of animal evolution. He nowhere gives a clear and comprehensive definition of evolution, though the introduction is largely devoted to a discussion of the term, and to a denial that evolution is equivalent to Darwinism. Throughout the book an evolution of animal forms is maintained, but the doctrines taught by Darwin, as understood by the author, are, in general, though rather vaguely, denied. The reader is made to feel, that, in the author's mind, Darwinism is the name of something wicked that good people must disavow; and, while the author reaches the conclusion that evolu tion is probably true, he wishes it to be understood that there is no taint of Darwinism in his beliefs.

The first chapter treats of the mutability of species, in which various facts, arguments, and opinions, *pro* and *con*, are briefly set forth, and an attempt made to derive an average therefrom; as if a mean result of contradictions could be used as a proximate truth, in the same manner that a mean of instrumental observations is used as an approximate determination. The same error, but in a minor degree, lurks in the remaining chapters.

In the second, third, fourth, and fifth chapters, the author reviews the arguments for evolution derived from the principles of classification, the paleontologic succession of forms, the development of the embryo, and the geographic distribution of animals. In these four chapters he skilfully and fairly characterizes four lines of inductive reasoning by which the specialization of a multiplicity of forms is demonstrated, and also, though not quite so clearly, shows how progress towards higher forms results therefrom. This part of the book, which is the body of the work, has great merit as a popular and fair discussion of the subject of the evolution of animals. It is reasonably devoid of technical terms, while broad facts and general principles are happily stated and explained to the understanding of intelligent readers who are themselves not specialists in zoölogy. In this respect the book is timely; and the general reader can gather therefrom a very good conception of the doctrines of animal evolution, and the status of development-opinions among scientific men, and of the new problems connected therewith that are arising through expanding research. The author has made as successful an exposition of this subject as, perhaps, is possible by this method of treatment, which is a characterization of facts and arguments, in lieu of a grand marshalling of the facts themselves, — it being the plan of the author to write for the general public rather than for the smaller body of scientific men.

If the reader of Mr. Conn's book could have a preliminary study of some one order of plants or animals, or of some line of embryologic development, or if he could study the origin and structure of some mountain-range, or the geology of some river drainage-system, so as to be able to fully appreciate the multitudinous facts that are gathered into some simple induction by the patient labors of modern scientific research, the general characterizations of the author would have a profound effect. Perhaps no man may have a very clear comprehension of what the

Evolution of to-day. By H. W. Conn, Ph.D. New York, *Putnam*, 1886. 8°.

doctrine of evolution is, until he has had an objective study in at least some narrow field of research.

The new questions and accessory principles which are rapidly springing up about the central doctrines of evolution are pretty well set forth in the seventh chapter, entitled 'More recent attempts to explain evolution.'

The last chapter is on the evolution of man, and it is altogether unsatisfactory. It seems to have been written as a logical complement to a work on animal evolution, but it deals rather more with moral and metaphysical speculations than with the facts of the science. So far as it treats of human evolution, aside from its speculations, it refers simply to the animal man in his zoölogic relations. Human evolution, that is, the development of those characteristics which make man *man*, — the growth of human activities, — is ignored, and yet this is the largest subject in the literature of the world. embracing, as it does, the evolution of arts, the origin and development of institutions, languages, philosophies, or opinions, and all modern scientific psychology.

But a very small part of human evolution is embraced in theories of man and monkey kinship. The origin and growth of the humanities, i.e., those things which characterize humanity, have always been the subject of history ; and all history is now in process of reconstruction upon a sounder theory than any which has hitherto obtained, and every writer in his own field postulates evolution by discussing the origin and development of the art, the institution, the language, the philosophy, or the psychic operation of which he treats. J. W. POWELL.

SIDGWICK'S HISTORY OF ETHICS.

THIS little book by Professor Sidgwick is a reprint of his article on ethics in the 'Encyclopaedia Britannica,' with considerable alterations and additions. As originally published in the encyclopaedia, it was necessarily quite condensed in style, and it still retains that character to a great extent, thus presenting a much greater quantity of matter than is usually found in books of the same size.

The work is designed especially for students, and it seems to us admirably adapted to its purpose. The compression of the style is perhaps a defect from a literary point of view, but this is of little consequence in a text-book. The work is divided into three parts, treating of Greco-Roman, Christian, and modern ethics respectively. It is evidently based, as the author himself says, on a thorough study of the original authors, only certain small portions, chiefly in part ii., being written at second-hand. It is marked, too, by almost perfect impartiality, — a merit of the first order in an historical work, but at the same time one seldom found in so high a degree. The author has been engaged in controversy with many ethical writers, and it might have been thought that a history of ethics from his pen would partake of the same character. On the contrary, it is devoted almost exclusively to the work of exposition, with only occasional criticisms when they seemed really required to point out serious defects in the systems described.

In the first part, attention is mainly directed to the three great ethical philosophers of ancient Greece, — Socrates, Plato, and Aristotle ; and, though less than fifty pages are devoted to them, their modes of thought, their leading doctrines, and their relations to each other, are very clearly brought out. The author also traces the connection between all the Greek ethical systems, and shows in an interesting way "how, from the spring of Socratic conversation, flowed the divergent streams of Greek ethical thought." The second part of the book is much shorter than either of the others, as it should be ; for, whatever may have been the influence of Christianity on practical morality, it can hardly be said to have contributed much to ethical philosophy. In treating of modern ethics, Professor Sidgwick confines himself in the main to English philosophers, on the ground that his work is intended for English readers, and that English ethical thought has developed itself, for the most part, independently of foreign influence ; to which he might have added, that English ethical philosophy is by far the most important that has appeared in the world in modern times. The doctrines of the various English philosophers are briefly but clearly outlined, and special care is taken to point out the positive contributions of each thinker to the ethical thought of the world. Professor Sidgwick's book can be heartily commended to all who wish for information on the important and fascinating subject of which it treats.

Outlines of the history of ethics for English readers. By HENRY SIDGWICK. London, *Macmillan*, 1886. 12°.

THE PSYCHOLOGY OF REASONING.

M. BINET, a prominent member of the Society of physiological psychology in Paris, has been busy for many years in experimenting upon hypnotic subjects, who seem to be so abundant and interesting in France. He has formed one of a small band of workers, with Charcot as their

La psychologie du raisonnement, recherches expérimentales par l'hypnotisme. Par ALFRED BINET. Paris, *Baillière*, 886. 12°.

head, who have brought to light many striking and remarkable facts about these abnormal conditions. This work suggested to M. Binet that some light might be shed on the nature of the reasoning process by observing the half-conscious actions of hypnotics; and the book before us is the result of this suggestion. The volume has been called out upon a slight provocation, and its argument in brief is as follows. A perception may be compared to the reading of a book: we attend to the sense, and not to the letters; we read something into these black marks. So, too, our sensations are taken, not for what they are, but for what they stand for, for what they tell.

By means of these perceptions the mind forms images, which are its fundamental elements. It is these images that form our stock in trade, and their prevalent nature determines many of our peculiarities of mind. They constitute one's mental background, one's apperceptive bent. These images come into combination and suggest each other as well as fuse together. The laws that condition this process are the laws of association of ideas, on which the English psychologists lay such stress. A close analogy can be traced between a syllogism and the process of perception: the perception is the conclusion; it expresses a judgment; it says, for example, this is an orange. The remembered images which enable me to recognize this as an orange play the part of the major premise, for this too expresses the results of past experience; and the minor premise which is brought into relation with the major by a certain similarity is the sensation itself. The analogy is closer than this crude outline indicates, and is really a highly suggestive view of the matter. It makes the syllogism the fundamental process of the human mind. It makes the triad, in which a middle term acts as the go-between for two others, of the utmost importance. This is the mechanism of reasoning, the general formula for getting valid deductions, as well as a fundamental natural process of the human mind. Man is thus in a new sense a rational animal; reasoning is a sort of new sense.

In the course of the development of this argument many interesting and valuable facts are brought out. It is only just to the author to notice a few of these. One result of his experimentation on hypnotics, and one physiological point, will serve as samples.

The subject, an hysterical young girl, was told that M. Féré (an associate of M. Binet) would be invisible to her. From that moment on, she ran against him, and thought it a miracle that she should be opposed by something she could not see: a hat on his head seemed suspended mysteriously in the air. At the close of the session they forgot to disabuse her of this forced idea, and three days later M. Féré was still invisible; and, what was more remarkable, it was found that she had lost all remembrance of him: she knew neither his name nor his person, although he had been her friend for ten years. When he was made visible, she did not recognize him. At this period she had an hystero-epileptic attack, and from then on, M. Féré was her old friend as before. This case is used to illustrate the law of regression, which requires the most unstable and latest acquired knowledge to go first in dissolution, and to be re-acquired last in evolution. The patient, in recovering, first recognized M. Féré as an object, then generally as a man, and lastly particularly as her old friend.

In discussing the topic of the criterion of the difference of two sensations, the point is made that two sensations are distinct when they have a different local sign, a differently arranged group of accessory, secondary sensations. Two compass-points are felt as two when they have sufficiently different local signs. This local sign means that they can be localized. M. Binet tries the experiment, and finds that when two points are at such a distance apart as always to seem distinct when simultaneously touched, then, when either is touched separately, one can decide with confidence whether the touched spot is to the right or to the left, i.e., one can localize the sensation; but when the distance between the compass-points is less than this, the points are localized correctly only half the time, i.e., as often as the action of mere guessing would bring about. This point is a really valuable contribution to the psychology of touch. M. Binet's study can be recommended for its suggestiveness and the facts incidentally noticed, as well as for his ingenious analogies between psychology and logic. J. J.

THE *Medical and surgical reporter* gives the following interesting facts concerning the water-supply of the European capitals: Rome heads the list with her 204,000,000 litres of pure water every twenty-four hours (her population being 345,036, every inhabitant can dispose of 591 litres per diem); London comes next, for every one of whose 4,085,040 inhabitants there are 300 litres daily; Paris takes the third place, her population amounting to 2,240,124, and each inhabitant having for alimentary uses 58 litres per diem, and for secondary purposes 169, — a total of 227 litres; Berlin has 1,302,283 inhabitants, with 140 litres daily to each; Vienna, 770,172, 100 litres each; Naples, 463,172, with 200 litres; and Turin, 278,598, with 98 litres a head every twenty-four hours.

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SCIENCE.

FRIDAY, SEPTEMBER 24, 1886.

COMMENT AND CRITICISM.

THERE IS NO MORE IMPORTANT SUBJECT for both thought and action than the wholesomeness of the milk-supply of our large cities. It has been estimated that in the city of Brooklyn the daily consumption of milk amounts to 152,575 quarts. A considerable part of this forms the sole food of thousands of children and invalids, and it is therefore of the greatest importance that it should be of the highest degree of purity attainable. The influences at work to deterioriate milk are manifold. The cows themselves may be affected with tuberculosis or some other form of disease which may by the medium of the milk be communicated to its consumer, or the sanitary condition of the stable in which these animals are confined may be so defective as to render the atmosphere impregnated with filth and the germs of decomposition, which act most perniciously upon the milk. In speaking on this subject before the Massachusetts medical society, Dr. B. F. Davenport called attention to the readiness with which milk will absorb impurities, and also to the fact that the milk which is delivered in Boston is, at the time of its delivery, nearly three days old, and that it has been exposed to such a probability of contamination as to be practically on the very point of souring. He attributes no inconsiderable part of the summer diarrhoea to this changed condition of the milk. Dr. Davenport believes that the difference in the coagulation of human and cow's milk in a child's stomach is owing to the difference in their chemical reaction; that of cows being acid, and the other neutral or slightly alkaline. If milk could be served to the consumers on the same day of its production, and in a condition free from all impurities, there is no doubt that this would be an important factor in reducing the sickness and death of the infantile population.

PROF. E. C. PICKERING, the director of the Harvard college observatory, has put forth a pamphlet in which he broaches a scheme which may result in much advantage to the astronomical world, and in time to the outer world, which is slowly but surely benefited by all progress in science. The premises from which Professor Pickering starts are these: observatories with good instruments but no funds to pay observers, and good astronomers with no instruments or money to get them. Like all schemes of this day, Professor Pickering's is one of consolidation. He would have a fund raised the income of which should be available for paying the cost of astronomical work, whether it be done at Harvard, at the Lick observatory, or in Europe, — no matter where, so long as the workers were fit for their labor. As Professor Pickering is cognizant of the good results obtained with the Elizabeth Thompson fund for scientific investigation in general, being one of the trustees, we judge he must be encouraged to employ the same method in his own field. The plan as given in the pamphlet is one deserving the attention of all able to aid scientific work.

The Lick observatory, although so well equipped, is a case in point. Of the $700,000 given by Mr. Lick, $500,000 have been expended for the 'plant.' Although the whole plan of the observatory has been made with direct reference to keeping its running expenses low, it is clear that the company of astronomers will have to be kept small. It would require a staff of at least ten astronomers to return the full results from the outfit, and at present not more than three can be employed. The work of these must be concentrated on the large equatorial, and even then their energies will not be sufficient to utilize every moment. Now, this is Professor Holden's plan, and we suspect he was hard-pressed to devise it: "We mean to put the large telescope at the disposition of the world by inviting its most distinguished astronomers to visit us one at a time, and to give to them the use of the instrument during certain specific hours of the twenty-four. Each day there will be certain hours set apart when the observatory staff will relinquish the use of the equatorial to distinguished specialists who will come from the United States and from Europe to solve or to attack some one of the many unsolved problems of astronomy. In this way we hope to make the gift of Mr. Lick one which is truly a gift to science, and not merely a gift to California and to its university."

IN A RECENT NUMBER of *Science* it was stated that cholera did not seem to be very active in Italy, although it had extended thence to Trieste and Fiume. From here it has invaded Carmola and Croatia. At Lie, a village of Croatia, it seems to have awakened to new life, developed doubtless by reason of the unsanitary condition in which it has found the inhabitants of that place, some nine hundred in number. Although it seems to have but just appeared in that place, ninety persons are reported as having contracted the plague, of which number twenty-eight are already dead. It will be seen from this that the disease must be of a very virulent type. The excitement among the people is said to be intense and uncontrollable. The scenes which were enacted in Spain during the epidemic which ravaged that country are being repeated in Croatia. The physicians are being stoned, and wives and children deserted. The superstition of these people is so great that almost any form of barbarity may be expected. The matter begins to have a serious aspect for central Europe, when cholera in a virulent form has obtained so firm a foothold in Austria; and, if the disease continues to spread, something like a panic may be anticipated. If the report of the appearance of cholera at Pesth is confirmed, the danger is greatly increased, as the onward march of this epidemic disease is greatly favored, when it reaches cities situated upon rivers which are great highways of travel.

THE FEVER which broke out in Biloxi, Harrison county, Miss., in August last, has occasioned great excitement and alarm throughout the length and breadth of the Mississippi valley. The opinion was expressed by us at that time, that it was undoubtedly yellow-fever. This was based upon our knowledge of the skill and experience of Dr. Joseph Holt, president of the Louisiana state board of health, who declared the disease to be of that nature. This opinion has been controverted by the physicians of Biloxi, which is not a matter of surprise, and also, as appears in the daily press, by the physicians of the U. S. marine hospital service. We have just received from Dr. Holt a detailed account of the outbreak and its subsequent history, and are more convinced than ever that the citizens of Biloxi have had true yellow jack in their midst, and that, if the disease is now under control, that result has been attained by the vigorous action of the Louisiana board in instituting a quarantine against the infected city. Had this not been done, the existence of the fever would probably have been concealed until it had obtained such a hold that months rather than weeks would have elapsed before it was conquered. It is a sad commentary on human nature, that not only the people, but even medical men and officials, will attempt to delude themselves into the belief that a pestiferous disease does not exist in their midst, simply to avoid the risks to reputation and commerce which a knowledge of the true state of things would create, when they must know, from an experience which has been repeated over and over again in the past, that concealment or suppression can at best avail nothing, and that such a policy can but result in a wide-spread and probably uncontrollable epidemic, which will cause untold suffering and misery, and increase the mortality a hundred-fold.

THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE British association meeting is now drawing to a close, and may be said to have been very successful in all respects, but without any great sensation. About twenty-five hundred tickets have been taken for it, and the local arrangements were most complete. A special feature in them is a large exhibition of the manufactured products of this so-called 'workshop of the world.' Great care has been exercised in the selection of the exhibits, which must have been produced within a radius of fifteen miles from the centre of the town, and they illustrate in a remarkable degree the applications of science and art to manufacturing processes. A very large number of firms have also thrown open their works to the inspection of visitors. An unusual number of colonial and American visitors are attending the meeting, among the latter of whom Professor Barker and Prof. Carvill Lewis, both of Philadelphia, are prominent figures. The president, Sir W. Dawson of Montreal, opened the meeting with an address upon "The geology of the Atlantic Ocean and the land on its borders," which, together with the addresses of Prof. G. H. Darwin, president of the section of mathematics and physics, and of Mr. Crookes, president of the chemical section, will be found in full in *Nature* for Sept. 2. The subject of the former was "The value of the unit of geological time, from the point of view of cosmical physics." Mr. Crookes dwelt, in somewhat hypothetical fashion, it is true, with the genesis of the chemical elements, and he suggested a process for their evolution by the gradual cooling of primordial matter termed 'protyle' (analogous to protoplasm), which contained within itself the potentiality of all possible atomic weights. The keynote of the presidential address by Professor Bonney to the geological section was contained in the phrase, "the application of microscopic analysis to discovering the physical geography of bygone ages." In the biological section Mr. Carruthers, the president, drew attention to the past history of those species of plants which still form a portion of the existing flora. Sir F. Goldsmid, who presides over the geographical section, took for his subject "The means of popularizing the study of geography," a contribution to which end is seen in an exhibition of appliances therefor, open during the meeting. In the section of economic science and statistics, Mr. J. Biddulph Martin, in his presidential address, gave an exposition of the claims of this subject to a scientific status. In that of mechanical science, the president, Sir James N. Douglas, dealt with the peculiarly appropriate subject of lighthouses, since probably the largest manufactories of lighthouse apparatus in the world are to be found in Birmingham. Lastly, in the anthropological section, Sir George Campbell recommended from the presidential chair the systematic and scientific cultivation of man with a view to both physical and mental qualities, — 'homi-culture,' in the same sense as oyster-culture, bee-culture, etc.

Turning to the general work of the meeting, it may be remarked that there were, at its commencement, between six hundred and seven hundred papers to be read and discussed in these various sections. Geology seems the most prolific, that section being almost overburdened with work. Two subjects for special discussion were selected some months ago: 1°, 'The theory of color-vision;' 2°, 'The nature of solution.' The latter was confined to the chemical section, but the former was conducted at a joint meeting of the physical and biological; and it was remarked at the outset that on no previous occasion had two sections held a joint discussion. The result was so successful, that it is hoped this precedent may be followed. No formal papers were read, but the subject was opened by Lord Rayleigh, who, in a speech of some length, reviewed the theory from the physical point of view. Colors might differ in three ways, — brightness, freedom from dilution with white, and hue: hence, from any four colors and black, a match might be made. He insisted very strongly on the distinction in effect between mixing colors (or paints) and mixing lights. No other known colors than red, violet, and green were 'primary,' though it was possible that some other unknown tints might be the real primary colors. In the so-called color-blindness, color-vision was usually twofold, or dichroic. All that he said, however, involved the assumption (probably true) that a mixture is more complicated than its ingredients. Dr. König of Berlin followed with an account of a large series of very careful experiments upon elementary sensations of color, — an analysis of color-sensations without any hypothesis, — which led him to the conclusion that the views of Thomas Young as to color, viewed in the light of modern experimental research, were certainly true. Dr. Michael Foster, speaking from the physiological point of view, pointed out to the physicists the difficulty of applying their theories of color, and expounded Hering's theory, according to which colors might be divided into pairs, one of which produced assimilation in the substance of the retina, and the other dissimilation, such as blue and yellow, red and green, and so on. Mr. J. Tennant pointed out that both Hering's and Young's theories had three independent variables, and led to the same general results. As, however, Hering's unquestionably explained the phenomena of simultaneous contrast best, he preferred it on that ground. The discussion came to a premature end, from lapse of time. That upon the nature of solution was opened by Dr. Tilden, who had studied the subject mainly from the point of view of the thermal phenomena occurring at solution. He presented an able summary of our knowledge of the subject, and showed that the solubility of a salt depended mainly on its melting-point, as well as on similarity of constitution between it and the solvent. Dr. Nicol showed experimentally that the molecules of a salt stood in the same relation to all the molecules of the water in which it was dissolved, or, in other words, that salts did not retain their water of crystallization in solution. Dr. Armstrong, Mr. Hartley, and Dr. Gladstone, however, differed from this view, considering that the hypothesis of 'residual affinity,' broached by Helmholtz, afforded a sufficient explanation of observed facts.

At one of the general evening meetings, Professor Rucker delivered a brilliant lecture to a very large audience, upon 'Soap bubbles.' The experimental illustrations, all of which were projected on a screen by the electric light, were of exceeding beauty and invariably successful. The particular point brought before the audience was the thickness and other properties of the black film of the bubble. The unit of measurement employed was the millionth of a millimetre. It was shown that this thickness varied considerably, but that the optical and electrical methods of measurements agreed closely in any particular case. Generally these black films range from 7.2 to 14.5 units in thickness, so that from 4 to 720 molecules could lie side by side therein, according to the view of the size of molecules adopted. A very extraordinary phenomenon was the sharply marked edge of the black film, a sudden and not a gradual increase of thickness taking place, between it and the colored film. The influence of surface tension and viscosity upon this was discussed, and the important influence of these researches upon the dynamical theory of liquids was insisted upon; the lecturer, who quoted Sir William Thomson in support of his views, considering that in this sharp edge there was experimental evidence, first, of a minimum of surface tension; and, secondly, of an alteration of the nature of force in play between the molecules, which had often been assumed in physical investigations, but of which direct evidence had hitherto been wanting.

A day was devoted to the consideration of electrical subjects from the mechanical or engineering side. A warm discussion took place upon the relative merits of electric light and mineral oil for lighthouses, the general result being, that, even for lights of a low order, the electric light could compete most favorably in every point, as to efficiency, first cost, and cost of maintenance. The balance of evidence brought forward was unquestionably on the side of the electric light as regards fog penetration. On the question of secondary batteries, some remarkable evidence was adduced as to the improvements in detail lately effected therein, which rendered them more practically permanent, and free from disintegration. The most important subject, however, was that of electric safety-lamps for miners' use. Mr. Swan exhibited his latest form, which fulfilled all the conditions laid down two years ago for the Ellis Lever prize. The lamp was self-contained, and, with a current of 0.4 amperes, gave the light of one candle for twelve hours: it weighed five pounds and a half, and its secondary battery was much more simply recharged than an ordinary Davy lamp. Moreover, a most ingenious fire-damp indicator, accurate to within 0.5 per cent, was attached to it. Mr. Swan claimed that it was more efficient, more safe, and more economical, than any miner's lamp in use.

At the general committee meeting held Sept. 6, Sir Henry Roscoe was elected president for the meeting to commence at Manchester on Aug. 31, 1887, and it was agreed to meet in Bath in 1888. An invitation from the government of New South Wales was received for forty or fifty representative members of the association to be present at Sydney in January, 1888, when the centenary of the colony would be celebrated. It was resolved to entertain the invitation; and the council was empowered to accept it, if, after due inquiry, they were of opinion that a sufficient number of truly representative men would agree to go.

On the night of Sept. 6 a lecture was given to the whole association by Professor Rutherfurd, who broached that night for the first time what might be termed a 'telephonic theory' of hearing. According to it, the cochlea does not act on the principle of sympathetic vibration, but the hairs of all its auditory cells vibrate to every tone, just as the drum of the ear does; there is no analysis of complex vibrations in the cochlea or elsewhere in the peripheral mechanism of the ear; the hair-cells transform sound-vibrations into nerve-vibrations similar in frequency and amplitude to the sound-vibrations; simple and complex vibrations of nerve energy arrive in the sensory cells of the brain, and there produce, not sound again, of course, but the sensations of sound, the nature of which depends, not upon the stimulation of different sensory cells, but on the frequency, amplitude, and form of the vibrations coming into the cells, probably through all the fibres of the auditory nerve. On such a theory the physical cause of harmony and discord is carried into the brain, and the mathematical principles of acoustics find an entrance into the obscure region of consciousness. Now, if nerve energy were only electricity, that theory would probably be accepted at once; but nerve motion is very sluggish when compared with electricity. The lecturer for five years had kept this theory back, because he felt that he had no evidence of the possibility of sending a rapid succession of vibrations along a nerve. It cost him a good deal of thought and experimental observation to find the evidence he required. In dealing with methods so difficult and obscure, one must beware of dogmatism; but it was the duty of the scientist to frame theories which seemed to explain phenomena. One might and often did err in holding back a theory lest it should give pain to the author of some theory which it was destined to oppose, forgetting that the suggestion of a new line of thought might in some other mind lead to ideas still farther in advance. Should his theory of the sense of hearing find acceptance, it would lead to a reconstitution of theories regarding the other sense-organs. The lecture was successfully illustrated by means of an extensive and elaborate collection of apparatus and diagrams.

THE authorities of Nancy, France, have voted to add 300,000 francs to the 500,000 francs already appropriated by the general government, to be devoted to the construction of chemical and anatomical institutes in that city.

SOME FEATURES OF THE RECENT EARTHQUAKE.

SOME knowledge of the local topography and geology in the vicinity of Charleston is essential to a complete understanding of the effects of the great earthquake.

The seaboard portion of the coastal plain, upon which Charleston, Summerville (twenty-one miles to the north-west), and the other towns most seriously affected by the recent catastrophe, are situated, is a nearly uniform plain from ten to thirty or forty feet in altitude, slightly inclined seaward, and diversified by broad, irregularly meandering, and inosculating troughs and pond-like depressions from five to fifteen feet deep. The depressions, or 'low-grounds' as they are termed colloquially, are frequently swampy, and toward the ocean merge into the tidal channels of the coast; but, when above the reach of the tide, they are lined with a rich semi-alluvial soil, either supporting luxuriant arboreal vegetation, or producing abundant crops; while the uplands constituting the plain proper (the 'high-grounds' or 'pine-barrens' of the rural population) have a light, sandy soil little charged with humus, and are naturally forested, chiefly with pine. This slightly accented topography is not the product of sub-aerial erosion and deposition, but was fashioned by oceanic waters as the land emerged from the sea; the high-grounds representing the slightly sloping beaches, and the low-grounds the tidal canals and estuaries, of an epoch during which the land stood from ten to thirty feet lower than now. Summerville is an aggregation of suburban residences irregularly scattered about in a pine-forest on the uplands, and is probably the most elevated point in its longitude between Cooper River on the north-east and the Ashley on the south-west. Ten-Mile Hill (midway between Charleston and Summerville) is on the eastern margin of the same upland, overlooking an irregular depression connecting these rivers; while Charleston is located on the extremity of a peninsular prolongation of the plain, bounded on the north-east and south-west respectively by the Cooper and Ashley rivers, which, by reason of the seaward tilting, is elevated but a few feet above tide.

The geologic structure is remarkably simple, and when the formations have been thoroughly investigated, and definitely correlated with those of other portions of the coastal plain, will doubtless be found wonderfully uniform over a considerable area. The superficial deposit in the uplands is obscurely stratified, fine yellow sand or (rarely) mottled clay reaching a depth of from five to fifteen feet. Beneath this member, and frequently immediately beneath the soil in the low-grounds, occurs a bed of fine clayey sand or silt, generally bluish in color. This stratum commonly contains sulphurets and various salts, either free or quickly liberated on oxidation. It is from ten to thirty or forty feet thick; the precise thickness being difficult to determine, partly because of the local thickening due to depressions in the subjacent surface, and partly because of the impossibility of separating it from the superjacent member: indeed, the superior sand appears to differ from this mainly in the greater amount of oxidation which it suffered. In the low-grounds, and along the coast generally, these sands are overlain or replaced by estuarine alluvium consisting of fine blue silt or clay, locally designated 'pluff mud;' for the land is now subsiding (and apparently most rapidly south-westward), and sedimentation is advancing upon the land. Beneath these superficial deposits occurs the commonly recognized 'marl-bed,' at the summit of which the South Carolina phosphates are found. The superior strata of this marl-bed in some isolated areas have been referred to the later tertiary by Holmes and others; but by far the larger portion of the mass represents the formations made classic by Tuomey under the names of 'Ashley and Cooper beds' and 'Santee marls.' These formations consist of a somewhat variable but nevertheless remarkably uniform succession of marls, clays, and sands, extending to a depth of about six hundred feet where they are underlain by petrographically similar cretaceous deposits, increasing in heterogeneity somewhat downward to two thousand feet below the surface. At this depth a good supply of artesian water has been obtained. The structure at greater depths is not certainly known; but, according to Hall, the fossils from the lowest strata reached by the artesian borings indicate that a considerable thickness of cretaceous strata are infraposed, while there is reason to believe that these, in turn, rest on pre-cretaceous beds.

To one traversing the disturbed area, the effects of the earthquake are themselves no more conspicuous than the indications of inequality and intensity, and variability in character, of the disturbance; and it is this phase of the subject that will be dealt with in the following paragraphs.

1. From the early commencement (Friday, Aug. 27) and the long duration (up to date) of the seismic disturbance at Summerville, from the frequent repetition and great intensity of shocks, from the frequency of detonations and their simultaneity with tremors, and from the vertical direction of the vibrations, that place may be regarded as the centre of disturbance. The predominant effects of the shock of Aug. 31 are,

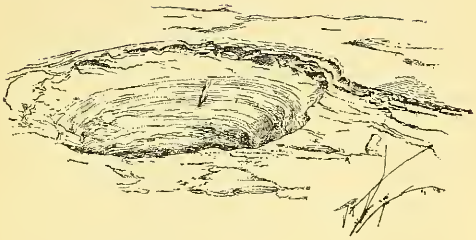


Fig. 1. — Craterlet at Ten-Mile Hill.

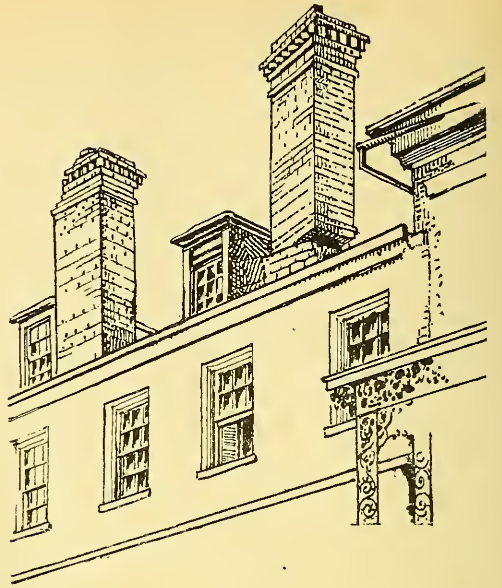


Fig. 3. — Torsionally displaced chimney in Charleston.

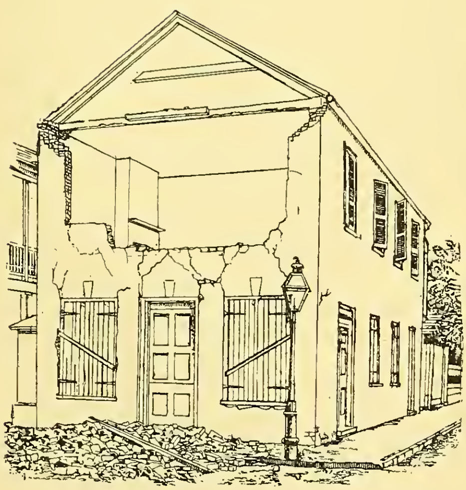


Fig. 2. — Displaced gable in Charleston.

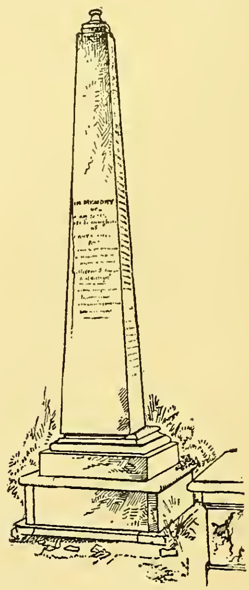


Fig. 4. — Displaced monument in Charleston.

first, fissuring of the surface of the earth ; and, *second*, crushing of foundations and chimneys; together with, *third*, slight displacement in different directions (and sometimes torsional) of buildings.

The fissures are irregularly distributed throughout the village and over the surrounding plain. They are generally confined to the high-grounds, but appear to reach maximum abundance about the peripheries of the more elevated lands. They are so numerous that sometimes not an acre in a square mile is free from them, and, three days after the great shock, were two inches and less in width, and from four or five feet to as many hundreds in length. From the testimony of the citizens, as well as from the sand and mud stains in their vicinity, it appears that sand-laden water welled from these fissures in vast volumes, and continued to flow for some hours, and even, in some cases, days : indeed, water was observed to flow freely from one on the highest ground in Summerville up to the fifth day after the great shock during which they are said to have been formed. The local streams were flooded by the water from these fissures, and the floods had not completely subsided a week afterward. The sand and clay washed from them was evidently derived mainly from the uppermost member of the superficial deposits, although in some cases the blue sand of the inferior member predominates. These fissures extend in all directions, and occasionally cross and bifurcate at various angles.

The architecture in Summerville is characteristic : the houses are generally of wood, lightly framed, either partially or wholly surrounded by wide verandas, and supported on slender pillars from four to six feet high, either of wood set in, or of brick built upon, the ground ; while the chimneys usually rest on independent brick columns built up from the ground. Few if any of them have suffered injury, save by the great shock of Aug. 31; and the injury to the houses themselves is astonishingly slight, and generally confined to racking of frames, shaking down of plastering, and occasional crushing of roofs by falling chimneys. Much injury was done, however, to furniture, which was overturned, tossed about, and in many cases broken. When the supporting pillars were of wood, the buildings have sometimes been displaced, and the entire structure, including the supports, has evidently swung to and fro in all directions, as indicated by the annular crevices surrounding the pillars ; and in such cases the chimneys have almost always toppled over, generally to the north or south, the direction having been determined to a large extent by the slopes of roofs. When, however, the supports were of brick, they have been crushed at top and bottom, and fissured obliquely in all directions, as if by blows of a pile-driver, and in some cases the pillars have been driven into the ground, depressing and concentrically fissuring the surface about their bases. The crushing of the pillars is invariably greatest beneath the heaviest parts of the building : indeed, in some cases the heaviest pillars have completely collapsed, and the buildings are now supported by the piers beneath the verandas and the lighter parts of the floors. The heavy bases of the chimneys are similarly crushed and fissured ; and in numerous instances they, too, have completely collapsed, and all that portion of the chimney beneath the roof has crumbled down into a mass of loose bricks, sometimes leaving the projecting portion intact and in place upon the roof. An example of the manner in which structures have been crushed vertically with little lateral displacement is found in the centre of the village of Summerville, where two apparently fragile chimneys, left in position when the building to which they were attached was destroyed by fire years ago, have been crushed and obliquely fissured, but have not been overturned, or displaced laterally to the slightest degree.

The writer experienced half a dozen or more shocks in Summerville, and heard four or five times that number of detonations. The individual shocks were of very brief duration : the longest observed (and from the testimony of the citizens it appears that this was second in severity only to the great shock of Aug. 31) was over in less than thirty seconds. The motions of furniture, etc., during this shock, were carefully noted. It was found, that, during the first two-thirds of its period, the vibration appeared to be directly vertical ; that a wrenching, torsional motion, turning objects in the direction of the sun, followed ; and that this was succeeded by a few gentle east-and-west rolls. The movements were identical in all the lighter shocks, when of sufficient duration to permit of observation, save in intensity. Ordinarily, however, the lighter shocks were simply spasmodic quivers of but an instant's duration, the direction of which it was impossible to determine. The shocks were invariably accompanied by sensibly simultaneous detonations resembling slightly muffled thunder-peals or heavy cannonading, commonly compared by the older residents, who remembered the bombardment of Charleston, to the booming of 'siege-guns' a mile or two away ; but the detonations were three or four times as frequent as the tremors. It may be mentioned that no two individuals, even among trained observers, agreed as to the direction whence the sound came. This fact, and the simultaneity of detonation and observed tremor, together suggest that the sound came directly from the earth, either as sonorous vibrations, or as soundless pulsations of such period as to be converted into sound-waves on passing from earth to air.

2. The principal physical record of the great shock at Ten-Mile Hill is found in the craterlets, or 'sand-spouts,' which there attain maximum size and abundance. They are simple circular or elongated orifices from which water has welled forth with such violence as to flood the entire surface over hundreds of acres to depths of from one to two or more feet, to carry out hundreds of tons of the yellow and blue sand overlying the marl-bed, and to spread this sand over scores of acres to depths varying from a fraction of an inch to two or three feet. These crateriform orifices are now surrounded by their solid ejecta in annuli attenuating peripherally, in which the shrinking streams from the dwindling fountains have worn channels and gullies, as shown in fig. 1; and most of them are now filled with water up to within a foot or two of the natural surface. By residents the waters are reported to have gushed forth during, and for some hours after, the great shock, sometimes by jets but generally continuously, to the height of trees; and, since they sometimes contained sulphurous compounds, they gave out characteristic odors that added much to the terror of the people. The volume of water extravasated was sufficient to flood many of the minor drainage-ways above even the highest freshet-marks; and five days after the great shock, water still flowed from some of the craterlets, and yet retained the odor of sulphuretted hydrogen. There is no indication that the orifices extend, or that the water flowed from, below the base of the superficial sands (in which the mean depth of permanent ground water is ten or fifteen feet), either at Ten-Mile Hill or elsewhere; and, indeed, at the phosphate-works nearest Ten-Mile Hill, in the immediate vicinity of which both fissures and craterlets occur, the marl-bed was so slightly disturbed at depths of sixty or seventy feet, that the water slowly percolating into the shafts was neither increased nor discolored. Nevertheless, these fountains, issuing from a surface fifteen feet above the level of ground water, the flow from fissures here, at Summerville, and to a less extent at Charleston, and the rise of waters in wells in various localities, all point to sudden and considerable contraction, either vertical or horizontal, of the water-bearing sands overlying the marl. 'Sinks' are, indeed (rarely), associated with the craterlets; but they appear to have been formed after the subsidence of the extravasated floods.

In the vicinity of Ten-Mile Hill, too, the kinking and distortion of railway-tracks is most striking. In a number of cases the rails were so bent as to necessitate removal; the displacement in alignment sometimes reading two feet or more, while that in profile was half as great. It should be mentioned, that, in all personally observed and well authenticated cases of compressive distortion of rails, the kinks occurred in the low-grounds at the bottoms of inclines, and generally in the vicinity of trestle-bridges approached by embankments, and that at least a part (and in one case all) of the contraction relieved by the kinking appears to have been caused by the down-hill settling of rails, ballasting, and embankment. Nevertheless, longitudinal fissures in the embankments, and lateral throw of the track, have evidently been produced directly in some cases: and near Ten-Mile Hill a locomotive was derailed (with destruction of life) during the second shock; but whether by the tremor, or as a result of antecedent displacement of the track, could not be ascertained.

In general terms, the injury to the few buildings at Ten-Mile Hill is similar to that exhibited at Summerville, save that the horizontal displacement has been greater, chimneys have been more generally overthrown, and the plastering of the ceilings is less seriously, and that of the walls more seriously, cracked and dislodged.

It is noteworthy, that, between Ten-Mile Hill and Charleston (perhaps three miles from the latter place), there is a considerable area or zone in which the effects of the earthquake are inconspicuous: chimneys have seldom been overthrown, buildings are not displaced on their foundations, the foundations themselves are not crushed, and plastering is but slightly injured. Even the tall brick chimneys of the fertilizer-works within the area appear to have escaped injury.

3. As has already been made known through the daily press, the most conspicuous effect of the seismic disturbance at Charleston was the lateral displacement and overthrow of chimneys, monuments, walls, entire buildings, etc. These records of the great earthquake have been examined and noted with care, with the view of applying Mallet's method of determining the origin and paths of the seismic tremors to the region affected thereby. The observations on injured buildings may be briefly generalized as follows: —

1. The throwing outward of walls, gables, cornices, copings, etc., is most common in walls facing north, next in those facing south, third in those facing east, and least in those facing west. 2. By far the greater number of overthrown chimneys have fallen either to the north or south, and more to the north than the south. 3. The most seriously cracked walls are those facing east;

those facing west are nearly as seriously injured ; those facing south follow, but are much less injured than the two former ; and those facing north are least injured, but only slightly less than the southerly walls. 4. When corners of buildings are thrown out, they have gone most frequently to the north-east, next to the south-west, third to the north-west, and least frequently to the south-east. So many isolated observations are inconsistent with these generalizations, however, that little value can be attached to them. Similar inconsistencies are observed in the behavior of the marble and granite shafts in marble-yards and cemeteries. Of those which have been overturned, the larger number have been thrown either to the north or south, but some have gone in various other directions ; many have suffered torsional displacement, but of these some have turned with others against the sun ; while others are displaced laterally without overthrow, and in as many directions as there are compass-points. Chimneys, too, have been twisted both with and against the sun, and during their oscillations have 'walked' in various directions. A Charleston chimney twisted with the sun, and slightly displaced southward, is shown in fig. 3 ; and a neighboring monumental shaft turned in the opposite direction, and displaced north-eastward, is represented in fig. 4. Perhaps the discrepancies among these observations may eventually be eliminated, and the apparent confusion reduced to order ; but for the present, inferences as to the azimuth of the wave-paths in Charleston and immediate vicinity are premature.

It is remarkable that the intensity of the seismic action has varied greatly within the limits of the city of Charleston. Thus in certain quarters the buildings have escaped with trifling injury, while similar and similarly oriented buildings in other quarters have been completely destroyed ; and all possible intermediate phases of injury are found in different parts of the city. The numerous observations on the variable intensity of the disturbance in Charleston and elsewhere in South Carolina have not yet been collated and digested ; but it would appear that there are large areas within which the intensity of the disturbance culminated (and Charleston is one of these), and, moreover, that within these areas themselves there are foci or nodes of maximum vibration circumscribed and separated by annuli in which the disturbance was less severe.

A few fissures, such as those abounding at Summerville, occur in Charleston and vicinity, and some small craterlets have also been observed in the neighborhood.

A number of slight tremors were experienced in Charleston. They differed from those felt at Summerville, 1°, in less intensity and greater duration ; 2°, in direction, which was manifestly more nearly lateral than vertical, though the azimuth was not accurately determined ; and, 3°, in the absence of detonations or other sounds than such as might be attributed to movements in furniture, in neighboring buildings, etc.

Briefly, it appears, that within a radius of a dozen miles somewhere near the centre of the district affected, and within an area of remarkably uniform topographic configuration and geologic structure, the effects of the recent earthquake are quite diverse : viz., that at Summerville the principal effects are crushing of structures in the vertical direction, and the formation of fissures with the outflow of a considerable volume of water ; that at Ten-Mile Hill, half-way between that point and Charleston, the principal effects are local deformation of the surface and the extravasation of a great volume of sand-laden water, with combined crushing and lateral displacement of structures ; and that in Charleston the predominant effects are lateral displacement in various directions (without vertical crushing) and overthrow of structures, torsional displacement and overturning in different directions of monuments, together with some fissuring of the surface and the extravasation of small quantities of water.

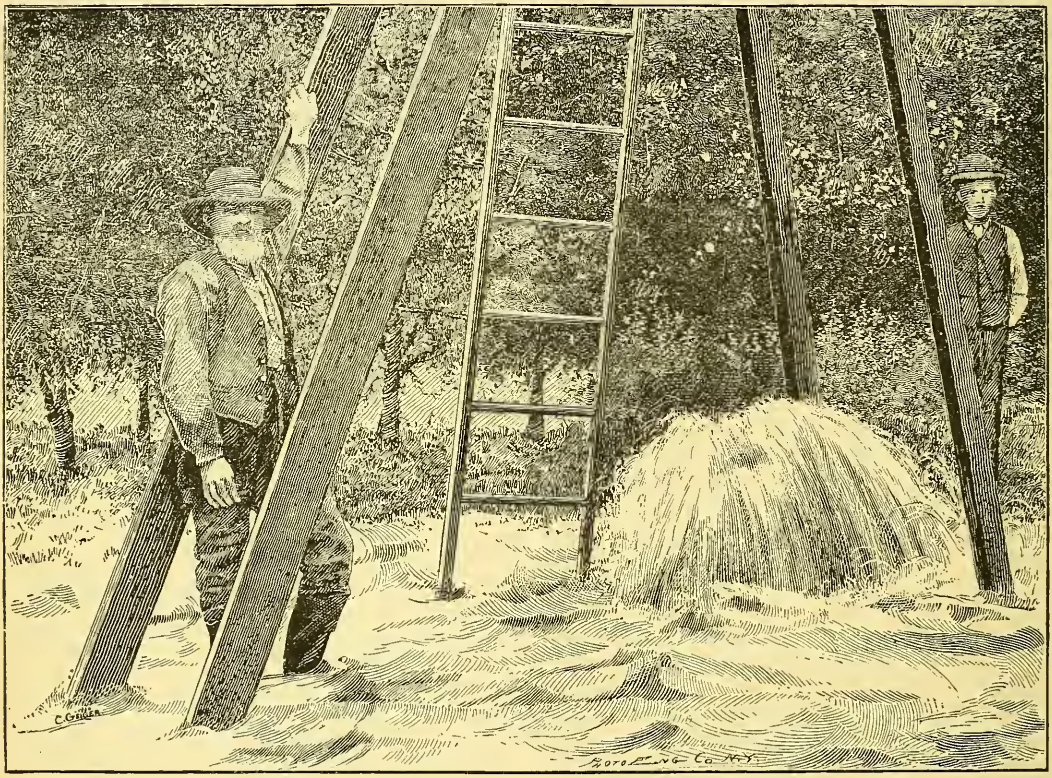
W. J. McGee.

COMPRESSED AIR ON CABLE-ROADS.

One of the minor annoyances in connection with the cable street-railway system is the fact, that, until the car is gripped to the moving cable, it must depend for its motive power upon some other agent ; that is, it must be run to and from the car-house by hand or horse power ; and switching from one track to another at the termini of the road is usually accomplished in the same manner. To dispense with this extra motive power, by making each car temporarily self-propelling, is the object sought in a series of experiments now in progress on the Tenth Avenue cable-road in this city. The experimental car is fitted with a small air-compressor, an air-engine, and several cylindrical air-tanks, placed beneath the body of the car. The compressor is connected by a clutch with one of the car axles ; and the engine or motor is connected in a similar manner, though with the addition of an intervening train of speed-reducing gear-wheels. On a recent trial trip, the air-tanks were filled to a pressure of about five atmospheres, at the car-house, by means of a compressor. The driver, or grip-man, then opened the valve admitting air to the engine, and the car propelled itself steadily and smoothly out of the car-house, around a curve, and over a switch to the main cable-track. Here another device, intended to lessen the labor of the grip-man, was brought into play. Air was admitted to a small cylinder on the grip, causing the latter to close firmly upon the cable, and the car sped on its way, up and down hill, out to the terminus at Fort George. The brakes were also operated by means of the compressed air acting upon a separate brake cylinder. To stop the car, the grip was let go, the air-brake put on, and, if the pressure-gauge showed much decrease of pressure, the compressor-clutch was thrown into gear, thus utilizing the motion of the car to renew the supply of compressed air. The compressor was put into action also, to keep the pressure at the proper point; so that, with a little additional work thrown on the cable, the car always held in reserve sufficient motive power to work the grip and brakes, as well as to run switches and to propel itself to or from the car-house. The trial trip, though it revealed some defects in the mechanism, was essentially a success. The general adoption of this or similar devices upon cable-roads will depend, of course, upon the economic results attained by extended trials in actual use.

THE ARTESIAN WELL AT BELLE PLAINE, IOWA.

SIMULTANEOUSLY with the report of the recent earthquake came sensational stories of an artesian eruption at Belle Plaine, Io., and speculation at once connected the two events with each other, and with renewed geyser activity in the Yellowstone park and seismic movement on the opposite hemisphere, as factors of a common disturbance of the earth's crust. Without reposing faith in such broad hypotheses, it seemed worth while to investigate the artesian phenomenon for its own sake.



ARTESIAN WELL AT BELLE PLAINE, IOWA.

The more sensational elements of the accounts were found to be chiefly the work of a romancing reporter whose moral faculties present the only similitude of seismic disturbance the case affords. The well is indeed phenomenal in some respects, but these are surely of the artesian order, and entirely without mystery. The following are essentially the facts: —

Last spring it was incidentally discovered that flowing wells could be obtained by deeply boring into the drift. Six wells were put down, varying from 210 feet to 301 feet in depth, wholly in drift, and without reaching its bottom. Five of these flowed, while the water in the sixth, which was on higher ground, came within three feet of the surface. These wells gave clear evidence of a common source which had an effective head of from 70 to 80 feet above the now famous well. This latter was the seventh attempt, and was located on ground from 15 to 30 feet below the five then flowing. A three-inch well was contracted for, but only a two-inch well sunk; the driller intending to take advantage of the wash of the current, and force in a three-inch pipe. Out of this rose the trouble. As in the preceding wells, only drift was penetrated. The record is defective in detail, and perhaps in precision, but doubtless represents the general truth: soil, 4 feet; yellow clay, 10 feet; fine sand, 16 feet; gravel, 18 feet; blue stony clay, 145 feet; sand and gravel in which flow was struck, depth unknown; total, 193 feet.

In the other wells, beds or pockets of sand were struck in the blue clay; and the subsequent history of this well makes it probable that they were present here also. A flow of water was obtained at the base of the blue clay in sand and gravel. Pieces of wood and other vegetal remains were brought up by the current. This also occurred in the other wells, indicating the presence of one of the 'Old Forest beds.'

The flow was struck Thursday evening, Aug. 26, and, though strong, was in due proportion to the preceding ones. On Friday, in attempting to force in the three-inch pipe, the water broke a passage outside of it, which it rapidly enlarged until a vast volume of water poured forth, inundating the street and adjoining lots, bearing with it much sand and some pebbles, among which a great variety of northern rocks were represented.

The eruption of water was impressive because of its volume, but not because of the height of its ejection. Instead of 'several hundred feet,' or any thing excusing such an absurd exaggeration, photographs show it to have been about waist-high when unconfined, and about shoulder-high when a sixteen-inch pipe was inserted in the endeavor to control it. At present writing (Sept. 9) it wells up vigorously, but does not form a jet. The minimum diameter is now not less than 3 feet; a cone of that dimension, inserted in the effort to govern the flow, having been pushed through to the bottom without entirely cutting off the current outside of it. The more trustworthy estimates of the volume during the higher stages range from 9,000,000 to 5,000,000 gallons per diem. My own data for Sept. 9 indicate a flow of about 3,000,000 gallons.

The other flowing wells promptly felt the effects of this lower and more capacious outlet, and declined steadily. The record of one is given as follows: on Monday morning, Aug. 30, three days and a half after the great well started, it ceased to flow; on Wednesday at 6 P.M. it had fallen 7 feet; Thursday evening it had fallen 23½ inches in 24 hours; and measurement Friday morning showed a fall still at the rate of about 1 inch per hour. All wells but one had ceased flowing prior to Sept. 8, and this I found then sinking at about 5 inches per diem. It is evident that the great well obtains its supply from the same subterranean body as these, — the lower water-filled stratum of sand and gravel, — and that it is rapidly drawing this off. It has already lowered its head at least two-thirds of the whole. It must continue to decline in the force of its flow until the discharge is reduced to equality with the supply, when it will settle into equilibrium. It will then indicate the maximum amount of permanent flow, a knowledge of which will be of service in its future utilization. This particular method of arriving at that fact is not, however, to be recommended for general use.

I infer that the elevated portion of the saturated stratum, forming the reservoir, is not very large, else even the great flow would not draw the head down so rapidly. Assuming a discharge of 5,000,000 gallons and a lowering of the head 5 inches per day, and taking no account of inflow, the reservoir indicated has a clear surface of less than 40 acres. A mixture of sand and gravel may easily contain one-fourth its volume of water, as may be shown by experiment; but, assuming one-tenth, the upper edge of the water-bearing stratum need not exceed 400 acres in extent. It is not therefore necessary to suppose any unusual subterranean source, either in area or kind. Nor is it necessary to suppose a distant origin. The head is not greater than could be supplied by the country adjacent on the north, which is the probable supply-ground.

It is simply a flowing drift well, run rampant for want of control. It has its phenomenal feature in its magnitude, and its lesson in its expensive and destructive career through injudicious handling. When it has drawn off its head, it can probably be put under control — which it has thus far defied — without serious difficulty, and the drained wells restored.

That it has no causal connection with the earthquake is evident from its character and the fact that it broke forth three days earlier.

T. C. Chamberlin.

NOTES AND NEWS.

So much has been said of late about the dangers of producing tuberculosis in the human subject by means of the milk of cows having this disease, that it would seem that there was nothing more to add. Bang of Copenhagen, however, calls attention to a new source of danger in these cases. He finds that the udder itself is not infrequently the seat of this disease, and that the milk produced by such a gland is capable of infecting animals fed upon it. The necessity of having competent veterinarians to examine critically all milch-cows is becoming daily more apparent; and a board of health that neglects such examination is aiding materially in the propagation of this disease, which must be regarded as one of the principal factors in the mortality of our population, both in city and country.

— The operation of tracheotomy, by which an opening is made with the knife into the windpipe for the relief of membranous croup and diphtheria, seems likely to be superseded by intubation of the larynx. In this new operation a small tube is inserted through the mouth into the windpipe, and all necessity for a cutting operation is thus avoided. It is claimed by the advocates of this method of treatment that it is far easier to introduce this tube than to perform tracheotomy, and that more lives are saved than by the old operation. The statistics which are given in the medical journals go far to confirm their opinions, and, as the process is being generally introduced, but little time will be necessary to substantiate the claims made for it.

— At the first exposition of the Iowa weather-service, recently held, there was shown a selection from the large amount of graphical material that has accumulated at the central station. At future exhibitions it is proposed to present instruments and other elements of the service.

— G. P. Putnam's Sons (New York) have published 'The life of Robert Fulton,' by Thomas W. Knox. The book is one full of anecdote, and will prove to be interesting to many a boy. It tells the story of one of America's most remarkable inventors, whose head, from youth on, was "so full of original notions that there was no room to store away the contents of dusty books."

— Prof. J. C. Faye of Appleton, Wis., has published through Van Nostrand a "Handbook of mineralogy, for the determination, description, and classification of minerals found in the United States." Professor Faye was induced to write this book through the success of his 'Mineral tables,' which quickly passed through two editions.

— *The American journal of biology*, a quarterly edited by H. D. Valin, M.D., is announced. The contents of the first number are, 'The laws of life outlined,' 'Evolution of life,' 'Origin of flowers,' 'Nature of animal colors,' 'Nature of light,' 'Development of the eye,' 'Nature of sight,' 'Origin of walnuts,' 'A ballade of evolution.' The journal is published by the American journal of biology publishing company, 802 South Halsted Street, Chicago.

— It is claimed, that, whenever an acute abscess forms, two varieties of micro-organism will invariably be found in the pus, —Staphylococcus pyogenes and Streptococcus pyogenes.

— Some years ago great expectations were excited by the claims which were made that the Eucalyptus globulus would banish malaria from the land, if only planted in abundance in malarious regions. Extensive plantations were accordingly made, but, so far as known, the result was a total failure. Dr. Brandes of Hanover now advocates, with a similar object in view, the growth of the Anacharis alsinastrum, a water-plant which is exceedingly common in some sections of the country. He bases his proposition upon the fact that in the district where he lives fevers of a malarial type were very prevalent until this water-plant was introduced, and that they diminished from year to year until four years ago, when they entirely disappeared, and have not since returned. As the Anacharis is easily obtained and grows spontaneously, requiring no attention, the experiment can be easily tried in marshy districts where malaria prevails.

— In China there is a curious device to make record of earth-tremors. It is of copper, and is shaped like a wine-bottle. Inside is a little pillar, so placed as to move in eight directions. On the outside of the bottle are eight dragon-heads, each of which contains a ball. Underneath these heads are eight frogs, so placed that they appear to watch the dragon's face, so that they are ready to receive the ball if it should be dropped. All the arrangements which cause the pillar, when it moves, to knock the ball out of the dragon's mouth, are well hidden in the bottle. When an earthquake occurs and the bottle is shaken, the dragon instantly drops the ball, and the frog which receives it vibrates vigorously. Any one watching this instrument can easily observe earthquakes.

— Prof. T. C. Mendenhall, recently at the head of the electrical department of the signal service, has accepted the presidency of the Rose polytechnic institute at Terre Haute.

— Decatur, Ill., or rather a suburb of that town, is the latest place from which cases of food-poisoning are reported. This time it is chicken-salad which has produced the evil results. At a recent wedding-party, at which this dish formed a part of the entertainment, fifty persons were poisoned, but not fatally in any single instance. The illness is attributed to the copper from a copper kettle in which the chickens were cooked and salted.

— The J. Marion Sims memorial fund now amounts to $7,759.91. The committee who have the fund in charge are about to take steps to erect a suitable bronze monument to the memory of the distinguished American surgeon.

— Sir Joseph Lister, the great exponent of the antiseptic treatment of wounds which is known as Listerism, has abandoned the use of the spray of carbolic acid which he formerly advocated so persistently, on the ground that his later experiments satisfy him that the germicide properties of a solution of 1 to 40 of carbolic acid thrown by a spray several feet into the air are absolutely nothing; and that the success obtained by this treatment was due to irrigation and cleanliness. He now employs sal alembroth as a dressing for wounds. This is a salt which was known to the ancient alchemists, and is a double mercurial salt formed by the sublimation of a mixture of perchloride of mercury and chloride of ammonium. Lister employs this in a solution of 1-1000, soaking in it his dressings of gauze and lint.

— The English commission for the investigation of hydrophobia is thoroughly organized and equipped for that purpose, but has as yet been unable to take any original steps in that direction, by reason of its total lack of material, no dog having become rabid since its organization.

— From the *Courier record of medicine*, we learn that a case of hydrophobia recently occurred at Fort Woith, Tex. After the child was bitten, he was taken to Fort Denton, where a mad-stone was applied, for which the parents paid twenty-five dollars. Hearing of another mad-stone, and desiring to do every thing in their power to save their child, his parents secured this one at a cost of fifty dollars, and applied it. Within a short time the child developed hydrophobia, and died.

— We regret to note the death of Prof. H. A. Bayne, Ph.D., of the Royal military college, Kingston, Ontario, Canada. Dr. Bayne was a native of Nova Scotia. After graduating in arts at Dalhousie college, Halifax, N.S., he spent five years in the special study of chemistry under Wiedemann at Leipzig, Bunsen at Heidelberg, and Dumas at Paris, and took his doctor's degree at Heidelberg. Returning to his native land, he first engaged in organizing the scientific department of the Halifax high school, assisting the faculty of Dalhousie college at the same time to start a science course. In 1879 he was appointed professor of chemistry in the Royal military college, then just founded. Since his appointment his time has been largely occupied with the organizing of his department, and only during the last year or so has he been able to find time for original research. At the last meeting of the Royal society of Canada, of which he was a fellow, he read a valuable paper on 'Chemical tests of the purity of silk.' He had begun in Germany a series of experiments on the properties of the rarer metals, and hoped to continue them when leisure came; but with leisure has come disease and death.

— In a letter to the *Beacon*, Mr. E. B. Elliott corrects an error made in *Science* for Sept. 3. In that number, p. 219, sixth line, 287.372 should read 287.03.

LETTERS TO THE EDITOR.

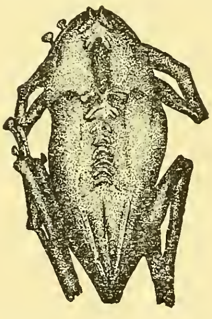
*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

A mummified frog.

Not long ago Mr. James Stevenson of the U. S. geological survey visited me for a day or two at Fort Wingate, and while here invited my attention to an interesting specimen that had fallen into his possession during a recent trip he had made in the coal regions of northern Pennsylvania. The specimen consists of a mummified frog taken from the coal-mine of McLean county, Penn., and the following account of it is from a local newspaper loaned me by Mr. Stevenson for the present purpose. I quote the short notice in full; and the writer of it says, "One of the most curious finds unearthed lately in this region, and what may yet prove a valuable fact in the study of science and history, was singularly found by Eddie Marsh, the fourteen-year-old son of Mr. D. B. Marsh, a book-keeper for Stevenson Brothers, hardware dealers. Eddie, becoming impatient at the fire in the stove, which was not burning vigorously, took the poker and began punching it. A large lump of coal lay smouldering, and he determined to break it; and, after punching at it for a moment, the lump burst open as if by explosion, and a number of pieces flew out of the stove. One piece he caught, and he was in the act of casting it back into the stove, when its lightness attracted his attention. On viewing it, he saw that it was nothing less than a perfectly formed frog. On last evening a large number of persons viewed the little curiosity. It had been embedded in the centre of the large lump of coal, and its bed was plainly discernible when the lump was laid open. The lump of coal came from the third vein of coal in the McLean county coal-shaft, which is 541 feet under ground. The curiosity apparently was not petrified. Apparently it had been mummified instead. It was shrivelled until it is about half the size of a full-grown frog, and it is light and soft. Its shape is perfect, and the warty protuberances of the skin are very plain. Its limbs are regular and properly shaped, including the finger-like toe of its feet, and its eyes and mouth are natural. There can be no doubt of its being a mummified frog, and now various and tough questions arise regarding it: How did it get that far under ground? How did it become embedded in that chunk of coal, which probably had been blasted from the centre of a thick vein? How many thousands of years had it been buried? and various other queries, which we will leave for the scientist to unravel and explain."

Mr. Stevenson tells me that he is personally acquainted with all the parties concerned in the discovery of this specimen, and has carefully examined the piece of coal whence the mummy was taken, and says, further, that it came from the vault, and not from either the sides or the floor of the mine.

He has done me the honor to turn the specimen over to me for diagnosis, as well as to take such steps as I saw fit to ascertain if there be any similar cases on record, and, finally, how geologists or paleontologists explain such finds as this. The specimen is now before me, and I at once recognized it as a species of Hyla, though I am unable to say which one. It apparently agrees in all its external characters with a specimen I have of Hyla versicolor, kindly diagnosed for me by Professor Cope last summer, though it is rather smaller. As will be seen



from the life-size figure I have made of it, which illustrates this letter, it is in nearly a natural position; its feet, however, are somewhat drawn up under it. I have figured it as viewed directly from above. It is completely mummified, and in a wonderfully perfect state of preservation, being of a dark, snuff-brown color, somewhat shrunken, and, in short, reduced to a condition, that, if properly excluded from the air, would keep for an indefinite length of time. I am aware that these tree-frogs very often climb into some of the most unheard-of places; but it struck me that it would be interesting to have some one tell us if they ever heard of a Hyla finding its way to the vault of a coal-mine 541 feet under ground, and climbing into the solid coal-bed after getting there. R. W. Shufeldt.

Fort Wingate, N. Mex., Sept. 14.

The source of the Mississippi.

A correspondent in the number of *Science* for Aug. 13 contributes an article on Captain Glazier's claim to have discovered the true source of the Mississippi. The writer commences by quoting *Science* of May 15, 1885, in which it is stated that Glazier gave his own name to the lake he discovered. This is an error invented by some official jealous that any man not in the employment of the government should presume to make a discovery falling within the range of the government survey. In the Brainerd *Tribune* of Aug. 14, 1881, occurs the following, from the pen of one of Captain Glazier's companions, a gentleman, it is to be presumed, of veracity. It may be premised that Brainerd is the nearest point to the source of the Mississippi that can boast of a newspaper. The writer says, after describing the ascent to the newly discovered lake through the stream that unites it with Lake Itasca, "On its one promontory our party landed after exploring its shores; and, after slaking our thirst at a spring of ice-cold water which bubbled up near by, the little party was marshalled in line, and Captain Glazier made a few remarks appropriate to the discovery of the true source of the Father of waters. After this, six volleys were fired in honor of the occasion, and then the question of a name for the new lake arose. *This being left for the captain's companions to decide*, Mr. Barrett Channing Paine, after alluding in warm terms to the time, money, and energy expended by Captain Glazier in this expedition, *proposed that it be named 'Lake Glazier'* in his honor. This proposition was received with applause, and carried by acclamation." Thus, we see, Captain Glazier did not 'give his own name' to the lake. He, on the contrary, suggested that it should retain its Indian appellation of 'Pokegama.'

There is nothing to be found in Schoolcraft's narrative to show that he penetrated south of Itasca. He speaks of an inlet to Lake Itasca leading from a smaller lake to the south, but clearly did not visit that smaller lake, and hence did not 'discover' it. Nor was it known to exist by Mr. Nicollet, who came after him. The latter explorer states that there are five creeks falling into Itasca. Captain Glazier discovered six, the sixth originating in a lake (not a lakelet) about five miles to the south of Itasca. This lake was not known to Nicollet. It lies nearly due south of the western arm of Itasca. He visited the others (which are mere ponds), but missed the most important one, probably owing to difficulty of access, the soil around it and for some distance from it being extremely swampy, and its inlet to Lake Itasca completely hidden by the densest vegetation. Such an inlet could not have been known to exist, except from the information of the Indian whose hunting-ground was in the immediate neighborhood. The 'infant Mississippi' flows from this lake, unknown until Captain Glazier forced his way into it in 1881, under the guidance of Chenowagesic. The lakelets or ponds shown on Nicollet's map have nothing to do with the source of the river; and the map itself, so far as Lake Itasca and its region are concerned, is altogether misleading. Itasca has three arms or bays, not two, as shown on Nicollet's map. The 'small lake south of and tributary to Lake Itasca' was not the lake discovered by the Glazier party; the lakes (or ponds) 'fully explored and mapped by Nicollet' did not include the Glazier Lake; and those 'surveyed, mapped, and named by the land office prior to 1879' were mere lakelets or ponds, all of them taken together considerably less in volume than the one discovered by Glazier. Your correspondent indulges in a glaring *petitio principii* in the paragraph from which the above quotations are made.

The following extract is from a letter received by the present writer in May, 1884, from Paul Beaulieu, interpreter to the White Earth Indian agency, Minnesota. Beaulieu is an intelligent half-breed, and has lived all his life within seventy miles of the head waters of the Mississippi. His letter was in answer to an inquiry as to the views of the people of that section on Captain Glazier's discovery. He writes, "I would respectfully state that, according to the ideas of the people of this section for scores of years past, in alluding to Lake Itasca, which is known only as Elk Lake, or Omushkos, by the Indians, it was never by them considered as the head or source of the Father of Running Waters, or May-see-see-be, as it is by them named. I have received a map showing the route of exploration of Captain Willard Glazier, 1881, and being well acquainted with his chief guide, Chenowagesic, who has made the section of country explored by Captain Glazier, his home for many years, and who has proved the truth of his often repeated assertion, when maps were shown him, that a smaller lake above Lake Itasca, would, in time, change the feature of those maps, and proclaim to the world that Lake Itasca cannot any longer maintain its claim as being the fountain head of Ke-chee-se-be, or Great River, which is called May-see-see-be by the Chippewas. The map as outlined by Captain Glazier's guide, Chenowagesic, and published by the Glazier party, *is correct*, and it is plain to us who know the lay of this whole country, (I mean by the word *us*, the Chippewa tribe in particular, also the recent explorers for pine,) that Lake Glazier is located at the right place, and is the last lake on the longest stream of the several rivers at the head of the great Mississippi."

Now, respecting the latitude given by Captain Glazier, it may be stated that he had with him no instrument for determining latitude; and assuming that the latitude given by Nicollet was that of the southern point of Lake Itasca, not that of Schoolcraft's Island, he did what any other person in like circumstances would have done, made as near an estimate as possible, and placed the new lake in latitude 10″ to the south of that given by Nicollet.

The extracts given by your correspondent from Schoolcraft and Glazier, in parallel columns, even if they do carry some slight resemblance, have no bearing whatever upon the latter's claim to have discovered a lake which was unknown to Schoolcraft, Nicollet, or the officials of the land survey. Whatever the merits of this controversy, it is most conclusive that there is a beautiful sheet of water above and beyond Lake Itasca, which the Indians and pioneers of northern Minnesota, as well as the majority of American geographers and map-makers, now recognize as Lake Glazier, the primal reservoir of the Great River. PEARCE GILES.

Boston, Mass., Sept. 4.

Hibernation of bats.

In a brief notice recently published in *Science* (viii. No. 187, p. 222), of a paper on the 'Migration of bats,' which I read at the Buffalo meeting of the American association, I am reported as saying that 'there is no evidence that any forms [of bats] hibernate.' Nothing in natural history is better attested than the fact of the hibernation of bats, and I hasten to correct the error made by your reporter.

C. HART MERRIAM.

An easy method of measuring the time of mental processes.

Lest it should seem that I lay claim to what is not my due, I would explain that I did not know of the exactly similar experiment of Dr. Oliver Wendell Holmes with a circle of people, until Professor Bowditch called my attention to it at the recent meeting of the American association. At that time the paper printed in *Science* had left my hands. I hasten to yield any claims to priority for this method of measuring simple reaction times for the privilege of having so distinguished an anticipator as Dr. Holmes.

I must thank Professor Mendenhall for the reference to his interesting article. I find, however, that his very ingenious method resembles the usual laboratory methods much more than it does mine.

JOSEPH JASTROW.

Germantown, Sept. 19.

The law of volumes in chemistry.

In my letter with the above title in *Science* for Sept. 10, there occurs an obvious error, since $1,628 \times 18 = 29,304$, and not 30,304. The slip of the pen was the more curious from the fact that the correct figures were already printed in my yet unpublished volume, 'Mineral physiology and physiography.' The above coefficient for the formula of water is calculated from the datum in Ganot's 'Elements de physique,' that the relation between the volumes of water at 0° and vapor at 100° = 1 : 1,698. I hope to discuss at length the questions raised in my late letter before the National academy of sciences at its meeting in November. T. STERRY HUNT.

Montreal, Sept. 17.

Cause of a recent period of cool weather in New England.

In a recent issue (*Science*, viii. p. 233) I called attention to a period of cool weather which prevailed in New England from Aug. 15 to Aug. 23, culminating on the night of Aug. 22; on which night, I now learn, frosts were observed in the lowlands near Boston.

I now desire to call attention to another aspect of this phenomenon; namely, that, while this abnormal cold prevailed at the earth's surface, at a not very great altitude above the earth's surface the temperature was above the normal, and increased during the night. At the top of Mount Washington the temperature was several degrees above the normal, and was slightly higher at the morning observation of the 23d than on the previous evening; but an absence of self-recording instruments prevents a more extended study of the phenomenon. This want was, however, supplied at Blue Hill, where a Richard thermograph at the top showed an almost continuous rise of temperature after the 11 P.M. observation of the 22d, until after noon of the 23d; while a Draper thermograph at the base of the hill, 400 feet lower, showed that the temperature fell almost continuously until 5 A.M. (about sunrise) of the 23d, at which time the temperature was more than ten degrees lower at the base than at the summit. Both thermographs showed short undulations common to thermograph curves. This fall in temperature during the night, no doubt, also occurred at the Boston signal office, since the temperature observed at 3 A.M. of the 23d was four degrees lower than at 11 P.M. of the 22d. The close coincidences between the readings of the self-recording minimum thermometer at the base of Blue Hill and at several surrounding stations seems to show that the phenomenon recorded at the base fairly represents what occurred over the whole of the surrounding country. A minimum thermometer observed by Rev. A. K. Teele of Milton, about two miles north of Blue Hill, gave a temperature of 41°; and one observed by Dr. Granger at Randolph, five miles south-east of Blue Hill, gave a temperature of 44°, — the same as that observed at the base of Blue Hill.

These observations show very clearly the gradual increase of temperature with height above the earth's surface: 1°, at the earth's surface in low places, the temperature fell to or below 32° F., as shown by the formation of frost; 2°, at the height of a few feet above the surface, the temperature fell to not quite 40°; 3°, at a height of 156 feet above ground, the temperature only fell to 49°, as shown by the records of the Boston signal office; and, 4°, at a height of 650 feet above sea-level, and more than 400 feet above the surrounding land, the temperature only fell to 50.5°, as shown by the records at Blue Hill observatory.

I pointed out in my last letter that on the night of Aug. 22 the sky was clear, and that the air was very dry, and must have descended from above over New England, since the surface-wind blew out from this region in every direction; and the facts just given seem to clearly indicate two opposing actions on the air: 1°, a heating effect, due to compression of the air by its descent; and, 2°, a cooling effect, due to radiation, chiefly from the earth's surface. At elevated points, such as Mount Washington, where the land surface is very small, the heating effect was in the ascendency; the temperature of the air was above the normal, and actually increased during the night. At lower stations the cooling from radiation was in the ascendency, and the temperature of the air fell continuously during the night.

H. HELM CLAYTON.

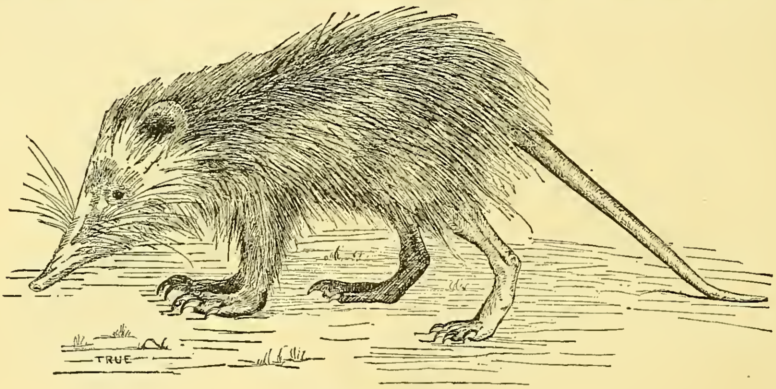
Blue Hill meteor. observ., Sept. 10.

The Almiqui.

The Smithsonian institution has recently received a living Almiqui, Solenodon cubanus, one of the rarest of American mammals, and the largest of American insectivores. Three individuals were captured, but only one survived.

The two species of Solenodon, S. cubanus and S. paradoxus, are indigenous respectively to Cuba and Hayti. Of the latter species almost nothing is known. The specimens of the Cuban species recently received were obtained by John Gundlach, Esq., in the interior of the Sierra Maestra, some thirty miles from Bayamo. He writes to Professor Baird regarding them as follows: "A friend, who has sent all the Solenodons to Professor Poey and myself, has, after the promise of many years, received a pair of living S. cubanus, captured in the high mountains thirty miles from Bayamo. This animal is very rare, and difficult of obtaining, because he lives in caves which in most cases pass under great trees, and cannot therefore be penetrated into."

The female and young individual died on the way, but the male arrived in excellent condition. Though in reality a nocturnal animal, he shows no dislike of sunlight. He has been fed on small pieces of raw beef, of which he seems very fond. Some of his attitudes are quite singular: when inspecting the floor of his cage, he rests the weight of his body on his hind-legs, while the front feet barely touch the floor; when his attention is attracted, he raises his long, flexible snout, and advances the abundant vibrissae so that they stand at right angles with the head. Ordinarily the vibrissae lie back against the cheeks.



THE ALMIQUI.

The specimen measures about eleven inches, exclusive of the tail, which is seven and one-half inches long. He will be sent to the Philadelphia zoölogical gardens.

F. W. TRUE.

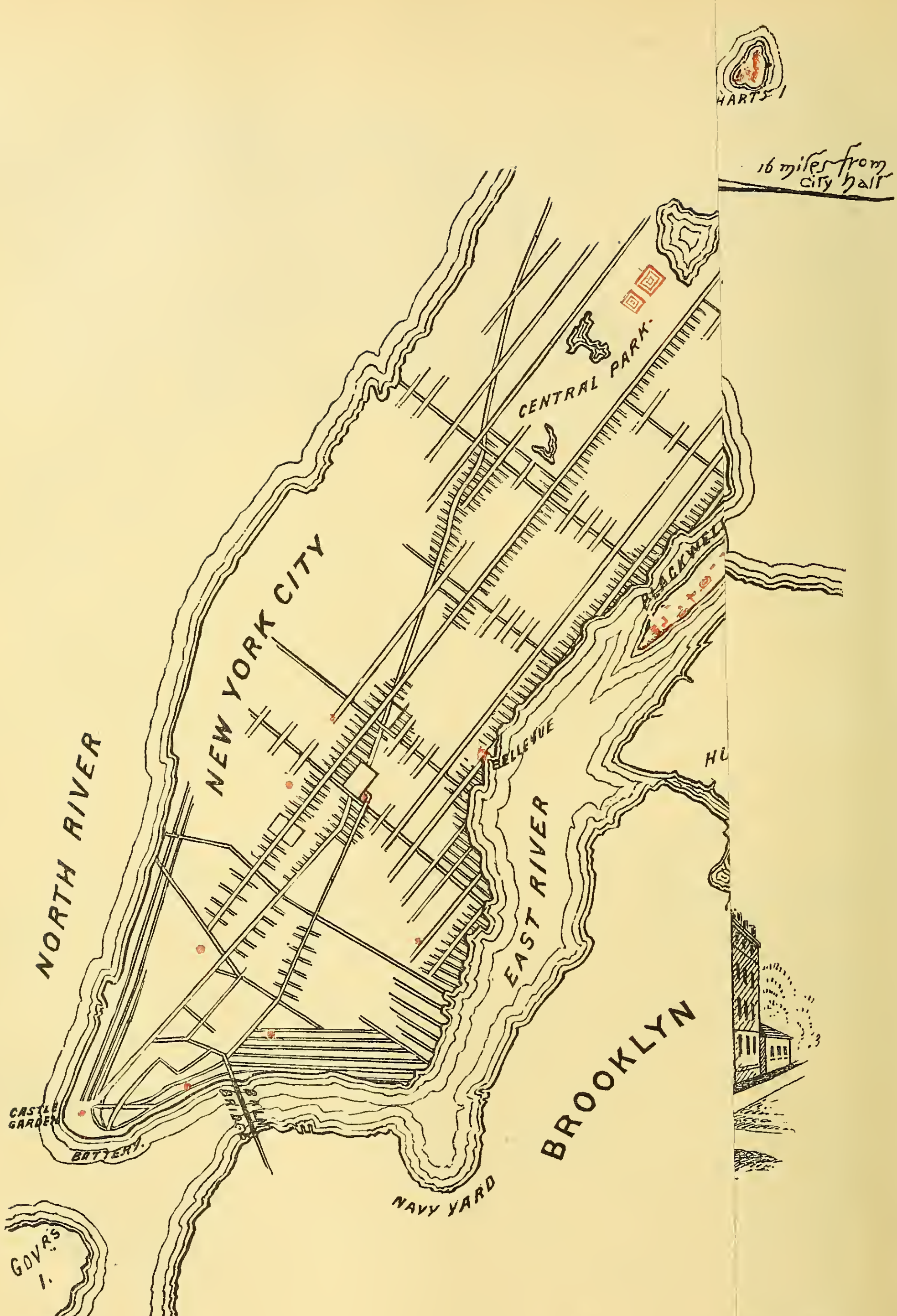
U. S. nat. mus., Sept. 13.

Revivification.

Your correspondent V. in *Science*, No. 187, inquires concerning the fakirs of India, and the wonders of their voluntary suspension of vitality. He will find the information of which he is in search very fully given — more fully than at any other place of which I am aware — in a small volume published in 1850 in London. Its title is 'Observations on trance or human hibernation,' by James Braid, M.R.C.S.E., C.M.W.S., etc. (London, *John Churchill*, Princes Street, Soho; *Adam and Charles Black*, Edinburgh). Both the facts and the proofs are very clearly set forth.

W. O. AYRES.

New Haven, Conn., Sept. 13.



mber 24, 1886.

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SCIENCE.—SUPPLEMENT.

FRIDAY, SEPTEMBER 24, 1886.

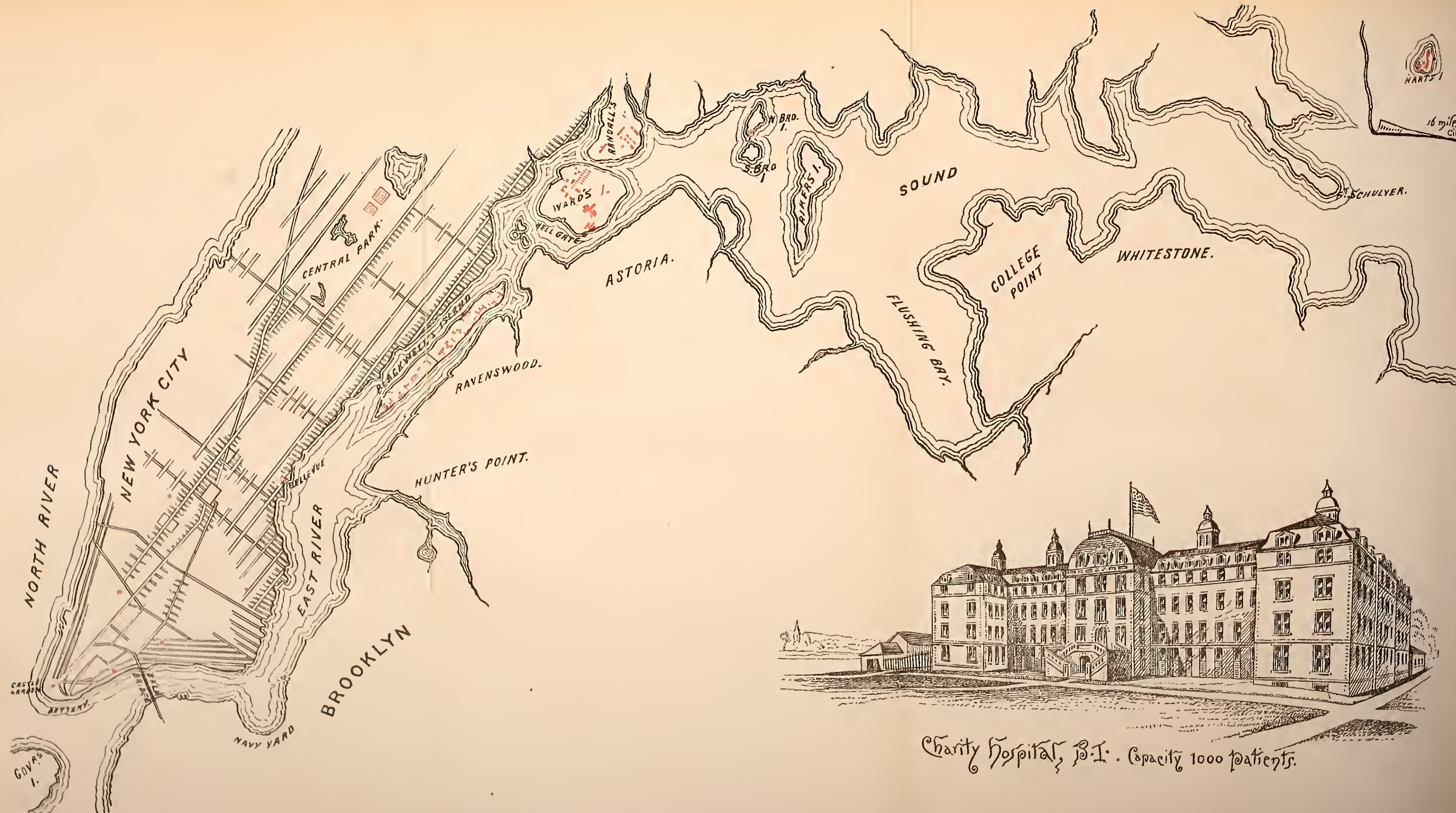
THE SOCIAL WASTE OF A GREAT CITY.

In the human body there is a legitimate waste of tissue and substance, structurally indispensable to its best development; and there is waste which depletes vitality, and is beyond the power of science to make good, while it is the herald of approaching dissolution. A great city is a corporation, a body politic. This complex organization, too, has a legitimate waste as a perpetual evidence of its thrifty increase; and at the same time it suffers waste which is dead loss of social capital and resource, while it points the way to ultimate disintegrations. Men and cities thrive, waste, and perish on parallel and strictly analogous lines. During a professional service of ten years among the charitable institutions under the control of the Board of commissioners of charities and correction, and also under the commissioners of emigration, this fundamental maxim of social science has gathered significance with the growth of experience. The people have become so accustomed to this downward drift, — this unresting current of wretchedness, profligacy, and crime, — possibly so hoodwinked by the imposing array of architectural groups, and the glamour of official reports bristling with statistics, that they miss the ghastliness of the situation, and think about it, if at all, in a vague and unconcerned way. But to the earnest observer, ghosts constantly arise which will not down. There is much ado in commercial circles about the *débris* and material waste of the streets and houses, and its best disposition; the people knowing full well that pestilence and epidemics bear with no trifling or superficial expedients. Besides, the harbor and its approaches must be neither choked nor befouled. The fear of disease, the dread of death, the timidity and greed of capital, keep sharp and suspicious watch, and in this direction the public welfare is measurably safe.

But outside a group of philanthropists and professional people, whose lives are spent in the service of this great and growing under-world of poverty (breeding desperation) and vice (breeding both poverty and crime), few care or think about it, or undertake to penetrate its dreadful secrets; while the casual shoaling of the harbor-channels, the grounding of an ocean-going steamer, the least chill or check of financial thrift, a trace of typhoid or small-pox, the transportation of dressed beef or cattle, the tug and chicanery of rival monopolies, the disgusting encounters of professional pugilists, stir and thrill the pulses of the metropolis to their liveliest beat.

All the while, this menacing under-world, with a biting irony, asserts itself, and compels recognition as imperatively as does the cancer as it eats its way to the vitals. It seizes upon and subsidizes the fairest string of islands that grace a metropolis the world over. Where there might have been, under a shrewder, better providence, parks, groves, museums, art-galleries, zoölogical gardens, wholesome games, exhilarants for honest industry and useful thrift, stretching at little intervals from Governor's to Hart's Island, full eighteen miles, the Nemesis of penalty and retribution has planted her growing colonies of social waste, — of broken, degraded, repulsive, dangerous human detritus; and this baleful colonization has pushed its way along those beautiful eastern waters, keeping step with the advancing city, until its entire line of eastern frontage, far up into Westchester county, is sentinelled by these menacing excrescences of a moribund civilization. The municipality is a body; and it requires no labored or exhaustive differential diagnosis to determine that a body thus smitten with boils and blains, with tangled and distempered wits, so scorched with fevers of drunkenness and debauchery, so threatened with poison in the very life-blood, is at best in a desperate condition.

So much for these 'institutions of charities and corrections.' In abundant outlay and thorough and intelligent organization, and in general scientific oversight, they stand, after their class, unrivalled, at home or abroad. Indeed, we have come to make much of them; so that when distinguished visitors, dignitaries, or scientists come upon us for municipal hospitalities, who does not forecast the inevitable festive picnic excursions through and among these same 'institutions,' with its steamer decked in bunting, its junketings, its congratulatory speeches, as the commissioners uncover our plague-spots and social ulcers, our paupers and desperadoes, our crazed, and our foundlings, for the edification of the day? Why not extend the route on future occasions, and so complete the panorama? This would take in the morgue and Potter's field, and their upland springs and feeders; the bagnios, with their more than fifteen thousand profligate women; the ten thousand dramshops; the underground hells and disreputable



Charity Hospital, B.I. Capacity 1000 patients.

THE INSTITUTIONS OF CHARITY AND CORRECTION OF NEW YORK.

concert dance-halls, which day and night, year in and year out, keep up the infernal work of peopling these islands. There would be something like logic and thoroughness in such an exposition.

The extent and magnitude of this social waste no man knows, and no man can know. There are outlying hidden realms of developing, maturing mischief and evil yet in the egg, scattered, unsuspected items of blemish and loss, which no report ever tabulates ; and we are thrown back upon the depressing consciousness that the larger part of this under-world, like the freighted steamer or the floating iceberg, lies well out of sight.

Let us take a rapid account of stock, and, in part at least, see where we stand. First these islands : Blackwell's, nearly two miles long, flushed by two swift channels of the river it divides, full ninety acres in extent, studded from end to end with the epileptic and paralytic, maternity, and charity hospitals, the New York penitentiary sprawling athwart well-nigh from shore to shore, the almshouse, the workhouse, and the women's lunatic-asylum and its growing population of more than seven thousand ; then Ward's Island, lying in a nearly rectangular area of two hundred and sixty acres, at the junction of the Harlem and East rivers at Hell Gate. Here are the lunatic-asylum for males and the homoeopathic hospital, together having about three thousand inmates. Immediately north, and separated by Little Hell Gate, some two hundred feet wide, is Randall's Island, a shield-shaped area of a hundred and sixty acres, and, with Ward's, lying close to the city. Here are the infants and Randall's Island hospitals, an asylum for idiots, a branch of the penitentiary, an insane-asylum for the young, and the house of refuge. Advançing a mile, we find Riker's Island, for the exclusive use of correctional institutions, a fair domain of sixty acres ; and yet farther up the sound, some seventeen miles from the city, the advanced post of this ever-growing colonization, with its area of some fifty acres, its hospital for incurables, and branch workhouse and lunatic-asylum (nearly thirty-five hundred inmates), and — the ghastly halting-place of all this interminable procession — Potter's field, with its myriads of friendless, dishonored dead : we reach and stop at Hart's Island.

Here are more than six hundred acres of the fairest islands lying all the way close to the city frontage, now become a rank witness of its loss and shame. Who will venture an estimate of the present and prospective value of this perverted, sequestered real estate, and the outlay represented in its multiplied structures ? Add to these assets of the Board of commissioners of charities and corrections a fleet of transports for the service of more than sixteen thousand colonists, Bellevue hospital, the various buildings in the service of the department, the hospital service at police stations, ambulances, equipments, prison vans, then the police stations and properties, the jails and prisons, and a just allotment of court and justice chambers, where the selections are made and the harvest of tares gathered,— this is but a fraction of cost and loss to the people, — a shameful investment, which, as will shortly appear, feeds the sources and energies that exact it.

We must not lose sight of the millions spent in the erection and support of foundling-asylums, reformatories of various sorts and uses, dispensaries, children's aid societies, infirmaries, and hospitals founded and sustained by individual and private beneficence, — all part of the great total exactions wrung from the public thrift, and turned aside from legitimate uses and benefits to the nourishment and maintenance of this terrible under-world.

It is equally impossible to measure the yearly outlay in this account with social waste. The board of commissioners alone send in estimates for their own disbursements for 1886, amounting to $1,947,607.50. According to the city comptroller's report for 1883, the appropriations for asylums, reformatories, and charitable institutions, presumably outside such as are committed to the care of the commissioners of charities and corrections, was $1,029,953.53, and this had in 1885 grown to $1,108,957.51. This total ratio of growth in the increasing cost of social waste must not be lost sight of, for the colonies grow by a visibly advancing ratio : so does the cost in all the municipal departments having special care of them ; while the conservative reparative institutions lag behind the constantly increasing development of the city. The Board of education, for example, for ten years past, scarcely breaks the even tenor of an annual appropriation, which fell to $3,400,000 in 1879, and rose to $3,769,086 in 1874, and only reached $3,750,000 in 1883. These data are drawn from the comptroller's report of 1883. Later accounts might throw light upon this apparent decline in the educational enterprise of the city. In this hurried glance at the schedule of assets, we are not to lose sight of the police department, — a standing army, keeping guard night and day, trained, officered, armed, and paid, — the picked brawn and muscle of the town, banded together for the public protection. Add to these another army of keepers, attendants, nurses, deputies, resident bodies of medical men and their student assistants, and we begin to catch an outline of the magnitude and proportions of outlay in money, values, time, and men, subtracted from the normal uses and functions of thrift-production both in social and civil life, both of which are thus far impoverished and debilitated because of this shrinkage and loss in vitality. Here the sociologist is baffled; for no statistical tabulation, however minute and exact, adequately or even approximately represents the substance of the problem.

I do not review the physical elements of this problem to arraign the authorities, or to challenge the costliness of the attempt to meet and discharge an absolute duty: it is simply the exaction of Nemesis, — the price of ignorance, unthrift, sensuality, and crime, which the people must pay in one shape or another. The questions left for consideration are the sources of social waste, and the practical hinderances in the way of their municipal relief and correction.

The sources mostly lie far back out of sight, and in unexpected places. Among these is the pressure of labor, especially women's labor; and the tens of thousands of young girls literally imprisoned over-hours at the sewing-machine, behind the counters of stifling shops, in cigar-factories and at tenement-house tobacco-work, in factories innumerable, where the fever of competition feeds on the blood and brain of girls and children, with the inevitable poisoned air, insufficient nutrition, and exhaustive toil, constitute one of the most perilous sources of supply for the vicious and criminal classes. Hunger, desperation, unendurable tension of nerve and muscle, are all the time goading thousands toward mercenary profligacy. These conditions are not only unfriendly to virtue and chastity: they create and intensify those critical conditions that breed shame and dishonor. Virtuous, easy-going ladies and gentlemen must get their haberdashery at bargain prices, even at the yearly immolation of hecatombs of girl and women workers who are literally starved into the ranks of the falling and fallen. Among all the thousands who drift into the island population, there are found few exceptions to this experience. Poverty, lust, and drink, — these three, — and their progeny, profligacy and crime, cover nine-tenths of the social and moral history of these coming and going islanders. The disreputable dance-halls and concert dives and bagnios, and vile places of resort of one kind and another, all connect with this range of hopeless, suffering world of women-workers.

When capital and commerce grow humane, and become as considerate of human hearts and lives as they are of machinery, vehicles, horses, and other useful appliances of industry and honest increase, then, and not sooner, will this diabolic waste of womanhood be checked and stayed.

Note again the viperous nests of friendless and orphaned boys and lads who herd in out-of-the-way covers in or about the city, without homes, teaching, or training; the progeny of criminals, or paupers, or drunkards; getting keenness and animal ferocity out of their hardships, and a training, of its kind, for the full-grown thief, burglar, and murderer.

Mr. Delamater of the New York police department, after careful estimate, states "that seventy-five per cent of our convicts are city born and bred," and adds, "that, of the 2,576 inmates of the three state prisons of New York on Sept. 30, 1884, 1,645, or 63.8 per cent, were from Kings and New York counties."

The secretary of the National prison association writes more conjecturally but more emphatically: "I looked over . . . my list of cases which I have investigated personally, and find that more than four-fifths of the wrong-doers were either born in cities, or had become residents of cities when very young. . . . If you had asked 'as between large towns and city, and country bred children,' I should have been obliged to add almost the other fifth."

"The celebrated French reformatory, Mettrai, has since its foundation admitted 3,580 youthful inmates: 707 of these were the children of convicts; 534, 'natural' children; 221, foundlings; 504, children of a second marriage; 308, those whose parents live in concubinage; and 1,542, children without either father or mother" (*Une visite à Mettray*, Paris, 1868).

"According to Dr. Bittinger (Transactions of the national congress, p. 279), of the 7,963 inmates of the reformatories of the United States in 1870, fifty-five per cent were orphans or half-orphans."

M. de Marsaugy, a clever French author, in writing of the causes of juvenile crime in France, says that "a fifth of those who have been the objects of judicial pursuit are composed of orphans, the half have no father, a quarter no mother, and, as for those who have a family, nearly all are dragged by it into evil" (*Moralisation de l'enfance coupable*, p. 13).

The precocity of the criminal classes is notorious and portentous. It sets back year by year, until the courts have long since passed the teens, and children under twelve are seen in the prisoner's dock with growing frequency, for serious misdemeanors and crimes. The police confess the practical difficulty, not so much of exterminating, as of repressing, these nests of juvenile outcasts, who prove more formidable, even, than bands of adult outlaws. Something is done towards depleting this threatening element, under the action of the Children's aid society and the various half-penal reformatories. But these latter too often send out graduates, ripe in the vilest lore of evil, contracted while under the costly care and training of the state.

Superintendent Kellogg of The charity organization society, in an address before the American association of social science, 1886, states: —

"In 1883 every twelfth commitment by the courts of New York was either of a girl under twenty, or of a boy under fourteen years of age: of the former there were 2,054, and of the latter, 2,118, a total of 4,172. At the same time there were thousands of children drawn from the poor, permanently lodged in the public correctional institutions and the fifteen or twenty reformatories of the city. Those youth who have fallen into police custody are probably lost for any good purpose to the community; and that loss, it will be seen, is greater pecuniarily and numerically than that caused by preventable death. As a social disease, their presence in the community is injurious beyond computation, since an infiltration goes on from them through gradually enlarging areas of society. Nor is their depravity like the calamity that comes with a blow, and then all is over. Having reached adolescence, they go on from year to year, dependent, predatory, contaminating."

We have taken too superficial an estimate of the tramp population in its relation to social waste and disorder.

The following statistics were taken from the Annual report of the Board of police justices of the city of New York, for 1884: "6,275 persons were arrested, or appeared in the police courts of New York City, in 1884, against whom a charge of vagrancy was preferred; and of this number, 5,892 were convicted upon competent testimony or upon their own confession."

Comparison with former years.

Year.	Number arraigned.			Number convicted.		
	Males.	Females.	Total.	Males.	Females.	Total.
1874	1,751	1,388	3,139	1,572	1,293	2,865
1883	3,012	2,566	5,578	2,737	2,434	5,171
1884	3,638	2,637	6,275	3,372	2,520	5,892

"The number of persons arrested upon the charge of disorderly conduct in 1884 was 28,696. Of these, there were convicted and fined, or held to bail for good behavior, 20,311."

Comparison with former years.

Year.	Number arraigned.			Number convicted.		
	Males.	Females.	Total.	Males.	Females	Total.
1874	13,568	7,125	20,693	7,058	4,699	11,757
1883	16,272	7,611	23,883	10,517	6,196	16,713
1884	19,944	8,752	28,696	13,141	7,170	20,311

"The registration bureau of The charity organization society of New York City records a list of 71,332 different families, or a total population of 285,000 individuals, involved in mendicancy or dependence" (*Report of Charity organization society*, 1886).

This waste shows a deadly apathy, a dying-out of purpose, a fatal estrangement from home, family, and society, for which there has, as yet, been found neither remedy nor cure. This tramp class grows, and grows dangerous and desperate too, and is chargeable with an increasing number of outrages, assaults, and crimes against both property and person. The island, the almshouse, and workhouses do not reach or touch their cases, for they gather physical endurance and resources from fresh campaignings across country, until rounded up again by winter weather in the great cities. Even the dead weight of this class, like sheer moral inertia, rests like an incubus upon the community; a species of leprosy, in short, that spreads while it kills, surely if slowly. This discouraged, cowed, broken-down class is likely to increase, under a civilization which develops millionnaires and monopolies out of the feebleness and misfortunes of the masses. Strange illustrations of this soulless work of disintegration may be found any and every day in hospital, penitentiary, almshouse, insane-asylum, or morgue.

But well-to-do labor, legitimate, hopeful industry, insensibly contribute their quota in the multitudes, who, too heavily handicapped in the struggles, in the irresistible spirit of emulation and haste for riches that stimulates and fires on all sides, succumb to some form of mania or insanity. The inmates of these insane-asylums are largely overworked, over-anxious lives, thrown out of gearing often by a very slight obstruction, — lives too far collapsed to resist an appetite or passion which might hardly ruffle the equipoise of a robust nature.

The heredity of evil is an element of incalculable significance, the fearful rolling-up or rolling-down from generation to generation, through all the ages, of the weakness, vice, and moral darkness of the past. The increase is more than compounded. It spreads and penetrates in every direction without spending or diluting its death-dealing vigor. Evil is gregarious, it is prolific. It grows into a society of its own, well named the half or under world. It stamps its offspring indelibly. It not only inbreeds to deadlier purpose: it grows by what it captures, defiles, and anneals in some vital, hopeless way to itself. No man or woman who is 'sent up' to these colonies ever returns to the city scot-free. There is a lien, visible or hidden, upon his or her present or future, which too often proves stronger than the best purposes and fairest opportunities of social rehabilitation. The under-world, with the police and detective forces practically in its interest, holds in rigorous bondage every unfortunate or miscreant who has once 'served time.' There is often tragic interest in the struggles of these insnared wretches to break away from the meshes spun about them. But the maelstrom has no bowels of mercy; and the would-be fugitives are flung back again and again into the devouring whirlpool of crime and poverty, until the end is reached on the dissecting-table or in Potter's field. Men who insist on breaking with this tyrannous fellowship are often driven to seek refuge among the various institutions on the islands in menial or half-menial service as helpers, messengers, or orderlies, under the beggerly wages of the department, as a better alternative than a life at large, constantly imperilled by the threats and allurements of evil association.

A serious percentage of this waste is thrown at our doors by emigration. "Less than forty-eight per cent of the criminals convicted in the police courts of the city of New York in 1884 were native born. Of the total number, 51,845, the United States contributed 24,511; Ireland, 16,349; Germany, 5,272; England, 1,801; Italy, 1,707; other countries, 2,205" (*Annual report of Board of police justices*, New York, 1884). Thus, while it is not properly our own, we become charged with its care and cost. Many of the old abuses have given way before a more intelligent and discriminating legislation; and the penitentiaries, workhouses, and almshouses of Europe no longer engage in the systematic and wholesale deportation of their paupers and criminals to our shores. But in the large volume of a growing and desirable immigration, the casualties and exhaustion of ocean travel, epidemics, and misfortune, leave many stranded and helpless in this great city.

But the crowning, almost inclusive source of public injury is unquestionably strong drink and drunkenness. Yet the people pocket a hush or conscience money of half a million or so yearly, and then legalize or explicitly connive at the establishment of more than ten thousand drinking-places in the city. The moralist and social reformer have for generations shouted in our ears and spread before our eyes the terrible statistics of this most inhumane and inhuman traffic. Judges from the bench take up and repeat the refrain. Science and philanthropy, hand in hand, demonstrate, expostulate, and threaten; yet the bribe-taking goes on, and the city, for its yearly dole of half a million, lets loose this army of incendiaries, more dreadful than conflagrations, more deadly than pestilence, more destructive than the field of battle. It is no metaphor to attribute this moribund, hopeless, repulsive, excrescence population to the parentage of strong drink; for drink and debauchery are inseparable, and poverty and crime and pestilence are their progeny. If drink and lust furnish three-fourths of the criminals, they are more lavish yet with the almshouse, and they have a busy hand in filling the wards of the hospitals. Eliminate or shorten within hygienic limits the traffic in strong drink, and these institutions of waste would in a decade shrivel and shrink well-nigh out of sight.

What can the moralist or scientist do by way of resuscitation? Very little at best. The flotsam and jetsam are mere shreds and fragments of wasted lives. Such a ministry must begin at the sources, — is necessarily prophylactic, nutritive, educational. On these islands there are no flexible twigs, only gnarled, blasted, blighted trunks, insensible to moral or social influences.

The physician, priest, and turnkey share a common outlook of nearly baffled hopelessness; and almost the sole blossom — the sole fair and precious jewel to be found in this world of refuse and desolation — is the culture of a stronger, surer medical science, and the training and education of ministrants for the sick-room and hospital wards. And the sole ground of hope and amelioration lies in the rigid enforcement of a more practical civil service, and in the vigilant, gratuitous, and inexpensive supervision of the State board of charities, whose stated and fearless probings into dark, unsuspected corners, whose scientific insight and humane devotion to their unwelcome mission, have instituted or energized every project or reform for betterment thus far attempted in our municipal institutions.

The hinderances in the work, and the conditions unfavorable and even hostile to its best administration, lie in full sight of every thinking observer.

First, we note the illogical and most unrighteous affiliation between crime and poverty. 'Charities' and 'corrections,' forsooth, some diabolic Malaprop surely linked these terms in unequal fellowship. What have criminals to do with the sick and poor, and why should conditions morally more widely separated than the poles be literally handcuffed in mutual ignominy? The relation between crime and poverty is no more essential than between crime and wealth. It is not for a so-called modern civilization to smirch and befoul a condition in life in itself honorable, reputable, and of a certain dignity, by involuntary association with the tramp, harlot, thief, and assassin. There is a charity called for at the hands of the municipality which suffers unendurable shame and affront under this duplex administration of charity and correction. There is much pitiable, unfortunate, blameless poverty finding shelter in the hospitals and at the almshouse. Why should it be thrust into intolerable contrast with shameful, dissolute pauperdom? Keep the abused term 'pauper,' if it must be, to mark the latter herd; but leave 'poverty' and 'the poor' to the patient, long-enduring, suffering, and often heroic victims of failures, that fall under the wheels of success or monopoly. To such, a true life pays involuntary courtesy as to the maimed, unshapely, helpless victims of the battle-field. Because of this graceless confusion and breach of duty, much that even municipal charities might undertake and accomplish is now hopelessly out of reach.

The conclusion is irresistible that a fatality lurks in the very organization of the board of management. Here is the sphere where there is a demand for the soundest philanthropist, the matured student in sociology, together with the bravest and wisest medical service. Such alone are competent to look after and administer this settlement of social waste. There is natural congruity in this postulate. Financiers, we say, for banking, trust funds, and the public treasury; metallurgists and chemists and engineers, for mining; learning, logic, and eloquence, for the forum: that is, the specialist full ripe for his specialty. But how is it with this board who have so long been in place? Here and there the tonic presence of a strong personality has been felt; but who is so weak or stupid as to identify the board, under its present constitution, with these necessary interests in the life of the community?

And here we are forcibly confronted with a monstrous anomaly, and it is the constant peril of this whole field of municipal administration. The Board of commissioners of charities and corrections, together with its entire system from greatest to least, from centre to outpost, is in abject slavery to municipal politics, is a recognized, hopeless appendage of the 'machine.' It does not spring frankly and wisely from the popular suffrage. It has no freedom, no will, no autonomy. On the contrary, it is honeycombed with bureaucracy and officialism; and the powers that move and manipulate every member of this great constituency are as far removed above their heads as the chess-player above the pieces he manipulates. This is the inherent vice of a system which relegates the administration of the under-world of social waste to the machine and its politicians: for at the outset a vicious circle is established. The dram-shops are the spawning-grounds of municipal politics and politicians. Yet these same dram-shops are chiefly responsible for the existence and growth of the very institutions over whose fortunes the politicians, their other progeny, have come to preside. What else could happen than has steadily happened, — perpetual jostlings, abuse of discipline, tampering with the courts, muddling of justice, and an impassable chasm which separates between a time-serving officialism and the scientific and professional superintendencies, — a deadlock which discourages, if it does not paralyze, the *esprit de corps* of medical administration; which withholds the incentive for legitimate emulation, and reduces the men who devote, and not unfrequently surrender, their lives to the standing of tide-waiters under the bidding of an irresponsible board, which is itself nothing better than an accident in political evolution? The machine is supreme; and the commissioners rattle their own handcuffs of partisan servitude while reducing this array of employees and subordinates to the lock-step of partisan bondage. The same process is going on in the kindred departments of municipal administration, as the Department of public works, the Fire department, and the Board of education. Pickings and stealings, the building-up of snug fortunes, the judicious nursing of thrifty opportunities, are insignificant elements, if they really lie in the subject. The crowning injustice, the superlative cruelty, lies in the fact that this gravest trust from the people is become at once the toy and makeshift of professional politicians.

When the Board of commissioners of charities and corrections shall come to be made up of philanthropists, men versed in sociology, who accept a duty toward the people as the highest and most inviolable of trusts, instead of men who regard public office as personal property; men who live above all entanglements of political chicanery, — then there will be found ways for checking and lessening this current of social waste, even if it may never be absolutely arrested, and moral disinfectants, deturgent and tonic energies, be brought to bear directly and hopefully upon these imperilled thousands.

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FROM THE THIRD TO THE SEVENTH YEAR OF CHILDHOOD.

M. PEREZ, in the present volume, continues his study of 'The first three years of childhood,' which has been made familiar to English readers by the translation under the direction of Mr. Sully. Our author thinks that these four years form a distinct period in child-development, — more so, at any

L'enfant de trois a sept ans. Par BERNARD PEREZ. Paris, *Baillière*, 1886. 8°.

rate, than that from the third to the sixth or the eighth year, — and is ready to employ the same psychological method of observation in this study as in the former one. The task is more difficult as the subject is more complex. Apart from the author's rather characteristic French diffuseness, the work bears the evidence of its being the first attempt to write the psychology of this period of childhood. As the book is addressed to a rather popular audience, the diffuseness is not so serious a fault as it would be if the subject were capable of that scientific treatment which is as yet only an ideal. One who appreciates the difficulty of the task will be lenient towards the defects due to the newness of the subject. It is perhaps rather an unfortunate period for writing the book: the evidences are abundant that in ten or fifteen years it will be possible to write a better and more scientific work. Great credit is due M. Perez for venturing into this new field.

At the very outset an important point is touched upon. As we pass from infancy to childhood, it becomes less possible to make precise statements. Children under three years will differ considerably in the development of their powers; but these differences are insignificant, compared to those between various children of six or of seven years of age. Here, again, that suggestive analogy between the infancy of the individual and the race seems to hold: savages, like young children, have no real geniuses.

This important fact at once changes the method of study. For some problems, statistics should be called upon, for which kindergartens and schools should be ready to furnish the material.[1] This part of the subject, M. Perez has almost entirely neglected. Where this method is inapplicable, one is thrown upon the insight and psychological tact of the observer, — a faculty closely allied to the insight into human nature attributed to novelists and dramatists. It is a quality of mind more feminine than masculine (witness George Eliot); and thus, while the father is better suited to study the psychic activity of the first three years, — requiring, as it does, an unprejudiced, matter-of-fact observer, — the mother's tact will do better with the next four years.

M. Perez has little to say of the physical development of this period, but confines his attention to the higher psychical processes, such as memory, association, imagination, abstraction, inference, emotions, will. He prefaces the discussion of each with the current psychological views upon the topic, and then treats of its place in the child's mind. Many interesting points are touched upon, a few of which may be here noticed.

At the end of the third year, no remembrance of the first two years remains: the child can with difficulty recognize objects after an eight or ten months' absence. In some cases the environment of the second year, though forgotten at the age of four, is recalled at the age of six. Apparently, the growth in the brain has made the impression more easily revivable. But the mere retentive power is strongly active, and, according to Bain, is at its maximum between the sixth and the twelfth years. This is the period the educator uses to store the mind with raw materials, the multiplication-tables, and so on. M. Perez found, that of a class of children six to seven years of age, asked to repeat a short passage after three hours' interval, only a very few could do so correctly, while two-thirds made from three to six mistakes. At the age of ten, the mere tenacity of memory has reached its height, the best memories have come to the front, and special aptitudes of memory begin to show themselves.

M. Perez is quite warm in his advocacy of the naturally optimistic bent of childhood. He regards physiological temperament as an important factor in one's philosophic views; holds that children fed on milk and fruit have a calm and sweet imagination, while those who over-indulge in meats, spices, and sugar are ardent and capricious; and thinks that the pipe, beer, and meat diet have much to do with the German form of that 'aristocratic neurosis,' pessimism. A well-fed, healthy child, whose temperament is naturally sanguine and nervous, with a touch of the lymphatic, whose circulation is quick, whose functions are constantly growing and adapting themselves to their environment (which, according to recent theories, is the definition of pleasure), is on a good path to optimism. The *rôle* of pain as an educator leaves the stage early: life doubtless begins with much pain; but, as soon as the habit of growth has well set in, the whole life of children is pleasure-giving, with a savage-like indifference to pain. Childish improvidence, and shortness of memory, reduce moral pains to a minimum. His imaginary troubles (so essential a part of our own troubles) are few and distant. Childhood is selfish and happy.

A German writer has written a pamphlet on the 'Lies of children.' The word must be understood in a wider than the usual sense. The distinction between the actual and the imaginary, the objective and the subjective, is not as sharp and clear to children as to us. Their world is more akin to that of the poets, where it is allowable to idealize common facts, and spice the truth with a pinch of fiction. A child of six will often tell an un-

[1] For an example of such a study, see 'The contents of children's minds,' by G. Stanley Hall, in *Princeton review*, May, 1883.

truth knowingly to get out of scrapes, to shift the blame on others, to arouse a laugh and thus change the subject, and do it with great logical acuteness. An emotional element often enters; fright makes them unable to clearly tell what has happened; distrust of adults often acts in the same way. One must gain the child's confidence to be able to correct the fault. It is only under bad treatment or hereditary taint that the habit becomes a serious moral fault: in its typical phase it is simply a stage in the intellectual development of the child.

The dawn of self-consciousness is an interesting stage in child-growth. This M. Perez very justly divides into two parts: the first is the age at which the child distinguishes its person as a thing apart from other external things, and which M. Perez puts at ten months, although Preyer's child, more than one year old, caught hold of its arm as an external object; the second, the age at which it recognizes itself as the centre of the emotions, thoughts in which it lives. This is not clearly done until the age of five or six: at about that age the child has ample material for taking the introspective attitude, and studying his own personality. Lotze, it may be noted, considered the attention to one's self which a new dress causes, as an important agent in the development of self-consciousness.

The logic used by children is an interesting topic. The unconscious processes of thought must be included under this term. When the child says it avoids the fire because it burns, it goes through an unconscious syllogistic process. But, having little knowledge of general propositions, its deductive processes are very rudimentary. The induction has the same faults as that of hasty reasoners,—generalization on too slim a basis. If the uniformity of nature is the guiding principle of induction, evidently one who has had little experience of this uniformity will go astray in his logic. Little Jack concludes that men do not go to church because his father does not.

The emotions of the first years are vivid, transient, and *naïve*. The child's actions are largely impulsive: it has no reasoned moral algebra. It has a meagre conception of time: it lives in the present, and future ills have little meaning. A child usually overrates its own powers, is sanguine and selfish. The higher sentiments, aesthetic and moral, depend largely on education.

The development of the will includes a motor, an intellectual and an emotional element. With the development of the muscular system, its acts come to coincide more and more with its intentions. The repressing of unnecessary, partly reflex manifestations is one of the most serious tasks of childhood. It requires all the skill of the parent and educator to make the child a useful, mentally economical member of society, without killing out that *naïveté* and naturalness of development so difficult to retain amid the artificiality of modern society. It is here that the formation of habit as a saver of time and energy becomes all-important.

Perhaps this sampling sufficiently indicates the contents of the work of M. Perez. It opens a rich field. Those who come after will be glad to profit by his experience. JOSEPH JASTROW.

WORK OF THE MAINE AGRICULTURAL EXPERIMENT-STATION.

THIS modest report of eighty-seven pages covers the work of the station from its foundation, July 1, 1885, to June 30, 1886, and, though small, is a model of what such reports should be. The first portion is devoted to the fertilizer control work, and contains analyses of seventy-five samples of fertilizers and fertilizing materials, together with explanations of the principles on which the 'valuation' of fertilizers is based.

The second portion of the report is of more general interest, and contains the results of several feeding experiments. Determinations of the digestibility of indian-corn, corn-meal, and corn ground with the cob, when fed to a pig, showed that the meal was much more completely digested than the whole corn, while the percentage digestibility of the corn-and-cob meal was below that of the whole corn. A computation based on the proportion of corn to cob in the corn used showed, that, if we assume the corn of the corn-and-cob meal to have had the same digestibility as the whole corn, about one-ninth of the cob was digested.

Some experiments on milk-production showed a decided gain to result from substituting cottonseed-meal for a portion of the corn-meal of a ration consisting of hay and corn-meal. Similar experiments by Armsby at the Wisconsin experiment-station have given the opposite result; but in discussing these, the director, Prof. W. H. Jordan, shows that the apparent conflict is due to differences in the conditions of the experiments in the two cases. A similar advantage was found to result from the use of cottonseed-meal in fattening steers.

Professor Jordan's report is noteworthy for its clearness of statement and its scientific spirit. The experiments are planned with a definite purpose, and the results are discussed in a way to render them intelligible to any thinking farmer.

Annual report of the Maine fertilizer control and agricultural experiment-station, 1885–86. Augusta, *State*, 1886. 8°.

SCIENCE.

FRIDAY, OCTOBER 1, 1886.

COMMENT AND CRITICISM.

CONTAGIOUS PLEURO-PNEUMONIA has broken out to such an extent in Illinois as to call for most prompt and vigorous measures on the part of the state authorities. This disease has prevailed in this country to a greater or less extent among the bovine species since 1845, when it was introduced in Brooklyn from Holland. Kings county and the city of Brooklyn have been hot-beds of this form of cattle-plague from that time to the present. The state authorities attempted some years ago to eradicate it, but failed. The local health authorities have also endeavored spasmodically to root it out, but it still exists to a greater or less extent on the western end of Long Island. We notice in the daily press, that the owners of the distilleries in the west who profit by the sale of swill to the owners of the cows in the affected districts claim that there is no danger from the milk of the diseased cows, as they do not yield any. This claim is utterly without foundation. The milk becomes reduced in quantity, but often continues to be secreted throughout the attack. This effort is made to delude the authorities and the public, in the fear, that, if compelled to destroy such milk, their revenue will be much reduced. The producers of swill-milk need the closest watching. Any one who will feed his stock upon such food will not hesitate to palm off upon the public the milk from the most diseased animals as being 'pure Orange county milk.' The people of the whole United States are affected by unwholesome meat, which finds its way into the Chicago stock-yards, and have a right to demand of the authorities, municipal, state, and national, that every precaution shall be taken to keep from the shambles animals sick or suspected to be affected with any disease which tends to produce sickness in the consumers. Fortunately, there is little danger from the milk for those at a distance, but the refrigerator-cars may bring to the door of every one the meat of animals killed in the slaughter-houses of Chicago.

THE SUPERVISORS OF KINGS COUNTY, N.Y., are bearing the onus of the charge of interfering with the proper care and recovery of the insane poor of that county. Although a large sum of money has been expended to purchase a farm at St. Johnland, Long Island, with the object in view of removing at the earliest possible moment the insane who are now crowded in the Flatbush asylum, and although every financial provision has been made to erect cottages for their proper protection, still this board neglects, week after week, and month after month, to take such action as will make possible the attainment of this end so much to be desired, and for which philanthropists have been working for so many years. The general impression prevails that the supervisors are actuated by motives which are, to say the least, very questionable, and the press is calling the attention of the grand jury to the matter.

THE NOTICE THAT HACHETTE of Paris is issuing a series of historical and archeological monographs of French towns is important as showing the increasing desire to make history something more than a dreary record of rulers and wars, and to make it tell the story of the people. In this series the volumes on Blois, Tours, Rheims, Nimes, Chartres, le Mans, Angers, Nantes, St. Malo, and Dinard, are already published. In the records of these towns and in their development are to be learned valuable lessons, and much of by no means antiquated social and political interest. In centres like these the people's life was truly lived, and it remains for the conscientious and industrious historian to reveal it to us. In England, similarly, the cathedral towns and the various shires are receiving attention; and American scholars are describing our early town and village societies, as well as tracing the development and administration of our large cities. Thus history is made; and it is owing to the broader and clearer idea of what history really means, which now prevails, that students are turning in increasing numbers to these important sources of information.

GLANDERS IS REPORTED to exist among the horses of Brooklyn and in a large stable at Coney Island. It is believed to have been spread by means of the watering-troughs, the affected animals soiling the troughs with the discharge of the nostrils, which thus communicates the disease. Infecting the horses is not the only danger to be feared: numerous cases are on record where grooms, and others whose duties brought them in contact with the diseased animals, have become themselves diseased, and have in most cases succumbed after suffering the most excruciating torture. The health and other officials should make every effort to discover infected horses, and to isolate them until they can be destroyed. The probabilities of recovery are so slight, and the danger both to animals and man so great, that the retention of the glandered beasts in public stables, or their passage through the streets, should not be permitted. Like the Indian, the only good glandered horse is a dead one.

The bad effects of the use of circular curves on city railways is shown in a striking way in Philadelphia, where the cable-road on Market Street has to make eight right-angle turns (four for each track) in passing around the public buildings on Broad Street. The harm is not only in the sudden development of centrifugal force in passing from the straight tangent to the circular arc, but also in the sudden starting and stopping of a moment of rotation — a turntable movement — as the car runs on and off the curve. In passing around the curve, every car is rotated through ninety degrees at a uniform rate; much as if an engine on a turntable were suddenly set turning, then moved steadily, until it as suddenly stopped. It is manifest that great strains are caused by such violent changes of motion, not only on the cars, but on the cables as well; and it would be worth while to go to much trouble and expense in the construction of parabolic curves in the beginning, to save wear and tear in the long-run. Horse-cars feel the bad effects of circular curves less than the cable-cars, because the velocity of the former can be adjusted to the occasion by good driving; while the latter move steadily and rapidly, without any allowance for the strain on the cars and the stretch of the cable that the curves produce. It is curious that so antiquated a device as the circular curve should survive in a construction involving so much special and ingenious arrangement as a cable-road.

The consumption of tea has become so enormous as to have suggested a study of its effects upon the health of the people. There are those who look upon it as an evil only second to that connected with the excessive use of alcohol. Tea is spoken of as an agreeable cerebral stimulant, quickening intellectual operations, removing headache and fatigue, and promoting cheerfulness and a sense of well-being. When it is used to excess, the digestive and nervous systems are especially affected. There is no doubt that there are cases of dyspepsia caused by the inordinate use of strong tea; and it is also a matter of common observation that sleeplessness, palpitation of the heart, and nervous irritability often follow the prolonged use of this beverage. Tea-drinkers, by which we mean those who use tea to excess, are to be found in all classes of society. The fact should be impressed upon such persons, that tea is not a food, and cannot therefore, without risk to health, be substituted for articles of diet which form both flesh and bone.

Another fatal result from the administration of chloroform is reported from Dallas, Tex. The patient was a vigorous Swede forty-one years of age. He was suffering from diseased bone, due to a gunshot wound received during the late war. There were two of the most careful and skilful physicians present, who exhausted all available means for his restoration to life, but their efforts were fruitless. This case illustrates in a most striking manner the great and unavoidable danger connected with the use of chloroform as an anaesthetic in surgical operations. This patient was examined prior to its administration, and pronounced free from any heart or other disease which would contra-indicate the use of chloroform; and yet while the anaesthetic was being given, with the surgeon's finger on the pulse to detect the first evidence of danger, the heart stopped beating instantly, nor was there any pulsation after that moment. As we have already said, and as we propose to continue to say whenever opportunity offers, the administration of chloroform in surgical operations is ordinarily unjustifiable. and, unless the surgeon can give some good reason for using it instead of ether, he should be held civilly and criminally responsible in case of the death of his patient.

Much has been written on the subject of mysterious noises, which in most cases, if intelligently inquired into, would be found to have no mystery at all about them. A professor at Philadelphia recently recorded that at a certain hour each day one of the windows in his house rattled in the most violent manner. On consulting the local railway time-table, he could find no train running at the hour specified; but on examining another table, which included a separate line, he found that a heavy train passed at the time at a distance of several miles from his house. He then referred to the geological formation of the ground between the two points, and at once saw that there was an outcropping ledge of rock which formed a link of connection between the distant railway line and his home. It was the vibration carried by this rock from the passing train that rattled the window.

A REMARKABLE LAND-SLIDE.

THE U. S. geological survey has learned from Mr. C. W. Cross, engaged in field-work at Denver, Col., the particulars of a remarkable land-slide near Cimarron, Gunnison county, which was described in the local papers as an earthquake. Professor Farnham, of the Nebraska state normal school, who chanced to be in the neighborhood, had personally visited the scene of the supposed earthquake; and when he called upon Mr. Cross, and described the appearance of the region, the fissures formed, etc., the latter inferred that a serious disturbance must have occurred along the line of faulting on the west side of the Trident mesa, indicated on the Hayden maps. As soon as practicable, Mr. Cross went to Cimarron. He found the locality about nine miles south of that town, on the east side of the west fork of the Cimarron River. Between the two forks of the Cimarron is a mesa capped by eruptive rock, the valleys on either side being eroded out of cretaceous rocks, apparently the clays of the Colorado group. The area involved extends from the base of the cliffs of eruptive rock forming the top of the mesa, down the slopes toward the valley bottom, nearly to the edge of the belt of timber. Such a crumpling of the surface had taken place, — throwing down forests in inextricable confusion, pushing the ground up into ridges, and leaving fissure-like depressions, — that the assumption by untechnical persons of an earthquake as the cause was not surprising; but, after a two-days' examination, Mr. Cross satisfied himself that there had been no earthquake, but a remarkable land-slide, involving an area of nearly two square miles. It was evident that the surface of the ground had become loosened from the underlying clay beds, probably in consequence of the sepage of water, and that a movement of the area, starting at its upper end, had been thereby instituted in the direction of the mesa. The lower portion having moved less, or not at all, the ground there had been most thoroughly ridged, fissured, compressed, and overlapped, in such a manner that trees had been overthrown, little ponds drained and new ones formed, and the courses of small streams changed. Ranchmen living near by had preceived no tremor or other evidence of earthquake disturbance, nor could they tell when the movement took place; but they agreed in saying that the rainfall had been unusually heavy. Evidences were found of similar land-slides of earlier date, at various places along the valley, and it seems clear that such slides must have played an important part in shaping out the valley depression.

THE 1886 PRINCETON SCIENTIFIC EXPEDITION.

AFTER a most successful working season of over ten weeks, the Princeton scientific expedition has returned from its explorations in the Bridger beds, south-western Wyoming, and the White River country, north-eastern Utah. It will be remembered by those familiar with the history of bad land explorations that this is the sixth expedition that Princeton has sent out to the west. Since 1877, Prof. W. B. Scott and his coadjutors have worked in the Bridger beds and Bitter Creek country of Wyoming, in the White River of Dakota country, in the Yellowstone region, and now in the White River basin in Utah. The result is that the Princeton museum has now a splendid collection of American fossils, less complete, it is true, than Professor Marsh's collection at New Haven, but in some important respects quite equal to it.

The expedition this year started in June last, under Professor Scott's personal direction; but, after the first two weeks, he was obliged to return east, and his place as leader and director of the work was taken by Mr. Francis Speir, jun., of Princeton (1877), who has had wide experience in the western bad lands. Mr. Speir had under his command seven men (mostly Princeton students), a guide, and a cook.

Fort Bridger was the original base of supplies, and the first working camp was on Henry's Fork, an important tributary of Green River, about thirty-five miles south of the fort. Work was begun near the spot where a fine skull of Uintatherium was found last year, and careful search resulted in exhuming the remainder of the skeleton nearly complete, and in excellent preservation. Twin Buttes, a spot some thirty miles to the east, was the second working camp, and in that vicinity was found an extraordinarily perfect skeleton of Mesonyx; and it is believed that Princeton will now possess the only skull of a carnivore of the American eocene.

This work on the south slope of the Uintah Mountains was only preparatory to the main aim of the expedition, — the exploration of the little-known White River country. The passage of the Uintahs was quite difficult, for the climbing is very steep and the road very poor. The road bears off to the eastward, and crosses the range at an elevation of over ten thousand feet. The scenery was very wild and grand, and the air delightful. The nights were always very cold, and on the night of July 25 there was a severe frost. The descent into the Ashley valley on the south slope is very fine, and the views toward Salt Lake City in the west, and the Colorado mountains in the east, superb. The valley of Ashley's Fork, another tributary of Green River, has by wonderful irrigation and great care become of much agricultural value, and is now supporting a considerable population, almost entirely Mormon. From the settlement of Ashley to Ouray, the agency of the Uncompahgre Ute Indians, is a long, hot ride of thirty-five miles through a desert country in which some of the cañon formations are most curious.

Ouray agency is on the west bank of the Green River, just above the mouths of White River, flowing in from the east, and Duchesne River, a tributary from the north and west. Green River was crossed here, — a work of great difficulty, because of the swiftness of the current and quicksand bottom, — and the march continued almost due east, following the north bank of White River. Camp was pitched in a small cottonwood grove, the only trees for miles and miles, in a bend of the river, and work prosecuted from there. No fossils were found within two miles of camp, and at the conclusion of the work the ride out was from twelve to fourteen miles. The expedition's work was well organized; and men detailed to dig out and pack followed the prospectors, who located the fossiliferous strata and particular outcroppings of bone. No bones of any account were found, save in the two white or gray strata, the one lying at the base of the buttes, and the other some thirty feet above it, with two distinct strata intervening.

The prospectors soon discovered much of interest and value; and when camp was broken, and the march back begun, some twelve or fourteen hundred pounds of fossils were ready for transport. Every thing was packed with greatest care; cotton, tissue-paper, wrapping-paper, canvas sacks, and thin gunny sacks being used for teeth and joints, and all save cotton being used in every instance.

Of Amynodon, which the expedition desired particularly to get, numerous fragments were obtained, enough to make one nearly complete skeleton and the major part of several others. Tapiroids were found in great abundance, and it is not improbable that careful study will reveal some unique specimens among the finds of this expedition. The bones are not all in the best preservation, though some are in a far better state than others found immediately adjoining. The real scientific value of the expedition will only be known when the authorities of the museum make a careful study and description of the bones found.

The weather on White River was intensely hot by day, and very hot even at night. Mosquitoes were in abundance; and the river-water, while not strongly alkali, is warm and insipid. There is absolutely no vegetation save grease-wood and scanty sage-brush, and no animal life beyond small snakes and lizards and a few rabbits. The snow-topped Uintah range was in full view, and thunder-showers could be seen there daily. But in this White River desert it never rained, and it was asserted that it had not rained there since April, 1885.

The third week in August the White River country was left behind, and the long, slow march over the mountains began. Perhaps the country was left none too soon, for the Indians were very insolent, and, even on crossing the mountains, General Crook was passed going into that country with a detachment of cavalry and infantry to locate a new military post, as a safeguard against Indian treachery and violence.

The expedition is greatly indebted for its comfort to the aid rendered in outfitting by the war department and the quartermaster-general of the state of New Jersey, and for courtesies extended by the officers at Fort Bridger and the officials at the Ouray agency. For its scientific success, it is indebted to the untiring energy and ability of its conductor, Mr. Francis Speir, jun., of South Orange, N.J. N. M. B.

THE LONGEVITY OF GREAT MEN.

THE conclusion that the intellectual giants of the race are favored by an abundance of years on the scene of their heroic activity, and are thus further differentiated from their more common fellow-men, seems natural, and has been accepted upon evidence which, in a less pleasing conclusion, would be considered ridiculously insufficient, and even false. The usual method of attempting to answer the question whether great men are longer-lived than others, is to prepare a list of the ages, at death, of a number of eminent men, take the average age, and compare it with a similar average of a number of ordinary men, or even with the average lifetime of the race, and in this way to make the results speak decidedly in favor of the superior longevity of great men. All that such a method can prove (and this it does prove) is that it takes long to become great. It neglects to consider that a select class of men is dealt with, and that, to be even potentially included in this class, one must have lived a certain number of years.

For example: in an article translated in the *Popular science monthly* for May, 1884, it is argued that astronomers are a long-lived race because the average life-period of 1,741 astronomers is 64 years and 3 months. An average human life is only 33 years; but, as one cannot be an astronomer before adult life, the author takes the expectation of life at 18 years, which is 61 years, and thus makes an excess of over 3 years in favor of astronomers. He also divides his astronomers into four degrees of eminence, and finds that those of the first rank live longer than those of the second, and they in turn longer than those of the third, and so on, thus implying that the best astronomers are most favored with years. The true conclusion is, that it takes longer to become a first-rank astronomer than it does to become a less eminent one.[1]

If great men were great from their infancy, and we had the means of ascertaining this fact, the method would be correct. But as it is, we must define in some way or other what we mean by greatness, and then fix the average age at which it becomes possible to distinguish an amount of talent sufficient to enable its possessor to be enrolled in the ranks of the great as already defined. What is known as the 'expectation of life' at any number of years tells the most probable age at death of one who has attained the years under consideration: a comparison of this age with the age at death of great men will decide whether they are longer-lived or not.

The attempt was made to select about 280 to 300 of the greatest men that ever lived.[1] Throwing out about 30 of the doubtful names, there remain 250 men, about whom the statement is hazarded that a list of the 250 greatest men, prepared by another set of persons, will not materially differ from our list, as far as all the purposes for which it is to be used are concerned. From this list I have selected at random a set of men of whom it was probably easy to fix the age at which they had done work which would entitle them to a place on this list, or work which almost inevitably led to such distinction: it is a date about midway between the first important work and the greatest work. The average of over 60 such ages is 37 years; which means, that, on the average, a man must be 37 years old in order to be a candidate for a place on this list. The real question, then, is, How does the longevity of this select class of 37-year-old men compare with that of more ordinary individuals? The answer is given by the expectation of life at 37 years, which is 29 years, making the average age at death 66 years. And this is precisely the age at death of these 60 great men; showing, that, as a class (for these 60 may be considered a fair sample), great men are not distinguished by their longevity from other men.

Further interesting conclusions can be drawn if we divide the men into classes, according to real psychological and physiological differences in the ways of manifestation of the several kinds of genius. It is almost surprising how well the ordinary trinity of faculties — intellect, emotions, and will — accomplishes this purpose. Greatness seems to appear either in a brilliant thought, a deep feeling, or a powerful will. Under men of thought would be included philosophers, scientists, historians, etc.; under men of feeling, poets, musicians, religionists, etc.; under men of action, rulers, commanders, statesmen, etc. Before comparing the relative longevity of these three classes of men, I assure myself that the period at which greatness begins to be possible does not materially differ[2] in the three classes, and, as was done in the former case, I exclude all cases of unnatural death. I find that men of thought live 69.5 years, or 3.5 years longer than ordinary men; while the lives of men of feeling are 3 years, those of men of action 5 years, shorter than those of average men, — a conclusion that agrees with the commonly

[1] Mr. Galton (*Hereditary genius*, p. 34) has allowed himself to neglect a similar consideration. In giving the number of men in each class that the population of the United Kingdom would have between certain ages, he gives 35 as the number of men of class G (a very high degree of eminence) between the ages 20 and 30, and only 21 such men between 40 and 50 years. But this cannot be true, because only a very small proportion of men could possibly attain the eminence requisite to be classed among the G's in 20 to 30 years, while almost all (of those who will attain it at all) will have attained it before the end of their fiftieth year. And this consideration far outbalances the excess in absolute number of men between the former ages over those between the latter. Similarly the falling-off in the number of men of class *g*, i.e., idiots, from decade to decade, would be more rapid than in ordinary men, — a fact which the tables fail to show.

[1] The names were selected by three others and myself, while engaged in a study of what might be called the natural history of great men. The process of selection was most rigid and careful, by a system which it would take too long to describe.

[2] Mr. Sully (*Nineteenth century*, June, 1886) has shown that men of feeling are more precocious than men of thought; but the difference in the age at which their first great work is done, though in favor of men of feeling, is very slight indeed.

accepted view on the subject. If we subdivide these three classes, we find, that, while all classes of men of thought live longer than ordinary men, the moralists live longest, scientists coming next; that among the men of feeling the religionists alone live the full period of life, while poets' lives are 5 years, and musicians' lives 8 years, too short; that, of men of action, rulers and commanders both fail to complete the full term of life by 4 years. One sees from these statements (which, however, in their detail at least, must be accepted with hesitation, owing to the fewness of examples) that the kind of psychical and physical activity pursued, influences the life-period; that certain types of genius are apt to die young, while others are particularly favored with a full allowance of years.

The question of longevity becomes important when we consider that through it the leaders of civilization are allowed to exercise their important function a few years longer, thus enabling more great men to be alive at the same time; and that, by its tendency to be inherited by the offspring, the children of great men will begin life with a better chance of reaching maturity, and, in turn, of becoming important to the world, if, as we have reason to believe it would, the genius of their ancestors has left its traces in them.

JOSEPH JASTROW.

PARIS LETTER.

THERE is a good deal of discussion going on at present concerning the Municipal laboratory in Paris. This laboratory, as is known, was established in order to furnish to all persons who require them, a means of making careful analyses of all sorts of manufactured goods, and especially eatables and drinks. Of course, this made the dealers and manufacturers who sell impure wine, milk, or preserves very angry. But this resentment showed the usefulness of the laboratory; and notwithstanding the efforts of some aldermen, whose votes are under control of wine-dealers, and whose voices are necessary to them, the laboratory has been kept up, and continues doing useful work. The present discussion concerns salicylic acid, and has brought a howl from the beer-men. The laboratory considers the use of salicylic acid as hurtful, and wishes all manufacturers who use it to be prosecuted. In 1877 a committee appointed to study the matter reported, saying that it is better to forbid the use of salicylic acid in the manufacture of beer. In 1880, another committee, on which were Brouardel and Würtz, reported in a similar manner, considering salicylic acid as a dangerous substance, which is preservative only when used in such large quantities as to render the beer toxic, and proposing that all alimentary substances containing that acid be destroyed, and their sale forbidden. In 1881 a law was enacted, forbidding the use of the acid. This brought such a number of protestations, that in 1883 the question was again brought before a committee composed of Würtz, Pasteur, and others. It reported as the preceding ones had done. It was immediately decided to prosecute all manufacturers of or dealers in alimentary substances containing the acid. But as the victims of the prosecution were generally innocent, being retailers, and not manufacturers, a plan was instituted to seize upon beer as it came into Paris, and before it was sold to dealers. But there arose a serious difficulty. Most of the adulterated beer comes from Germany, and the law has no force among foreigners. But then the dealers to whom German beer is sent have it analyzed; and, if it contains salicylic acid, they merely have to send it back. On the whole, the course followed by the Municipal laboratory is a very good one, and profitable to public health. It will always have enemies, since unscrupulous dealers will always exist, as they have always to the present day; but every man who cares for his health must be a stanch supporter of it.

The *Journal officiel* has recently published the annual report on the statistics of the population of France for 1885. The results are very unsatisfactory. The birth-rate has diminished (it is 922,361), being smaller than usual by twenty or thirty thousand. The number of illegitimate children is larger than in preceding years, being more than eight per cent instead of seven. The death-rate also has diminished, but not to a degree commensurate with the birth-rate, which exceeds the death-rate by 85,464. This difference is much smaller than it was some ten years ago, when it was 140,000 or 150,000 yearly. However, it must be remembered that the effects of the war of 1870 are still felt, and that the diminished birth-rate may be ascribed to the loss of a great number of men, who, at the present time, would have been heads of numerous families.

M. Paul Bert has recently created in Tonquin a scientific society. He wished to imitate Napoleon in Egypt, no doubt, and has given a sister to the Institut d'Egypt. The Bac-ki-ham-lam-vien — such is the name of the new academy of sciences — has for its mission the collecting of materials for the history of Tonquin. Of course, M. P. Bert has created himself president of the academy, and is sole elector. It is he who decides who shall be the members: they must be of Tonquin blood.

Professor Herzen of Lausanne has published an interesting review of the researches recently conducted by two Italian physiologists, concerning the physiological action of the thyroid gland. It is known that the views held by the different investigators are very diverging, and that many are obliged to confess, that, though this gland seems to be connected with blood-corpuscles, the exact relation between the two is quite problematic. MM. Albertoni and Tizzoni, the above-mentioned investigators, believe they have found out the real function of this gland, and, after a careful study of blood in animals deprived of the gland, they have come to the conclusion that it gives to hemiglobin the faculty of absorbing oxygen. The fact is, that the blood of animals which have been deprived of the thyroid gland contains a very small proportion of oxygen. Their arterial blood contains less of this gas than does the venous of healthy ones; and the investigators ascribe the symptoms of acute cachexia strumipriva in dogs to this very considerable diminution of oxygen which always follows upon enucleation of the gland.

M. Trouvé, the well-known electrician, has recently devised ingenious contrivances for surgical diagnostic purposes, in the case of a man who had swallowed a fork and applied for treatment to a surgeon who was afraid of being mystified. But M. Trouvé, much more expert in electrical matters than the surgeon, who understood little or nothing on the subject, and was more than usually ignorant, relieved the scruples of the latter in a very simple manner. He devised a *sonde oesophagienne* connected with an electrical apparatus and a bell, and made in such a manner that contact with a metallic substance allowed the passage of the current, and made the bell ring. The bell was heard very distinctly. In addition, he made some very simple as well as convincing experiments, that the surgeon ought to have thought of. He placed a very sensitive magnetic needle in the vicinity of the patient, and saw the needle turn towards him; he brought a large electro-magnet into the vicinity of the stomach, and, each time the current was on, the fork came towards it, upheaving the skin and muscles of the abdominal walls in a marked manner; and at length the surgeon was convinced, and he performed the operation.

The twins of Locana, who have been shown in almost every town of Europe as the successors of the renowned Siamese twins, are at present dying in Vienna, or at least are very ill. These twins, now aged ten, are united from the sixth rib downwards. They have but one abdomen and a single pair of legs. One of these is under Jacob's control; the other, under that of John. They cannot walk, and cannot easily keep their balance. One is much stronger and healthier than the other, and eats more: it is Jacob, and he keeps his brother alive. Some time ago, both quarrelled over a toy, and John got so excited that he fell into a state of syncope, or trance, from which he did not recover till the next day. He had already had an illness of the same kind, and Virchow of Berlin had prognosticated that a second one would kill him. This Jacob knew well: so, of course, the illness of his brother (an apparently lifeless body) gave him all the more concern, since the death of his brother would but shortly precede his own. The physicians are doing their best to save the unfortunate children. Of course, no operation can be thought of in the present case. Even in that of the Siamese twins, there were great difficulties attending a surgical intervention; and, before it was resolved to intervene, death had already done its work. If the twins recover, they will go to the states, where they were engaged, it is said, at the rate of six thousand dollars per year; if not, their skeleton is already promised to a London anatomical museum for eight thousand pounds.

A schoolmate of M. Marcel Deprez, the able engineer who conducted the experiments related in one of my last letters, concerning the transmission of electric force at great distances, published some days ago an interesting paper on the biography of his friend. M. Deprez was an unsuccessful scholar, who failed to enter the Ecole polytechnique, but was remarkably endowed as to scientific and mathematical pursuits. He was extremely religious, and of a very militant turn of mind. He could never bear discussion; but, when it came to religious matters, he was a fanatic, and would, in the times when the Inquisition flourished, have been an intolerant and dangerous man. Another singular trait of this able and gifted scientist is his hatred for all forms of art. It must be added that M. Deprez's eccentricities have been considerably modified by age.

The French government has decided to greatly extend the department of ballooning for military purposes. There are to be eight aerostatic stations; namely, at Epinal, Toul, Verdun, Belfort, Montpellier, Grenoble, Arras, and Versailles, the principal one being the last named, which is also the only one existing at present. All the military corps will also be shortly provided with the implements necessary for strategic ballooning. No further progress has been made in the art of balloon-managing: the problem is considered solved, and only few improvements, of secondary nature, are needed.

An interesting case of protracted pathological sleep is at present receiving attention in the Salpétrière. It is that of an hysterical woman, who, in consequence of a left-sided hemiplegia, has been in that establishment since 1862, and has remained in bed ever since. This protracted sleep comes on in January generally, sometimes also in July. The patient sleeps for a week or two, or even longer. In January last, Eudoxie Hilouin — such is her name — slept fifty days; in July, only eighteen days. Before falling into this sort of trance, she is very much excited, shouts, and thinks she sees animals of all sorts. During the sleep, her breathing is irregular, alternately calm and regular, then short and rapid. She is insensible to pain, and nothing can wake her. She eats, however, what is given her, and repels substances the taste of which is unpleasant to her. She is fed with liquids most of the time. She is very fat. She weighed 280 pounds (160 kilograms) some time ago, but her weight falls off during the sleeping periods. Before awaking, nervous trembling is perceptible, and she laughs immoderately. She hears during her sleep, as has been shown by a physician who has succeeded in getting her to do various things, in the usual manner.

An often and periodically debated question, which is always arising, like the fabulous Phoenix, is that of *Paris, port de mer* (Paris, a marine port). Its solution is not impossible, and some day next century may see the big steamers of the White Star, or Cunard, or some other line, steam from New York directly into the middle of Paris. However, at present the question is not much advanced, since it rests only on the material feasibility of the canal from the Atlantic to Paris, as it did in the times of Sully and Vauban, who had given much consideration to the matter. The projects are numerous. The first, that of Passement and Billard, in 1760, consisted in increasing the depth of the Seine. In 1790 the Marquis of Crécy proposed a canal going from Paris to Dieppe; but this plan was not a good one, owing to the porous nature of the layers of the soil. In 1860, M. Lebreton proposed a canal one hundred and sixty kilometres long, eighty metres wide, and ten metres deep; but the cost would have been enormous. In 1869, M. Dumont proposed a plan similar to that of the Marquis of Crécy, in which water had to be brought from two rivers, and in which numerous locks were established. Many other plans have been proposed; but the best of all is yet of little use, on account of the expense: it seems to be that of M. Lebreton, as it does not require locks, and there can be no trouble about the water, which will be that of the Channel. Some day or other it may succeed, however, when progress in the mechanic arts shall have lessened the expense.

Dr. Tanner has found in Italy a competitor, Succi by name, who has undertaken a thirty-days' fast. He began the experiment on the 17th of August, and the trial will soon be over. The experiment seems to have been conducted in good faith. A committee of physicians has been appointed to witness the experiment from beginning to end, and the patient has a constant body-guard, relieved twice a night and six times per day, of persons who keep vigilant watch over him, to prevent all fraud. Succi pretends to be able to fast the thirty days, if he is only allowed to drink some water, and some drugs which he has prepared from African plants, — a composition which he keeps a secret as yet. He requires also some tartar-emetic, olive-oil, and anisated water. The first day of the fast he drank some of his drug, and remained in bed, because during the first week he is generally a little indisposed, and requires rest. The ninth day he took a drive, and then a ride, for an hour, without feeling the slightest discomfort. The loss of weight was only five kilograms; muscular energy was unabated, as well as agility. The 1st of September the condition of the patient was very good. He went to a bathing establishment, and swam three-quarters of an hour without any fatigue. He went home on foot. The next day he ran for more than half an hour, at gymnastic pace. His muscular energy was in very good order. Succi is a man forty-five years old, who has travelled a good deal in Africa, and has been thought mad for a time: in fact, he has been shut up in a mad-house in Rome. The herbs from which his liquors are extracted grow in Africa, but are also found in Italy.

Among recent publications, space allows only notice for two. One of them is a little book published by Professor Forel of Lausanne, concerning the Lake of Geneva; Lake Leman, as all the inhabitants of Canton de Vaud call it, having some antipathy to the name of Geneva and to the inhabitants of the town. This book is a very interesting one, and it could be used as a model for similar works. Forel gives details concerning the situation, form, altitude, depth, dimensions, and affluents of the lake; the currents therein; the waves and winds; the chemical analysis of the water, its color, temperature, and singular barometric oscillations (the *seiches*), etc. A good part of the book is devoted to the fauna and flora, and to the prehistoric remains that have been found on its borders. Of course, the facts contained in this book are especially interesting to inhabitants who live in the vicinity of the lake. The plan is a very good one, and may be of use to persons engaged in similar pursuits, concerning some other lake or large body of water.

The other book is a short pamphlet by Dr. U. Perronnet, and treats of mental suggestion. It is a very interesting little work, relating curious facts, and that seems to be appreciated by competent persons. Two works are in preparation on the same subject, — one by Dr. Ochorowitz; the other, by Dr. Barèty of Nice. These two works will be interesting, their authors being especially competent, which is not the case in many others recently published, and of which I prefer not to speak. V.

Paris, Sept. 14.

VIENNA LETTER.

A NEW and very sensitive test for cellulose and vegetable fibres has been described recently by Dr. Hans Molisch, an assistant at Professor Wiesner's phyto-physiological laboratory. It is based on the fact, that, by the action of water and concentrated sulphuric acid, cellulose is converted into sugar, or, to speak more correctly, into dextrine and dextrose: therefore vegetable fibres consisting mainly of cellulose exhibit indirectly the reactions of sugar. The importance of this new test for detecting adulterations of wool, etc., can easily be understood.

An important discovery in reference to cellulose has been made here. It was generally assumed till now that the occurrence of this body was restricted to the vegetable kingdom, and to a few families of invertebrated animals — viz., the Ascidia and Tunicata — containing tunicin, or animal cellulose, in their 'mantle.' Now, Mr. Ernst Freund claims to have found cellulose in the human blood and organs under particular pathological conditions. These conditions are produced by tuberculous disease. Taking into consideration some etiological facts, especially the effect of the quality of food on the spread of tuberculosis among the population, Freund was induced to examine if cellulose may be a chemical substratum for the formation of tuberculous growths. The tuberculous organs (lungs, spleen, miliary tubercles of the peritoneum) and blood, when treated properly, yielded an organic non-nitrogenous body, belonging, as it was proved by ultimate analysis, to the carbo-hydrates, and possessing all the properties of cellulose. In all the cases, — those taken from normal organs, and those afflicted by various non-tuberculous diseases, — Freund failed to find cellulose at all: therefore he feels himself compelled to conclude that cellulose is a typical constituent of tubercles and of the blood in tuberculosis.

The seventh meeting of the International congress of orientalists will be held here from Sept. 27 till Oct. 2. Many illustrious orientalists, especially Indians, will be present, more than three hundred and sixty members being already announced. The principal orientalists' associations will send their delegates. More than forty papers will be read, among them some on ethnological matters. The publication of the so-called 'Fajum papyros' found some years ago in Egypt, being now in possession of the Archduke Rainer, promises to be of great interest.

On Sept. 2 the highest European meteorological observatory was dedicated solemnly. It is situated on the Somblick Mountain (near Rauris, Salzburg), 3,103 metres above the sea-level, and consists of a tower and three other rooms. It is supplied with all the necessary meteorological instruments, and is connected by telephone with the nearest telegraph-office. Herr Rojacher, proprietor of the Rauris mines, has aided the progress of the work in a very munificent manner.

The number of medical students at the Vienna university is rapidly increasing. During the winter session just past, 2,407 ordinary and 266 extraordinary students were there matriculated. The minister of public instruction, therefore, issued a circular to the medical department of Vienna university, asking if the number of students would not have to be restricted by introducing a *numerus clausus*.

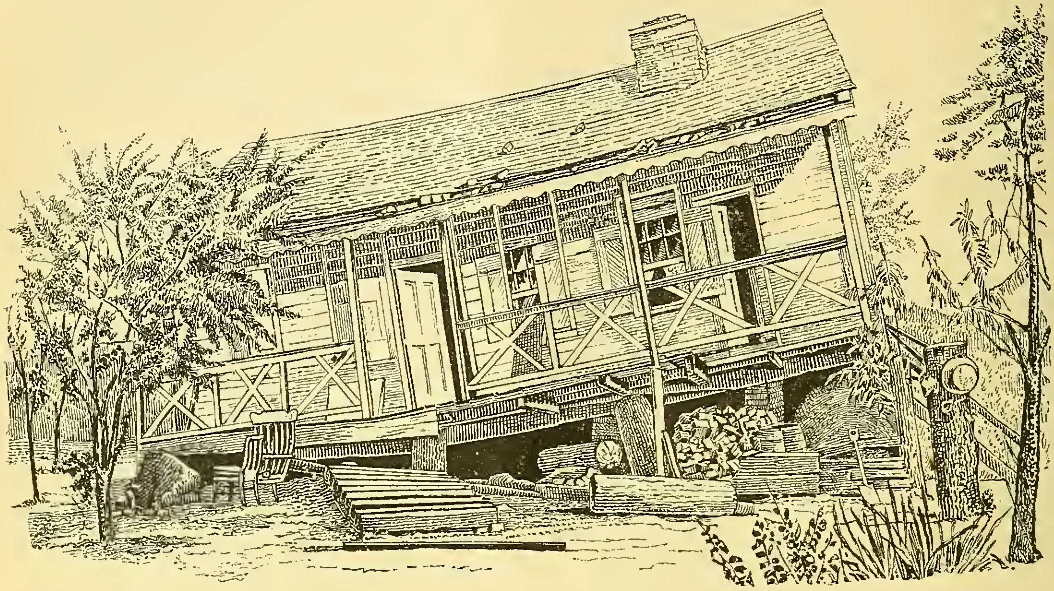
As I am now informed, the mantle of Auer von Welsbach's lamp, described already in a previous letter, is prepared by impregnating the gauze with solutions of salts of zirconia, oxides of lanthanum (and yttria). V. C.

Vienna, Sept. 14.

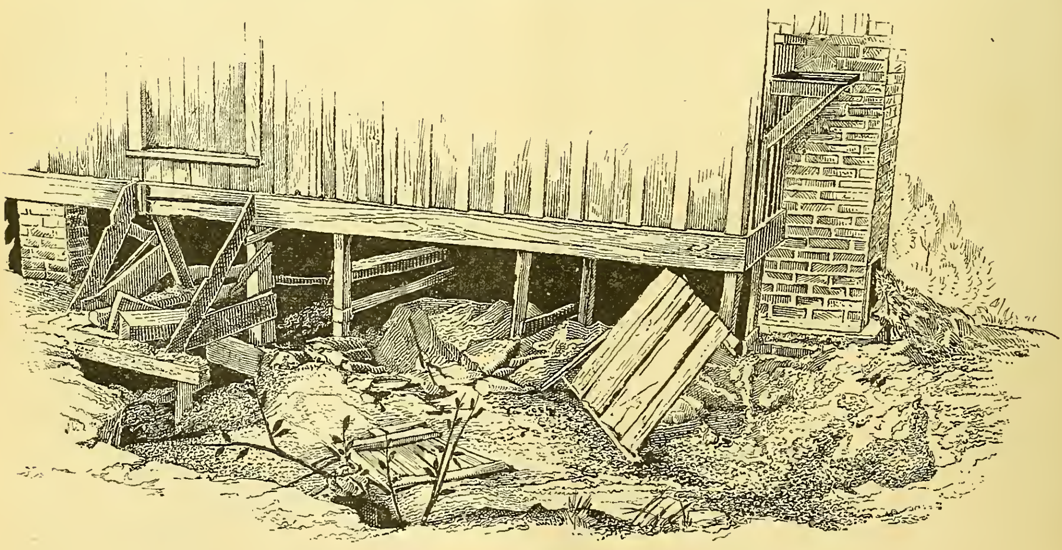
NOTES AND NEWS.

CASES of so-called hydrophobia, in which an interval of years elapses between the bite and the appearance of the disease, are to be regarded with suspicion. Dr. Jardin-Beaumetz, in a communication to the Conseil d'hygiène, gives the interval, or the period of incubation, as it is termed, as averaging between three and four months, in fifty-eight cases of hydrophobia in man, observed since 1881. A well-authenticated case, which is a striking exception to this rule, has recently occurred in France, in which nineteen months elapsed.

— Mr. Arnold Hague, of the U. S. geological survey, who is now in the Yellowstone national park, writes that the accounts which have appeared in various newspapers, of an outbreak of the Excelsior geyser coincident with the date of the recent earthquake that was so destructive at Charleston on Aug. 31, are entirely without foundation. He has been studying this geyser for the last four years, and is confident, notwithstanding various reports to the contrary, that it has not played during that time.



HOUSE IN LINCOLNVILLE, SHOWING CHIMNEY-BASE CRUSHED BY UPWARD MOVEMENT OF THE EARTH.



SINK AT TEN-MILE HILL AFTER THE GREAT EARTHQUAKE.

— A cable despatch from the Cape of Good Hope through Dr. Krüger at Kiel, Germany, announces the discovery of a comet at the cape by Professor Finlay on the 26th of September. Its position was, Sept. 26d. 8h. 3m., Greenwich mean time; right ascension, 17h. 2m. 5.9s.; declination, — 26° 4′ 6″. Its daily motion was in the direction of increasing right ascension 2m. 20s., and toward the south 4′. It is described as circular, one minute of arc in diameter, with some central condensation, and is very faint.

— A company in this city is endeavoring to perfect a process for the desiccation of garbage, with a view to utilizing the vast quantity of city refuse now dumped in the sea from garbage-scows. The matter to be treated is run through a shoot into one end of a revolving cylindrical oven about sixty feet long by ten or twelve feet in diameter. The oven, which is strongly constructed of boiler iron, is enclosed in a brick furnace, one end being higher than the other. A fire in the furnace keeps an equable heat in the oven, and the latter is slowly revolved by a steam-engine. The garbage or refuse enters at the elevated end, is thoroughly stirred and dried as it slowly travels from one end to the other of the revolving oven, and emerges from its lower end desiccated and inoffensive.

— Though there is nothing novel in the propulsion of boats by means of electric motors, the recent voyage of the electric launch Volta across the English Channel, from Dover to Calais and back, has attracted much attention. Many electrically propelled boats, deriving their motive power from primary or secondary batteries, have been experimented with by electricians; but heretofore these experiments have been confined to rivers or other bodies of comparatively smooth water. The honor of having made the first sea-voyage — brief though that voyage was — must be accorded Mr. A. Reckenzaun of London. Accompanied by nine other gentlemen, Mr. Reckenzaun left Dover at 10.40 A.M., Monday, Sept. 13, in the Volta, and reached Calais at 2.32 P.M. On the return trip, the party left Calais at 3.14, and arrived at Dover at 7.27. Taking into account the drift due to the tide, the total distance travelled was about fifty-four statute miles, the total running time being a few minutes over eight hours. The Volta is 37 feet long by 6 feet 10 inches beam, and is built of steel. The secondary battery, of sixty-one cells, weighing about four thousand pounds, was arranged along the bottom of the boat. The propellor is three-bladed, 20 inches in diameter, and 11 inches pitch, and was driven at a maximum speed of one thousand revolutions per minute by a duplex Reckenzaun motor, or, more accurately, two motors carried on one shaft. The motors weigh between seven and eight hundred pounds, and develop a maximum of sixteen horse-power.

— Large floating fields of pumice, thrown up by the great volcanic eruption at Krakatoa, Java, have been seen in the Indian Ocean, nearly seven hundred miles from where they were seen a year ago.

— Dr. Miller of Austria has been making some extremely valuable observations on the action of the stomach upon fungi. Inasmuch as one of the common methods by which zymotic diseases are believed to be produced is by the introduction of their germs into the alimentary canal, it can readily be seen that this investigation is replete with interest and importance. He finds that if these fungi, as, for instance, bacilli and bacteria, are introduced at the beginning of the meal, before the hydrochloric acid of the gastric juice is poured out by the stomach glands, they pass on to the intestine uninjured. If, however, they are taken into the stomach at a later time, when the reaction of the stomach is acid, they are destroyed. It has been satisfactorily demonstrated by numerous observations that persons were more likely to contract cholera when the stomach was diseased, or, as is commonly said, 'out of order.'

— We give this week two more illustrations showing the effects of the great earthquake. One is of a 'sink' at Ten-Mile Hill. These sinks were, in general, after-effects, being formed, as Professor McGee pointed out in the last number of *Science*, after the subsidence of the floods of water which came from the 'craterlets.' The other illustration shows a fallen house at Lincolnville. This is chiefly of interest as showing how, by a probable upward thrust of the earth, the base of the chimney, which offered the most resistance, was completely crushed.

— Dr. Charles L. Dana discusses in the *Forum* the question, 'Is life worth saving?' He places the value of an adult life to the state at at least $750, and its annual productive power at $95. One-half of all the deaths occur during the productive age, so that the two hundred thousand deaths at this period, which occur annually in the United States, represent an enormous loss to the country. It is also calculated that every death represents about two years of sickness, and that there are in this country about a million and a half persons sick all the time. In England and Wales it has been found that every workingman averages a week and a half of sickness in the year. It is estimated that the wage-loss from sickness in France is $70,000,000 each year, and from death $188,000,000.

— Mr. Mackellar, chief surgeon to the London police, has issued the following directions to the surgeons of divisions, for their guidance in treating persons bitten by rabid dogs: "When possible, a ligature to be applied above the part bitten; prompt and thorough suction of the wound, freely washing with water, and the application of absolute phenol (pure carbolic acid); the individual sucking the wound (usually the patient himself) to spit out all the matter so sucked, and to freely wash out the mouth with water; should the wound be a punctured wound, make a crucial incision, promote and encourage bleeding, and treat as above." Mr. Mackellar condemns the use of nitrate of silver, and says the pain caused by the phenol is of short duration.

— *La nature* recommends the following method of cutting thick glass tubes: wind an iron wire half a millimetre in thickness around the glass tube, and connect it with a galvanic battery of sufficient power to raise the wire to a red heat; then put a few drops of water near the wire upon the glass; the latter will then crack in the direction of the wire, and, the thicker the glass, the more exact will be the fracture.

— Ten thousand cases of cholera occurred in Japan during the first six months of this year, of which 7,803 were fatal. During the preceding six months, 12,000 cases occurred, with 7,152 deaths. The disease is now prevailing in Osaka and Yokohama, the mortality varying from sixty to seventy-five per cent.

— The monthly bulletin published by the New York state board of health contains the following vital statistics: the reported mortality throughout the state during the month of June was 6,336, of which 35.3 per cent were under five years of age; 1,220 deaths were due to zymotic diseases, or 193.65 in 1,000 total mortality; the ratio per 1,000, of deaths from typhoid-fever, was 6.20; from diarrhoeal diseases, 73.80; from croup and diphtheria, 60.32; from consumption, 144.60.

— The examination and criticism of the last annual report of President Eliot of Harvard, that Prof. Andrew F. West of Princeton published in the *Independent*, has been issued in pamphlet form. It is chiefly devoted to refuting President Eliot's arguments in favor of the elective system as practised at Harvard.

— The collection of *Mémoires et documents scolaires publiés par le Musée pédagogique*, under the auspices of the department of public instruction in France, is to be enriched by a learned and curious *Répertoire des ouvrages pédagogiques du xvi^e siecle.*

— The *Journal des économistes* has been publishing articles describing the principal economic publications of the world. In a recent issue, M. Maurice Block, member of the institute, reviewed the publications other than French, and gave a most flattering notice of the *Political science quarterly* recently started by the faculty of the school of political science, Columbia college.

— Where accuracy is desired in the measurement of liquids, 'spoons' and 'drops' should be discarded. The ordinary teaspoon, which is presumed to hold a dram or sixty minims, in reality holds eighty, and can with a little care be made to hold one hundred and twenty minims, or twice what is ordinarily attributed to it. A drop is also a very indefinite quantity, — a fact of which any one can satisfy himself by dropping an equal number of drops of molasses and alcohol into a measure of known capacity, and comparing the amounts. The size of the drop is also materially affected by the vessel from which it is dropped. The 'minim' is a definite quantity, sixty of these making a dram, and should always be used, especially in dispensing medicine.

— The *Journal of reconstruction* states that an infant loses from three to six ounces in weight during the first four to six days after birth; by the seventh day it should have regained its birth-weight; from that to the fifth month it ought to gain about five ounces per week, or about six drams a day; after the fifth month, about four drams a day; at the fifth month it ought to have doubled its birth-weight, and in sixteen months quadrupled it.

— Carl Meyers made from the fair-grounds in Franklin, Penn., on Wednesday, Sept. 8, the first ascension known with natural gas, the balloon rising just one mile, and sailing about one hour.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Psychophysics.

MR. HYSLOP, in his article on 'Psychophysics' in *Science* for Sept. 17, charges the writers on that subject with laying claim to a scientific accuracy which they do not possess. Any such charge as this manifests so plainly a misconception of what psychophysics really professes and attempts, that a word of defence seems to be in place. The conclusion was drawn from the alleged incorrectness of Fechner's mathematical statement of the psychophysic law. From some admissions of M. Ribot regarding the same, Mr. Hyslop concludes that "such admissions prove fatal to any such exactness as is enjoyed by the physical sciences." Aside from the question of the truth or falsity of Fechner's statement of the law (Mr. Hyslop queerly admits that it is true), let it be observed that psychophysics, so far from professing to be a mathematical science, does not profess to be a science at all; but it does modestly claim to pursue a scientific method. This method, which, as Wundt explains, is peculiar to the physical sciences, is the experimental method. It does not differ from the old psychology, as Mr. Hyslop thinks, so much in having discarded introspection. Any psychology, even physiological psychology, must, by the nature of the case, be introspective. It differs fundamentally in this: that whereas the old psychology assumed the *dictata* of *consciousness* to be the whole sphere of psychology, started with these and reasoned out a complete so-called science, the new psychology modestly starts with physiological experiments, and records the psychological results. It works from without inward. It begins with external conditions which it can control, and, by subjecting these to as exact and accurate measurements as are known in modern science, it observes the corresponding mental phenomena. We can conceive of almost any other criticism being brought against psychophysics than that it is unscientific or inaccurate. Whether it is a fruitful study, or has thus far repaid the immense labor expended upon it, may be questioned; but that it is characterized by the most patient research, the most precise measurements, the most cautious conclusions, and a scientific spirit that the old psychology never approached, cannot be reasonably denied.

As regards the psychophysic law of Weber, under the following statement it has been generally accepted, and found useful and suggestive: "The difference between two excitations, must, in order that the differences in sensation be equally appreciable, grow proportionally to the magnitude of the excitations." The mathematical statement of the same by Fechner — "The sensation grows as the logarithm of the excitation" — has given rise to the question whether differences in sensations can be expressed in terms of quantitative measurements. This objection is urged by Zeller, and rejected by Wundt. It implies the old error of a physical world without, and a spiritual world within, which have nothing in common. While Wundt's position here is theoretically correct, the question may nevertheless be raised, whether, ultimately, differences in sensations are not qualitative rather than quantitative differences.

GEO. T. WHITE.

Science for a livelihood.

I have just read the communications of C. B. of New York and W. F. Flint of New Hampshire in Nos. 188 and 189 of *Science*, under the above heading, in which there is a strain of lament over the frugal table which the field of science has spread for ambitious young men who desire to live, or at least exist, on a purely scientific diet. As I deem the subject of vital interest to nearly every young man with scientific tendencies about to choose a profession, I desire to add a few words.

I graduated in the spring of 1884 from a scientific department of the Kansas state university. After taking a pretty thorough general course of study as an undergraduate, I finished my work by spending two years in the Natural history laboratory, under the direction of Prof. F. H. Snow. If I did not receive a 'good' or 'first-rate scientific education,' I did, at least, master a few principles, and laid a foundation for future work and study. During my last year in the laboratory, I had the refusal of two positions as teacher of natural history, both of which paid good living salaries. Within a year's time after graduation, I was offered three positions, with no salary less than twelve hundred dollars. Meanwhile I had not made a single application for a position.

George F. Gaumer, Annie E. Mozley, and Richard Foster graduated from the same department while I was in the lower classes, and all three have held good positions. Gaumer went to Cuba, then to Yucatan, and afterwards to various parts of Central America. On his return, after an absence of three years, he reported fine success, particularly in a financial way. He cleared twenty-five hundred dollars by selling specimens of the golden turkey, and increased his finances in various ways as a collecting naturalist. But this was only a small part of his success. He collected many rare birds and insects, some of which were new to science, and returned with a reputation as a rising young naturalist, to receive an appointment as professor of natural history in the University of Santa Fé, New Mexico. Richard Foster speaks for himself as professor of natural history in Howard university, Washington, D.C.

W. C. Stevens graduated from the natural history department in 1885, and immediately received a good position as a teacher of natural history. J. D. McLaren graduated from the same department with the class of '86, and in less than a month's time his scientific training secured him a position as teacher at a hundred and fifteen dollars per month. W. H. Brown, member of the senior class, who has spent but a single year in the department, went to the Smithsonian institute to spend a month of his summer vacation, and learn what he could by observation, expecting to return, however, and resume his work in the laboratory. But, alas! news soon came that his enthusiasm and skill had secured him a good place with increasing wages.

As much, if not more, might be said of the students of the other scientific departments of the university. All the graduates from the 'course in chemistry and physics' are professors enjoying enviable positions as well as good salaries. Many of the advanced undergraduate students from this course hold respectable positions, and receive good wages.

I must be brief as possible, but not so brief as to omit the civil engineering department, the graduates of which receive larger salaries, perhaps, than those laboring in other scientific fields. The most surprising thing about this department is, that there is such a present demand for the young men, that nearly all of them are called into the field to hold responsible positions, and receive remunerative wages before they have finished their work in the department.

As regards the 'wealth' and 'friends' of the young men of whom I have spoken, allow me to say that all of the graduates, with a possible single exception, were farmer boys who earned with their own hands most if not all the money which kept them at the university. And the only 'friends' they had 'to forward them in their chosen fields' were those which industry and good progress won for them in those fields.

I think the facts will bear me out in saying that no class of Kansas young men are doing better, or have more brilliant prospects, than those which have done good work in the scientific departments of the university.

L. L. DYCHE.

Lawrence, Kan., Sept. 20.

Photography of the solar corona.

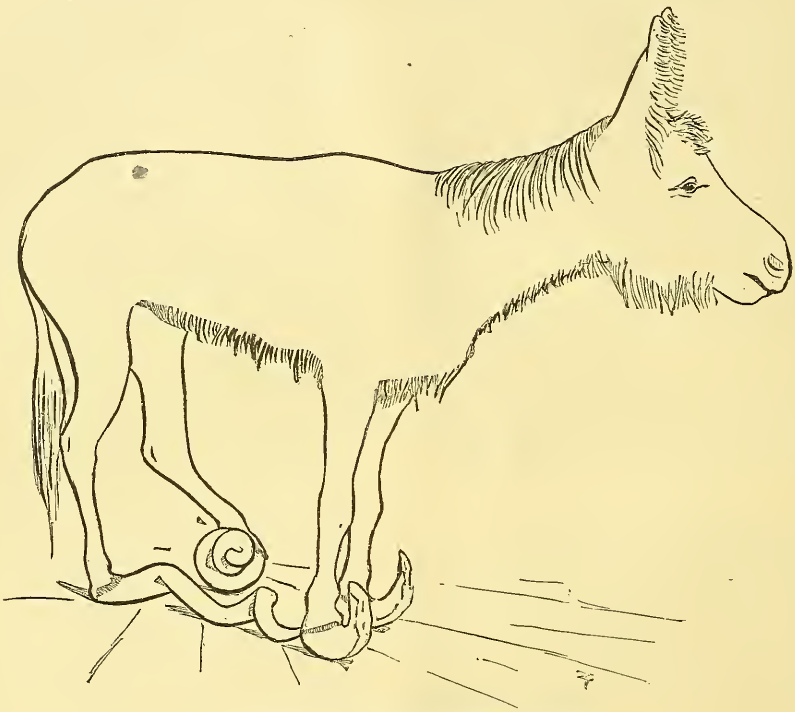
Accounts have appeared in your journal, of my attempts to photograph the corona of the sun without an eclipse. Many of the plates obtained presented appearances which, not to myself only, but to several scientific men who must certainly be considered to be among those who are exceptionally competent to give an opinion on this point, seemed to be most probably due to the corona. Plates taken in England about the time of the eclipse of May 6, 1883, and drawn by Mr. Wesley before any information reached this country of the observations of the eclipse, presented not only a general resemblance to those taken during the eclipse, but showed the remarkably formed rift on the east of the sun's north pole, which is the main feature of the corona as photographed at Caroline Island. It is true that since the summer of 1883 I have not been able to obtain in England photographs which show satisfactory indications of the corona; but the abnormally large amount of air-glare from finely divided matter of some sort, which has been present in the higher regions of the air since the autumn of 1883, might well be considered a sufficient cause of the want of success. This well-known state of the sky rendered the plates taken by Mr. Ray Woods in Switzerland in the summer of 1884 inconclusive as to the success of the method. During the past year, photographs of the sun have been taken at the Cape of Good Hope, and are under discussion by Dr. Gill.

Such was the state of things before the eclipse of Aug. 29. The partial phases of this eclipse furnished conditions which would put the success of the method beyond doubt if the plates showed the corona cut off partially by the moon during its approach to and passage over the sun. As the telegrams received from Grenada, and a telegram I have received this day from Dr. Gill at the Cape of Good Hope, state that this partial cutting-off of the corona by the moon is not shown upon the plates, I wish to be the first to make known this untoward result. I regret greatly that a method which seemed to promise so much new knowledge of the corona, which, under ordinary circumstances of observation, shows itself only during total eclipses, would seem to have failed. At the same time I am not able to offer any sufficient explanation of the early favorable results to which I have referred briefly in the opening sentences of this letter.

Of course, the above statements leave untouched the criticisms I felt called upon to make on the imperfect methods employed by Professor Pickering.

WILLIAM HUGGINS.

Upper Tulse Hill, London S. W., Sept. 11.



AN ASS WITH ABNORMALLY DEVELOPED HOOFS.

An ass with abnormally developed hoofs.

A pair of very abnormal hoofs has been recently received by the Smithsonian institution from J. C. Baldwin, Esq , of Houston, Tex. They are the hind hoofs of an ass reported to have been bred at San Antonio, Tex., and which was exhibited in Chicago and other cities of the union.

The right hoof is twenty-six inches in length, and is spirally twisted, like the horn of an Indian goat. The left hoof is in the form of a helix.

The front hoofs were not received, but, from the photograph which accompanied the hind pair, it appears that they were also abnormal.

The animal, as it appears in the photograph, is greatly emaciated. The neck and shoulders are clad with rather long, curled hair, while on the posterior half of the body the hair is short and smooth.

F. W. TRUE.

U. S. nat. mus., Sept. 27.

SCIENCE.—SUPPLEMENT.

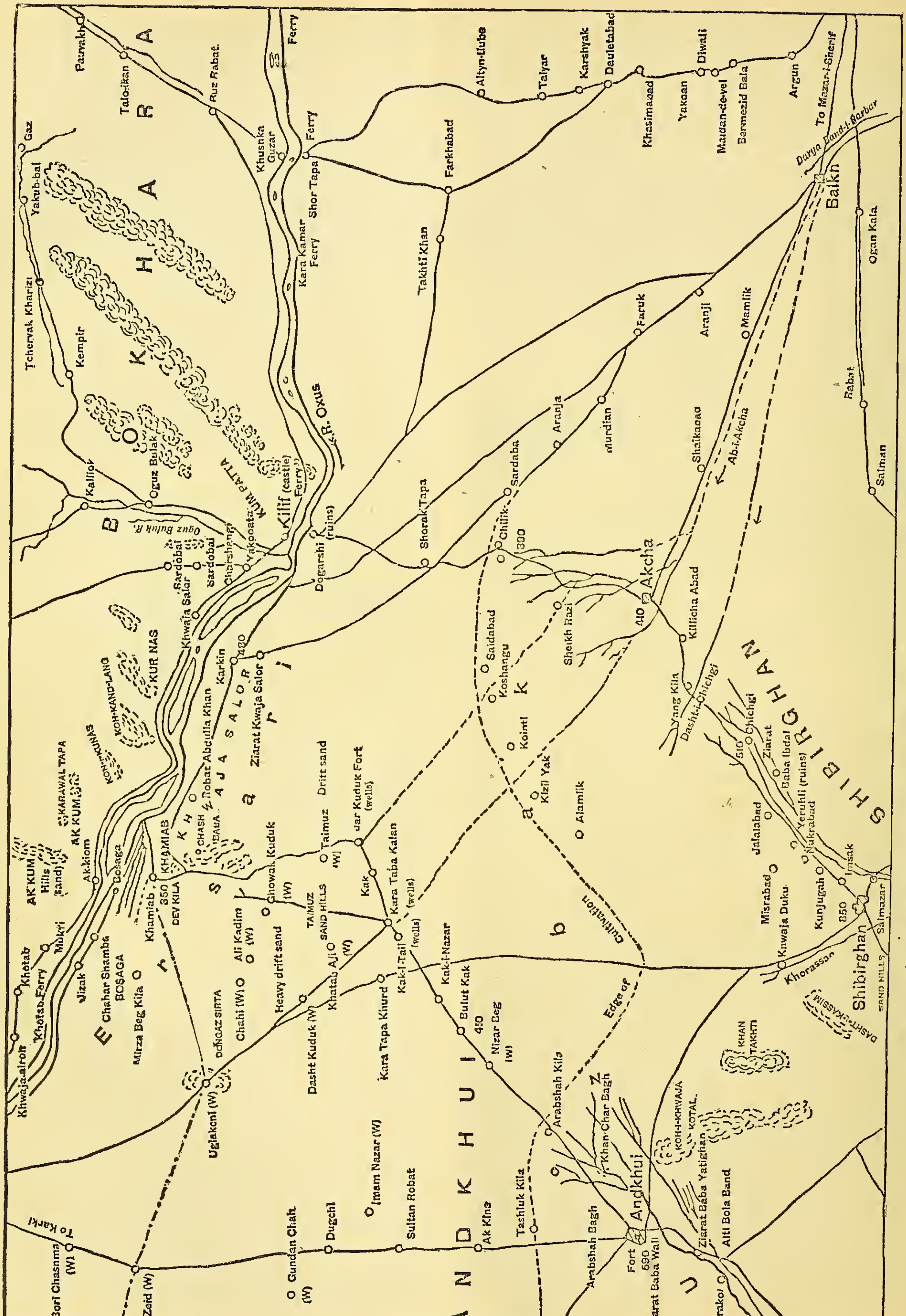
FRIDAY, OCTOBER 1, 1886.

KHAM-I-AB.

The accompanying map from the London *Times* of Sept. 3 gives with the greatest attainable accuracy, as it contains the most recent surveys of the engineers attached to the English commission, the relative positions of all the places of importance in the last part of the Afghan frontier. The frontier has been absolutely laid down and marked with pillars as far as Dukchi, which is forty miles from the Oxus; and, as a general statement, the reader may accept the fact that Afghanistan retains pasturages of from fifteen to twenty miles north of the road from Meruchak to this place. Andkoi and Kerki on the west, Mazar-i-Sherif, and Chushka Guzar ferry on the east, form the four limiting points of the tract of Afghan territory which is of importance in connection with the final stage of the Afghan frontier question. The district of still more immediate importance is the forty miles separating Dukchi from the Oxus. It is here that the commissioners have been unable to come to an agreement on the spot, and that the governments of England and Russia must devise some means of reconciling conflicting views so that the frontier delimitations may be brought to a clear end. The government of Russia has employed, during the recent exchanges of opinion, the most conciliatory language, and there does not seem at present any reason why the negotiation should not, after all, terminate in an amicable manner. At all events, it is a question calling, in the interests of both countries, for calm consideration and delicate handling.

Since the British commission has been on the Afghan frontier, — and this, we may remind our readers, has been since November, 1884, — it has been found that the existing frontier of Afghanistan and Bokhara on the Oxus, and the one recognized by the tribes and chiefs on the spot, lies between the border districts of Kham-i-Ab and Bosaga respectively. English officers discovered that in 1873 or thereabouts the local officials of Afghanistan and Bokhara actually marked out this boundary. No place of the name of Khoja Saleh was found to exist; but the tract of country from the shrine of the Saint, called Ziarat-i-Kwaja Salor, down the river to Kham-i-Ab, or for a distance of twenty-five miles in all, was known to the Afghans as Khwaja Salor, or Khoja Saleh. It is thus marked on the map. The district is of some fertility, and forms a subdivision of the Akcha governorship, to which it has belonged for nearly a century. It is appropriate to observe that by the 1873 agreement, which has been so much referred to as the basis of the present negotiations, Akcha was declared part and parcel of the dominions of Afghanistan. The district of Khoja Saleh is inhabited by Karkins as well as Ersaris. The former are not Turcomans; and the latter, who reside in Akcha and other Afghan towns, as well as along the Oxus, are not nomads, although Turcomans. They have been cultivators of the soil for a very long time past, and have paid their taxes regularly, and given no trouble to the Afghans.

The confusion which has arisen with regard to Khoja Saleh must, no doubt, be attributed to the account given by Sir Alexander Burnes of his passage of the Oxus at this place. No subsequent traveller has visited this particular point on the Oxus (Vambéry crossed at Kerki; and the Russian envoys to Afghanistan, at either Kilif or Chushka), and the hasty impressions of the English traveller have guided geographers ever since. We have no knowledge of what reports the captains of the Russian vessels, which began to ascend the river as high as Kilif in 1879, may have sent in as to where they first came into touch with Afghan authority, and this would be a point about which the English government might usefully institute some inquiries; but it is encouraging to know that that government has something to say in reply to the demand that the frontier should be laid down in rigid accordance with the terms of the protocol which repeated the phrase of Khoja Saleh employed in 1884 at the time of the formation of the commission, as well as during the negotiations of 1872–73. Accompanying the protocol a Blue-book (Central Asia, No. 3, 1885), containing certain maps, was published, and among these was an extract from the Russian staff map of Afghanistan. This map was intended for the guidance of the commissioners; and a zone of investigation, as well as a line of a proposed frontier, was marked on it. Kham-i-Ab is not mentioned on this map, but the point marked 'Khodsha-Salor' on it corresponds as nearly as possible in latitude and longitude with the Kham-i-Ab of the Afghans. Thus it is a fair contention that the Khoja Saleh of the protocol and agreement of 1873 should be taken as indicating



MAP SHOWING THE DISPUTED AFGHAN FRONTIER AND THE NEIGHBORING REGION.

a point on the Oxus corresponding to the western limit of the district called Khoja Saleh, and that, as the Afghans possessed this tract at the time of the earlier agreement, they should be allowed to retain it. This would, moreover, be in strict accordance with the principle laid down on that occasion ; viz., that Afghanistan should be considered identical with the actual possessions of the Ameer Shere Ali.

To sum up the points presented by the Kham-i-Ab question, Russia has in her favor the specific mention of the name Khoja Saleh in the diplomatic documents. Beyond this fact, strong as it undoubtedly is, Russia does not seem to possess a weighty argument. On the other hand, there is the Afghan right of possession, unquestioned by anybody, going back for a long period, and confirmed in 1873. There is the recognition in 1873 of the Khanate of Akcha forming part of the dominions of Shere Ali, and consequently of Afghanistan. Finally, there is the practical fact that the Kham-i-Ab of the Afghans occupies almost the identical geographical site of the 'Khodsha Salor' of the Russians. Extraneous arguments may be easily introduced into the case by irresponsible writers ; but these are really all the considerations that need affect the judgment of the two governments.

PACIFIC COAST WEATHER.

Lieut. W. A. Glassford, in charge of the Pacific coast division of the signal service at San Francisco, has lately presented a paper to the California academy of sciences on 'Weather types on the Pacific coast.' These types differ from those of the eastern United States in their relative lack of progressive motion, and consequently in their duration and in the less variability of the weather. Distinct areas of low pressure are rare in southern California, but increase in frequency northward, until they are most numerous about Vancouver's Island. The types recognized for the rainy season (winter) are, 1°, North Pacific cyclonic ; low pressure over Oregon and Washington, high pressure in the Great Basin, with southerly gales along the coast, and general rains, heaviest in the north ; 2°, interior anticyclonic ; like the preceding, but with less distinct cyclonic conditions ; the temperature is high with south-easterly winds ; the warm 'Santa Anna' winds of Los Angeles occur under this distribution of pressures ; 3°, North Pacific anticyclonic ; high pressure in the north, and low in the south, giving clear weather with light, variable winds in the north, but with high winds and southerly gales on the coast of California ; warm days and cool nights, often frosty ; the dreaded dry 'north wind' of the Sacremento and San Joaquin valley prevails at this time : 4°, general cyclonic ; a rare type, with very low pressure on the coast, giving severe storms of high southerly winds and heavy rain ; 5°, South Pacific anticyclonic ; moderately high pressure along the south-western coast of California, and no distinct centre of low pressure visible, but giving southerly rain-bearing winds ; 6°, sub-normal type ; irregular isobars and no decided gradients, with variable winds and weather. During the dry season (summer), the weather is very constant, with high pressure to the north-west over the cool ocean, and low pressure over the hot land to the south-east, northerly winds and no rain. The change from the wet season to the dry is indicated when the air temperature on the coast rises permanently over the ocean temperature. Lieutenant Glassford has also compiled an extended table of the rainfall on the Pacific coast from all sources, including some two hundred stations with records varying from one or two years up to thirty-seven (San Francisco and Sacramento). This was published in the San Francisco daily *Commercial news* for July 1, 1886. The maximum precipitation is given for Neah Bay, Washington Territory, where the annual average of nine years' record is 110.12 inches. Many other stations in the north exceed fifty and sixty inches a year. In the south, the minimum falls nearly to two inches, being 2.56 at Yuma, Arizona, from an eleven-year record. The lowest of all is a three-years' average for Bishop Creek, Cal., where the annual precipitation is only 1.31 inches. The table gives the months separately, as well as the yearly total, so that the seasonal variation is well brought out. In July and August only nine and ten stations respectively have over an inch of rain, and these are all in the north or in the interior ; while no rain at all is given for eighty-two and ninety stations, and a number more have only a trace or one or two hundredths of an inch.

DR. ROMANES ON PHYSIOLOGICAL SELECTION.

Dr. George J. Romanes, who, in more than a literal sense, may be said to be the legatee of Darwin, publishes in *Nature* (Aug. 5, 12, 19) an abstract of a paper read before the Linnean society, entitled "Physiological selection : an additional suggestion on the origin of species."

The necessity of such an additional principle is made evident by considering three objections to natural selection as a theory of the origin of species. 1°. The difference between species and varieties in respect of mutual fertility. It is a fact that many domesticated varieties, though differing from one another to a greater extent than many natural species, retain a perfect fertility among themselves. The consideration that sterility between natural species is not absolute, slightly changes but does not solve the problem. Mr. Darwin admitted the difficulty, and suggested the improbable hypothesis that the sterility was the incidental effect of uniform conditions of life on the generative system. 2°. The swamping effects of free intercrossing upon any individual variation would more than outweigh the action of natural selection; and to answer as Mr. Darwin does, that many individuals might simultaneously undergo the same modification, is to appeal to a highly improbable series of events, especially when it is remembered that, 3°, these specific distinctions are so often of a useless character. Mr. Darwin frankly admitted that many of these meaningless detailed distinctions, like the general distinction of sterility, were not explained by natural selection.

In view of these objections, Dr. Romanes thinks that the theory of natural selection has been misnamed. It is at once a different and a much broader theory, — different, because it explains the origin, not of species, but of adaptations of all kinds, morphological, physiological, and psychological; broader, because it accounts for these adaptations, whether they occur in species only, or also in genera, families, orders, or classes. To realize, on the one hand, that natural selection does not primarily explain the origin of species, but only the development of adaptations, and, on the other hand, that the distinctions which it does explain are not confined to species, is the key to the right understanding of this great biological principle. When natural selection did produce species, it was because accidentally the differences to which it gave rise were specific in character: its business was to evolve adaptations.

It is to one among these other causes which have been shown to be necessary for accounting for the origin of species that Dr. Romanes devotes special attention: he calls it the prevention of intercrossing with parent forms, or the evolution of species by independent variation.

The number of trifling variations, even in one generation, is enormous. The fact that natural selection preserves the useful ones alone, and yet can furnish 'the whole adaptive morphology of nature,' gives us a glimpse of the necessarily enormous number of non-surviving, useless variations. Now, if the possessors of any of these useless variations were prevented by any means from intercrossing with those who did not possess them, these unuseful variations would be perpetuated by heredity (witness our domesticated productions), and those varieties of the old species would gradually pass into a new species. On this principle, the opportunities for independent breeding without crossing with the parent forms explains the extraordinary prevalence of peculiar species in isolated oceanic islands. Geographical barriers and migrations can produce the same result. And this hypothesis is made doubly strong by the consideration, that, in these cases where the extinction of the variation has been prevented (by preventing the swamping effects of intercrossing with the parent form), the variations thus perpetuated are generally of a useless character. But the existence of natural barriers will not account for all cases of species-formation by independent variation, because some degree of sterility occurs between even closely allied species, and because closely allied species are not always separated by geographical barriers. The principle of physiological selection must be called in to complete the explanation.

Probably the most variable part of the organism is the reproductive system; and these variations are either in the direction of increased or of diminished fertility. These variations would be more commonly observed, were it not that by their very nature they lead to more or less immediate extinction. But if the sterility were confined largely to crossing between the parent and the varietal form, while the varietal form continued fertile *inter se*, the conditions for the formation of a new species would be furnished. The result of this would be, that, as before, some individuals living on the same area as the rest of their species would be prevented from having progeny with this rest. The only difference is, that in the former case the barrier was geographical: here it is physiological. It is understood, then, that wherever such a variation in the reproductive system occurs that diminishes the fertility between the varietal and the parent form, though retaining it among the varietal, this physiological barrier will end in dividing the species into two sections, each free to develop independent, distinct histories. On this principle, variations in parts other than the reproductive system, unless such variations were useful in character, would not be preserved; but, when the difference in respect of the reproductive system had set in, other differences would secondarily supervene by independent variation. To prevent an unfair objection, it may be added that this theory is not concerned with the kind or cause of this variation any more than that of natural selection: it sets out with the fact.

It will be impossible in so brief a notice to do more than outline the evidence which Dr. Romanes gathers in support of the hypothesis of physiological selection, on the segregation of the fit. Domesticated varieties cannot show much evidence for physiological selection, because breeders keep their strains separate artificially, and this kind of variation is not in their interest. They do show very strongly, however, how important it is to prevent intercrossing with the parent forms if the varietal form is to maintain itself. It is hardly possible that a species could be formed without the prevention of intercrossing with other forms: it is even difficult to imagine any single variation so intensely useful as to resist the swamping effects of free intercrossing. In the natural state the variation in question would not be noticed until the process were over; and so, as is the case with natural selection, the process cannot be directly observed. But it can be proved that the kind of variation which the theory requires does occur in nature and under domestication. If the season of flowering or pairing were advanced or retarded (and changes in the environment would frequently produce the result), the conditions for physiological selection would be given.

But physiological selection will be best shown in what may be termed 'spontaneous variability of the reproductive system.' Of this fact we have evidence in *individuals* (e.g., Mr. Darwin observes that "it is by no means rare to find certain males and females which will not breed together, though both are known to be perfectly fertile with other males and females"), in *races* (e.g., under domestication, "the yellow and white varieties (of Verbascum), when crossed, produce less seed than the similarly colored varieties" — *Darwin*), in *species* (for, as the distinction between varieties and species is of degree only, and as the main distinction is as regards mutual sterility, every instance of sterility between parent and varietal forms is evidence of the action of physiological selection).

Dr. Romanes then proceeds to show that "the facts of organic nature are such as they ought to be, if it is true that physiological selection has played any considerable part in their causation;" and to do this he shows that the three cardinal objections to the theory of natural selection — namely, sterility, intercrossing, and inutility — find a ready explanation in the hypothesis of physiological selection. In this evidence it is brought out that in all probability the variation in the reproductive system is the primitive and distinctive one in the formation of species, and not that it was developed as secondary to another specific distinction in any other part of the organism. In addition, it is shown that the theory is capable of explaining why species have multiplied, and have not become transmuted in a linear series, and that the large body of favorable evidence furnished by the geographical distribution of organic life is perhaps the strongest argument for the truth of the theory. For the details of these points, reference must be made to the original paper.

A word as to the relation of the theories of natural and of physiological selection. It has already been noticed that the kind of evidence on which each depends is alike; that the former deals with the origin of genera, families, orders, and classes, even more than that of species, while the latter relates to species alone; that the former perpetuates useful distinctions alone, while the latter takes up the non-adaptive kind. It remains to add, that the two theories are in no way opposed to one another, but are complementary and co-operative. Without physiological selection, natural selection would be overcome by the adverse influences of free intercrossing: without natural selection, physiological selection could perpetuate no differences of specific type other than those of mutual sterility and trivial details of structure, form, or color.

In conclusion, Dr. Romanes suggests the following experimental verification of his theory, and asks the co-operation of observers in different geographical areas. The experiment consists in taking well-marked natural varieties of plants, and testing the relative degrees of fertility, first within themselves, and next towards one another; in continuing the process "in successive years over a number of natural varieties, by carefully conducted artificial fertilization, and by counting the seeds and tabulating the results."

LAUNHARDT'S MATHEMATICAL ECONOMICS.

Professor Launhardt has made what seems to us quite a notable contribution to the literature of mathematical economics in the volume before us. Whatever may be thought of the importance of investigations of this nature, it cannot be denied that the works of the principal writers on the mathematical theory of political economy — Cournot, Walras, Jevons, and perhaps others — are marked by insight as well as ingenuity, and in many respects by true scientific method as well as scientific form. They have nothing in common with that pseudo-science which we occasionally find endeavoring to conceal its emptiness behind a breastwork of mathematical formulas.

Professor Launhardt bases the theory of political economy on the Walras-Jevons idea of utility in

Mathematische begründung der volkswirthschaftslehre. By Wilhelm Launhardt. Leipzig, *Engelmann*, 1885. 8°.

relation to value. This may be indicated with sufficient precision in a brief space. One of the first points noticed by economists in the theory of value is that the exchange values of different commodities are not at all proportioned to their utilities. The theory advanced by Jevons — and Walras's is substantially identical with it — points out, that while it is true that the aggregate utility of the whole amount of a given kind of commodity has no relation to its exchange value, yet in a certain sense commodities do exchange in the ratio of their utilities. The total utility of different amounts of the same commodity is not proportional to the amount: as successive equal increments are added to the existing quantity, they add less and less to the aggregate utility. Now, what the theory asserts is, that the exchange value of any commodity is determined by the utility which would result from the addition of a small quantity of it to the amount already possessed. Thus commodities do not, indeed, exchange in the ratio of their *total* utility, but they do exchange in the ratio of their *final* utility; that is, of the utility of the last small portion produced, or, what is the same thing, of the next small portion that might be produced. The total utility, u, of the whole quantity, x, of a given commodity, is, then, given by an equation,

$$u = f(x),$$

which may be called the utility-equation; and the exchange value of the commodity is proportional to the derivative of u with respect to x. We might conceivably obtain the form of the utility-equation of any article from a study of its commercial statistics; but this has not been done for any commodity, and it may be doubted whether it ever can be done — with even the lowest tolerable degree of accuracy — unless, possibly, in some very peculiar cases. We do know, however, in practically every case, that $f(x)$ increases with x, but increases at a diminishing rate; that it is 0 when $x = 0$, and reaches a maximum for some value of x. This last point might at first sight be doubted, for it is equivalent to saying that for every commodity there is a point beyond which the quantity on hand cannot be increased without its becoming a nuisance; but it is plain that such a point does in general exist, though it may be very far beyond the quantity actually possessed.

What Launhardt has added to the work of his predecessors is chiefly the discussion of a large number of applications of the general theory, — a discussion which was in most instances made possible only by a special and arbitrary assumption concerning the form of the utility-equation. Since the function $ax - bx^2$ (where a and b are positive constants) is a very simple function, possessing the properties above mentioned as belonging to the utility-function, — viz., it is 0 when x is 0, then increases but at a diminishing rate, and reaches a maximum at a certain point, — Launhardt adopts it, stating at the outset that he would employ it for purposes of illustration, but insensibly falling into the way of deducing from the assumption of its sufficiency the greater part of his theorems. That the form is not sufficiently general for even the roughest approximation, despite the fact that the choice of different coefficients, a and b, gives a wide range for the different characters of different commodities, one may easily convince himself. The derivative of $ax - bx^2$ is $a - 2bx$: accordingly, the exchange value of a unit of any commodity would be a linear function of the entire quantity of that commodity available; so that, if we consider any three quantities, x_1, x_2, x_3, such that x_2 is the arithmetical mean of x_1 and x_3, the exchange value of the article when the quantity is x_2 would necessarily be a mean between its values when the quantity is x_1 and x_3. This is certainly not even approximately true for commodities in general; and this consideration alone would be sufficient to justify us in not accepting the form $ax - bx^2$ as sufficiently general for purposes of investigation. Indeed, as already stated, the author seems to have had no deliberate intention of so using it.

We have dwelt at some length on this point, because the most striking conclusions in the first section of the book — that devoted to exchange — are dependent upon it. One or two theorems of this kind may be quoted, and they will also serve to indicate the nature of the questions discussed by the author. The theorems are printed in italics, as embodying the net outcome of the mathematical investigations which precede them.

"When the merchant is so placed that he can fix his rate of profit at the point most advantageous to him, he obtains two-thirds of the entire economic gain accomplished by the exchange, or twice as much as the producer and consumer together.

"The most advantageous duty is therefore equal to one-third the difference between the price which the domestic goods would bring if there were no importation, and the price at which the foreign goods could be sold with no profit to the producer."

The simplicity of these results is equalled by their unreliability. It is not very surprising that a simple result should be reached from a mathematical hypothesis so much simpler than the facts warrant, even for the purposes of the purest theory; but, in spite of the small value of the results, the methods of arriving at them, often ingenious and depending on a refined analysis of the subject-matter, seem to us of decided interest to any who may be considering the part which mathematical methods are capable of taking in the development of economic science. We cannot here enter upon a discussion of this general question; but we may be permitted to say that we do not look forward to their giving important direct aid in the investigation of the fundamental questions of economics, though they may, when the science has reached a more advanced stage, be useful in the more minute discussion of special problems. In a certain indirect and incidental way, we think that mathematical inquiry may be useful even to the fundamental theory; for the necessity under which the mathematician lies, of clearly and exactly comprehending his premises, will doubtless in some instances bring about a more accurate view of economic phenomena. Upon the mathematical economists themselves, this necessity of accurate definition is apt to act in a most harmful manner, as their writings abundantly prove. When they have got hold of a notion which lends itself to mathematical treatment, the temptation is very great to unduly extend its province. Jevons's theory of utility in relation to value is a conspicuous example of these merits and defects. While the accurate analysis of some features of the phenomena of value which was a necessary preliminary to the mathematical discussion has been useful to economists in general, the results reached by the mathematical theory are open to the gravest objections; and this quite apart from any subsidiary defects, such as those occurring in some of Launhardt's discussions, as pointed out above. In the mathematical development of the theory, its exponents overlook two capital points, — first, that, under a *régime* of separation of employments, the direct utility of a product to its producer has little or no significance; secondly, that, when an addition to the amount of a given commodity supplies with it a new class of individuals who formerly could not possess it, the utility thus arising is very different — and, if measurable at all, its amount follows a very different law — from that which arises from an increase in the quantity possessed by those who were already provided with the commodity.

We have not left ourselves space to speak of other points, some of them very interesting, in the section on exchange, nor to make more than a passing mention of the other two sections, on production and transportation respectively. On the subject of money, the author takes, in our opinion, a very erroneous view. In the section on transportation, the mathematical premises come nearer than almost anywhere else to a representation of the actual problem: a large part of the questions there discussed are, in fact, such as are necessarily considered in an essentially mathematical way, though doubtless with little scientific method, by railroad managers. A satisfactory idea of the book can only be obtained by reading it. For the benefit of those who may contemplate doing so, we may state that a knowledge of the first elements of the differential calculus will make the little volume of two hundred pages sufficiently easy reading.

THE POPULATION OF MEDIAEVAL CITIES.

Social science has certain problems of reconstructing past conditions out of fragmentary remains, which are analogous to that reconstruction of terrestrial life and conditions which has been the triumph of modern natural science. History does not now content itself with a mere narration of events, but strives to portray the whole social condition of the people, — to give a vivid picture of society as it existed at the time. Modern historical writing has accomplished this to a greater or less extent, and the result is that our histories are histories of the people rather than of dynasties.

In one particular, however, this reproduction is incomplete. The historians do not give us exact statistical details of the relations of population, industry, commerce, etc., without which any description of a modern community would be considered entirely incomplete. It is impossible for them to do so, because such statistical investigations are entirely modern, most of them reaching back only to the beginning of this century. In former times there were no statistical bureaus, no census of the people, no returns of trade and commerce. There was no demand for such information, either for governmental or scientific purposes. It is notorious that ancient and mediaeval writers had no sense for numbers. The figures they give of the strength of armies or the population of cities are mere estimates, and on the face of them are often obvious exaggerations. One of the most difficult problems the historian has before him, is to weigh the statements of different writers as to the number of people concerned in any event, and very few purely literary historians have the requisite scientific training for such work.

The pure historian must here appeal to the professional statistician for help. The acute and learned work of which we give the title is an example of what German industry can accomplish

Die volkszahl deutscher städte zu ende der mittelalters und zu beginn der neuzeit. Von J. Jastrow. Berlin, *Gaertner*, 1886. 8°.

in this direction. It takes up the question of the population of mediaeval cities, and explains elaborately the methods of ascertaining such population. Of actual censuses of the people, we have but two cases, — Nuremberg, in 1449; and Strasburg, in 1475. The first was to estimate how long the corn would last during a siege; the second, to get at the military strength of the city. With these two exceptions, all our knowledge of the population of mediaeval cities rests on estimates of various kinds. Sometimes we have the number of houses in a city, and can guess at the population by reckoning the probable number of people to a house. The old church registers give the births, deaths, and marriages, and from these we can estimate the number of inhabitants. Finally, there are the tax-lists and the army-lists, occasionally a list of persons enjoying citizenship, or statistics of the consumption of the chief commodities. Our author points out, however, that all these estimates must be accepted very cautiously, because we are not accurately acquainted with the relations of mediaeval life so as to reason, for instance, from the consumption of meat in a city to the number of people.

The actual population of mediaeval cities appears from this scientific investigation to have been astonishingly small. Those imperial cities, which ruled themselves, bade defiance often to the emperor, and played an important part not only in the industrial but in the political life of Europe, we are accustomed to think of as places rich in wealth and population. In the fifteenth century, Nuremberg, Strasburg, and Dantzic, three very important commercial cities, probably contained less than 20,000 people each; Basle and Frankfort, from 10,000 to 15,000 each. In the sixteenth century Augsburg and Dantzic reached possibly 60,000; Nuremberg, from 40,000 to 50,000; Breslau, 40,000; Strasburg, 30,000; Leipzig, 15,000; and Berlin, 14,000. These were by far the most important cities of the empire. The other so-called cities were villages and market-places running down to from 1,200 to 1,500 people.

Richmond Mayo Smith.

A Vienna workman sick with sore throat was ordered a gargle of chlorate of potash. The prescription called for 'a coffee-spoonful in a glass of water,' although verbal instructions were given that it was to be used as a gargle. The wife of the sick man gave him a teaspoonful of the chlorate of potash dissolved in a tumbler of water, repeated the dose in an hour, and at four and again at five hours subsequently gave half a teaspoonful. After suffering with cramps and diarrhoea, followed by profuse perspiration, the patient became unconscious, and died the following morning, twelve hours after taking the first dose. Dr. Fountain, who did much to bring this remedy to the notice of the medical profession more than twenty years ago, in order to demonstrate its harmlessness, took an ounce, and died seven days after. Dr. Tully repeated this dangerous experiment on several occasions without any bad results. It is probable that the difference in the results in these two cases was due to the difference in the concentration of the solution.

— In 1884 there were 284,115,862 passengers carried by the railroads in New York City; and, as statistics show an annual increase of twenty millions in the number of passengers carried, the railroads should receive a total of at least 320,000,000 fares during the present year. At five cents each, this would give sixteen million dollars as New York's care-fare bill for 1886.

— The herring fishery in Scotland this year presents some features of interest. About a century ago the estuary of the Moray Frith was most sought after, and fishermen, both local and from a distance, caught large quantities of fish there. But in a most unaccountable manner the herrings suddenly disappeared about forty years ago, and were found only in shoals about the entrance of the frith and on the Caithness side. There, also, the inshore fishery became unproductive; and it was not until new haunts were discovered on the Dogger bank, from thirty to forty miles off the land, that the fishery again became abundant. On this bank heavy fishings are obtained, so that the produce of last year's fishing on the east coast was estimated at nearly $7,500,000. Meanwhile, Shetland had yielded but poor returns as a fishing-ground until 1877, when a beginning was made, and in 1885 the fish cured there amounted to 370,000 barrels. This year, however, the fishing at Shetland has been a comparative failure; but in the mean time the herring has returned to his old haunts in Moray Frith, and the fishing on the east side has of late been very successful. The total catch for the present year, up to the middle of August, is estimated at upwards of 250,000 barrels.

— A new method of preparing fresh fish for transportation to distant markets is being tried at North Sea fishing-ports. The fish are packed in steel barrels, in an antiseptic solution of three per cent boracic and tartaric acids and salt in ninety-seven per cent pure water, the liquid being forced in under a pressure of sixty pounds to the square inch. Fresh fish thus prepared are now supplied to the London markets from the Danish, Scottish, and Shetland Island fisheries.

SCIENCE.

FRIDAY, OCTOBER 8, 1886.

COMMENT AND CRITICISM.

TWENTY-NINE MEN, at an expense of ninety dollars per diem, are employed in Chicago by the U.S. government in quarantining cow-stables which are infected with contagious pleuro-pneumonia. Our federal authorities are wonderfully paternal when they desire to be, and the U. S. laws are at times remarkably flexible. Singularly enough, however, the activity is usually displayed in a direction which is suggestive of a desire to propitiate the farming interests. Thus a tax is put upon oleomargarine, and local cow-stables, from which disease might spread to other localities, are quarantined at the national expense; but when the question of restricting the importation of possibly infected rags is broached, we are told that the matter is one with which the general government cannot interfere, and that it must be left to the local authorities. We are far from deprecating governmental interference in this matter of pleuro-pneumonia, but we would like to see the same careful supervision exercised in all matters which affect the public health, as much when they concern the urban as when they affect the rural population.

THE PROBLEM of how to deal with the financial difficulties in the way of obtaining any very great number of graduate students at our colleges and universities, in spite of the great educational advantages offered, is one that has given and is giving considerable trouble. When a young man takes his bachelor's degree at twenty or twenty-one, he is quick to see the advantages of a post-graduate course of special study as a broader and deeper preparation for his professional career, but he hesitates to incur the necessary expense. Not only must he be a non-producer during the extended period of study, but his expenses, including usually a considerable tuition fee, are heavy. When this aspect of the question is considered and weighed against the inducements to follow some career that will provide self-support immediately, we cannot wonder that the financial consideration is the determining one in the minds of many young men. President Barnard of Columbia sees this obstacle to the increase of students in our university courses, and in his report for the past academic year, which has just been published, earnestly recommends that the tuition-fee now required of graduate students be abolished. This is a step in the right direction, and we trust that it will be taken by Columbia's trustees, and followed by other institutions. A more efficient and advantageous remedy is the foundation of numerous graduate scholarships and fellowships, but to enter upon this on any considerable scale requires more spare funds than more than one or two of our educational institutions can boast of. It is here that private munificence should step in to aid educational and scientific advance.

THE PUBLISHED REPORTS from the English eclipse expedition to the island of Grenada show, in general, a very gratifying amount of success; and, although thus far the photographs of the corona have failed to establish Dr. Huggin's method upon the firm footing we had hoped for, a fuller account of the circumstances may throw some light upon the matter. We shall also await with peculiar interest the results of Mr. Pickering's work. Photometric observations, and photographs of the corona and of its spectrum, were obtained by the different branches of the English party, and also good spectra of the prominences, showing the bright lines of highly incandescent vapors. "In this respect the result resembles that obtained in the two previous eclipses, though it was thought possible that this year, being one when sun-spots are tending to a minimum, would be marked by the more continuous spectrum that bespeaks lower temperature." The bright lines of the prominences were displaced in such a direction as to prove that there was a downrush of gas towards the sun. The observations of the corona also confirm those of the last two eclipses.

THE LACK OF INTEREST which is manifested by public bodies in matters which pertain to the improvement of the public health has never been better illustrated than by the common council of Brooklyn in their treatment of certain proposed amendments to the ordinances of that city relating to tenement-houses. While New York has, by virtue of recently enacted laws, made great strides in the matter of tenement-house reform, Brooklyn stands where she did in 1867, when the Metropolitan board of health existed. In May, 1885, more than sixteen months ago, the health commissioner forwarded to the common council a number of amendments to the old law, which the experience of nearly twenty years had proved to be necessary for the welfare of the poor. These amendments required the construction of all new tenement-houses to be in accordance with the requirements of the health department as to light, ventilation, plumbing, and drainage, and prohibited the building of such a house so as to occupy more than sixty-five per cent of the lot on which it stands. Other suggested changes were of equal importance and value. Before the amended ordinances can have validity, they must be approved by the common council. Thus far, no sign has been given that this body has the least intention of acting upon them in any way, and it is more than probable that they have been consigned to a pigeon-hole, from which they will never be removed.

THE ATTENTION OF PHYSICIANS and other philanthropists has of late been more directed to the care of the inmates of public institutions than ever before, and as a result many cases of neglect and ill treatment have come to light which would otherwise have been soon forgotten by every one cognizant of the facts ; excepting, perhaps, the poor victims, who, being without friends or influence, could not bring their wrongs to the notice of the authorities. In view of the possibilities, to say the least, of what might happen in institutions, the friends of reform succeeded in passing through the last legislature of New York a bill which is entitled "An act for the better preservation of the health of children in institutions." It went into effect Oct. 1 of this year. The provisions of this law apply to all institutions which have been founded for the harboring of children. The act, which is known as chapter 633, requires every institution of this kind to have attached to the service a regular physician of good standing. His duties consist in examining every child that applies for admission, and issuing a certificate of its freedom from contagious disease or not, as the case may be. The certificate must also state the mental and physical condition of the child. He is also held responsible for the sanitary condition of the building, and must report the same to the officials of the institution and to the board of health. It is made the duty of this latter body to investigate at once any complaints made to it, and to remedy in a prompt manner the defects found. If any of the children become affected with any of the contagious diseases, including those of the eye and skin, they must not be permitted to remain unless they can be properly isolated and taken care of without prejudice to the other children. The law also requires that special attention be paid to the ventilation of the buildings. A refusal to comply with the provisions of the law constitutes a misdemeanor. We had occasion, in a recent issue of *Science*, to speak of the large number of children in public institutions who suffered from contagious ophthalmia, — a disease which, if neglected, is liable to destroy the eyesight of those attacked. The law to which we have just referred will do much to reduce this evil, and indeed, if completely fulfilled, to eradicate it entirely from the places where for so long a time it has found its victims by the score.

M. EUGENE STROPENO, the writer who has an article in a late issue of the *Revue internationale de l'enseignement* on higher education in the United States, has very carefully digested for his readers the report of the commissioner of education for 1883–84. M. Stropeno gives no evidence, in his article, of any personal acquaintance with our educational system, and therefore has nothing critical to advance. He merely gives an exposition of Commissioner Eaton's report, and the elaborate tables of statistics accompanying it. In touching on the Harvard system of electives, M. Stropeno quotes the criticisms of Presidents Porter and McCosh, and is inclined to side with them in the view they take of President Eliot's policy. Whatever the writer's views, it is refreshing to see so full and painstaking an exposition of what our colleges and professional schools are, and are doing for the benefit of foreign readers. And among no people is the new pedagogical movement more active than among the French. In the following number of the same review, there is an appreciative account of Fichte's pedagogical theory and influence, by Professor Hallberg of Toulouse. We can heartily recommend this short sketch to those educators who would know what Fichte taught and did. It must be borne in mind that he was the man who showed Pestalozzi the latter's essential agreement with Kant, and it was he who predicted that from Pestalozzi's institute would come the regeneration of the German nation. Fichte's own *Reden an die deutsche nation* is an educational classic, and his influence in Germany is perceptible to this day. What Professor Hallberg has to say is far too brief to be exhaustive, but it is very instructive so far as it goes.

THE MODERN MUSEUM.

THE Prince of Wales, in a letter to the lord-mayor of London under date of Sept. 13, proposes the formation of a permanent museum, to represent the arts, the manufactures, and the commerce of the queen's colonial and Indian empire, as a fitting memorial of the queen's jubilee. In the London *Spectator* of Sept. 25 is an article upon the Prince of Wales's idea, which brings out so prominently the advantages of the modern museum, that we quote from it extensively below. The *Spectator* refers to the difficulty of treating as a whole the English colonies and the English dependencies; but, as diversity is so singular a character of the empire, it ought certainly to be reflected in any such institute. The Prince of Wales points out especially the advantage of such an institution in stimulating and efficiently directing emigration by giving to those frequenting it a more correct picture of the lands to which they might have thought of going. Again, it is almost needless to point out the commercial advantages of a permanent museum of the products of the empire, for it would serve the purpose of advertising, which is an essential of mercantile progress; but, as said, the prince is probably right in putting emigration first of all in his list of benefits.

Emigration, wisely undertaken, is an unmixed blessing to the working-classes. It gives the man who emigrates the opportunity which no man can ever be quite content till he has had, whether he fails or not, — the opportunity of making a fortune, and of emerging from the dulness of the ranks of life. It gives to the workman who stays that relief from the pressure of competition which he so much needs. With these results before them, people of the upper class constantly wonder how it is the workingmen are not more eager about emigration, and in general can only be induced to adopt it as a final resort from misery. They argue, "In our rank of life, the younger sons all emigrate," and call to mind the not unfrequent cases where, out of a family of six, four will have left England. "We do it easily enough," they say; "why, then, won't the workingmen, where the pressure is so much greater and the inducements comparatively so much higher?" The answer, of course, rests in the fact that the one class of men know geography, and the other do not. The young man who determines to go to Florida knows where Florida is, and, before he chooses it, has been able to picture to himself, by the information he has the means of getting easily, the kind of life he will have to lead. The notion has no nameless, shapeless, unknowable terrors for him. He has seen plenty of Americans, and knows that they are like other men, and that, but for the banishment from England, he will be happy enough. So, too, with the woman of education who accompanies her husband when he emigrates: she has not that physical dread of an awful existence, with no relation to previous experiences of life, which is so often to be witnessed among the women of the poor. With the artisan, or at any rate with the laborer and his wife, it is just the reverse. They have not the means of obtaining knowledge by which to compare the various lands that invite emigration. They are quite unable to acquaint themselves, or to grow familiar, with the idea of the new social and material conditions that await them. Thus their ignorance of the colonies allows the wildest notions of misery and discomfort to take possession of them, — notions that practically forbid them emigrating, except in case of severe pecuniary pressure. They will seldom emigrate to better themselves; only do it, in fact, to prevent themselves falling lower. An institute where these spectres can be laid will be of immense use in increasing timely emigration, — emigration of men who are not driven by despair. If the London artisan can see good photographs of the Australian and Canadian towns and settlements, and can notice around him the rich produce of the colonies (the sugar, the wool, the wood, the corn, the wine, the oil); if he can learn that men live there as they live here, that there are public-houses and Sunday-schools, and that he will not be daily expected to encounter naked savages; and if at the same time he can get intelligent advice and direction from competent instructors on the spot, — he will soon find his fears and dismal forebodings of colonial wretchedness die away.

But if the working-men are really to make use of the institute, for this or for the other purpose of political education, it will be utterly useless to place it in the West End. Working-men will not and cannot travel for miles, at a considerable expense of money and comfort, to see a museum. If it is placed in a convenient situation, they will flock to it as eagerly as they do to Mr. Barnett's Easter exhibitions of pictures. If the institute is to do the good work it ought to do, and can do, it must be placed, if not geographically, at least morally, at the East End of the town; that is, it must be built in a poor quarter. Even in common fairness, the poor have a right to the site of the next museum. When the natural history collections were removed from the British museum to South Kensington, a great opportunity was missed. There is no taste more common among the poor than the taste for natural history. Had the stuffed beasts and birds with which the people of the West End are so heartily, so naturally bored, been put up in Whitechapel, they would have been welcomed by streams of admirers. Such a mistake ought not to be made this time. Of course, the architects, the men of science, and the artists like to see ranges of imposing galleries, and consider the collections and the advantages of the site far more than they do the public that looks at them, or that pays for them. Even they, however, would relent if they realized how useful, how pleasure-giving, how healthful a triumph might be secured by placing the great collections of art and science within the reach of the poor. Practically, they cannot go to the collections, and so the collections should go to them wherever possible or reasonable. But the rich can go into the East End to see exhibitions, and the more they are compelled to go there, the better. Let them, by going to see the new institute, learn where the poor live in London, and let them realize the condition of life there, and discover how, though materially it is nothing like so awful as they fancy in their compassionate and sentimental moments, it is, as far as education, self-improvement, rational and healthful pleasure are concerned, far below any standard which we can be content with.

Although so much of this was written for English readers, its truths are of value in America.

THE HEALTH OF NEW YORK DURING AUGUST.

THE population of New York is estimated at 1,446,000. Of this number, 3,246 died in the month of August, a decrease of 952 deaths as compared with the preceding month. Among children under five years of age, 939 less deaths occurred than in July, while there was also a diminished mortality from diarrhoeal diseases, amounting to 677. Diphtheria proved fatal in 104 cases, as against 133 in July; and scarlet-fever caused but 15 deaths, a gain of 10 as compared with the preceding month. The week ending on the 28th is noteworthy as having no deaths recorded from scarlet-fever, which is a most remarkable incident in a city of a million and a half of people. The deaths from consumption were 443, four more than are recorded for July. It will be seen from these figures that the health of New York is improving; and, unless the temperature and humidity of the early fall are unpropitious, we shall expect to see a gradual falling of the death-rate until winter sets in, when the deaths from diseases of the respiratory organs will so increase as to again augment it.

August was pre-eminently a cool month. The mean temperature was but 70.19° F. An examination of the record of temperature as far back as 1870 fails to show any August in which the mean was so low. The nearest approach to it was in 1874, when it was 70.25° F. In most of the years during the past decade the mean has been above 72° F., and in one year, 1877, reached 75.37° F. The maximum point attained by the mercury during the month was 90° F., at 4 P.M. of the 28th. In four of the past ten years the August temperature has been the same as this year. In 1884 and 1885 it was one degree higher, and in 1880 and 1883 one degree lower. 90° F. may be considered as the maximum temperature for August for the past ten years. The lowest recorded temperature this year was 53° F., at 3 A.M. of the 22d.

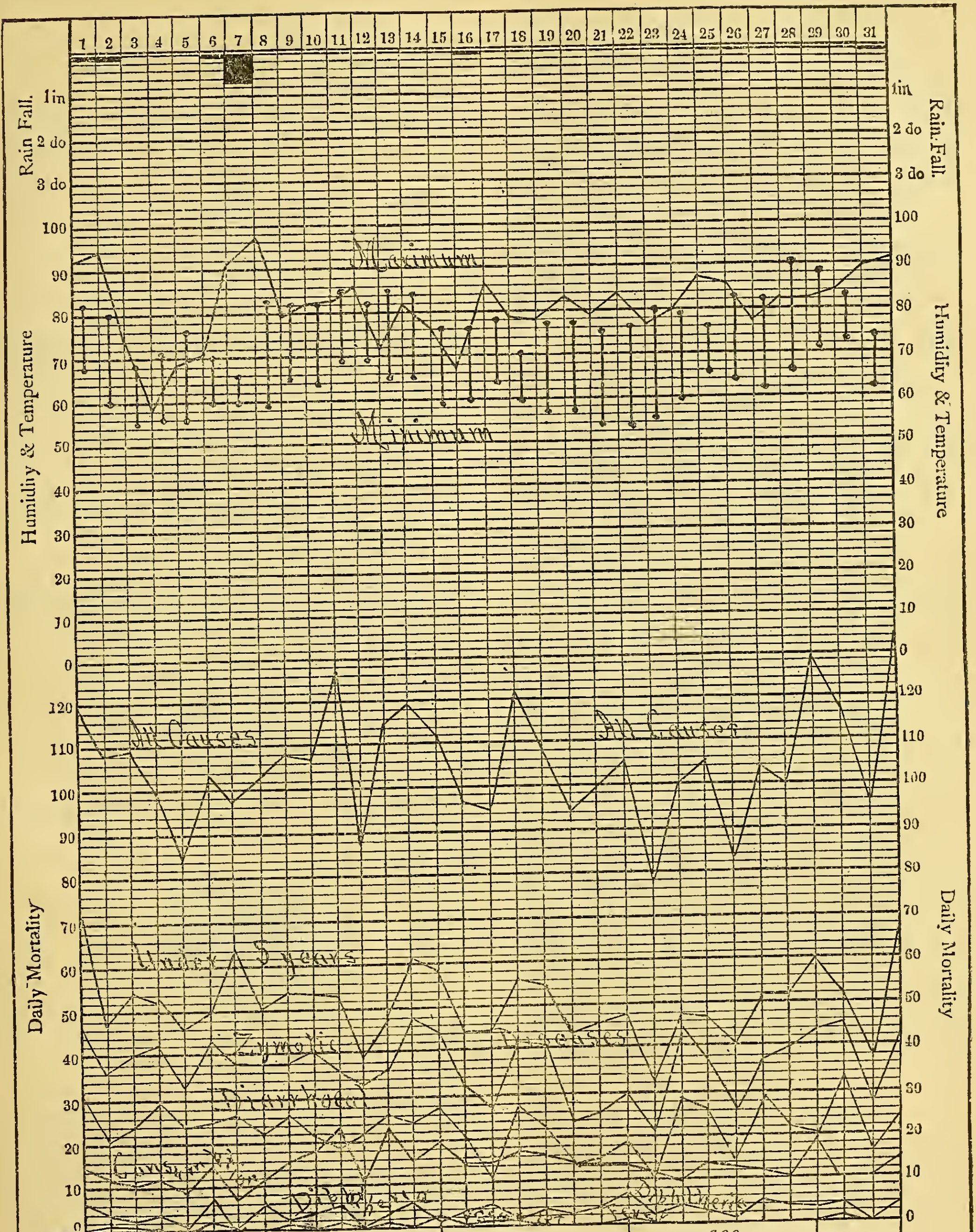
The rainfall of August, 1886, was also remarkable. Although some rain fell on six days of the month, the total amount was but .95 of an inch. From this it will be seen that the month was a very dry one. In but one year, 1881, since 1877, has the rainfall been so small. In 1885, 5.67 inches fell; and in the previous year, 1884, no less than 7.90 inches is recorded. The mean for ten years was 4.22 inches. July and August have been very noteworthy for the small quantity of rain which has fallen.

ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS.

THE Proceedings of the third annual convention of this association, which was held in Washington on the 26th and 27th of August, have just been issued as Bulletin No. 12 of the chemical division of the department of agriculture.

The benefit which has been derived from these meetings of the chemists of the country, who are engaged in the analysis and control of commercial fertilizers, has been very marked; and the adoption of a uniform official method of working has not only resulted in greater agreement among official chemists, but has also, by informing the analysts employed by those manufacturing fertilizers, of the methods in use, brought about greater harmony between the manufacturers and the control stations.

The results in this direction having been so sat-



Weekly Mortality	705	774	719	699	
Weekly mean Thermometer	67.3	73.7	66.9	71.0	
Weekly mean Barometer	29.822	29.928	30.014	29.883	

isfactory, it was decided this year to enlarge the scope of the association, so that it now includes "the consideration of uniformity and accuracy in the analysis of fertilizers, soils, cattle-foods, dairy products, and other materials connected with agricultural industry," and "affords opportunity for the discussion of matters of interest to agricultural chemists." All persons exercising official control of the materials above named, or who are connected with departments of agriculture, agricultural experiment-stations, agricultural colleges, and state boards of agriculture, are eligible to membership. Under this extension of its field, the association will, no doubt, do as much for the improvement in accuracy and uniformity of the analysis of other materials as it has done for fertilizers.

The Proceedings contain the reports of committees on the estimation of phosphoric acid, nitrogen, and potash, the discussion of the previous year's experience, and concludes with the official methods adopted for the ensuing year.

The officers elected and the committees appointed by the president are as follows: — president, Dr. E. H. Jenkins of the Connecticut agricultural experiment-station; vice-president, Mr. P. E. Chazal, state chemist of South Carolina; secretary and treasurer, Clifford Richardson of the U. S. department of agriculture. Members of the executive committee: Dr. H. W. Wiley of the U. S. department of agriculture, Prof. M. A. Scovell of the Kentucky agricultural experiment-station. Other committees: phosphoric acid, Prof. W. C. Stubbs (Baton Rouge, La.), Prof. W. E. Moses (Knoxville, Tenn.), Dr. C. W. Dabney, jun. (Raleigh, N.C.); nitrogen, Dr. W. J. Gascoyne (Richmond, Va.), Mr. P. E. Chazal (Columbia, S.C.), Prof. M. A. Scovell (Lexington, Ky.); potash, Mr. Clifford Richardson (Washington, D.C.), Prof. H. A. Huston (Lafayette, Ind.), Prof. W. W. Cook (Burlington, Vt.); feeding-stuffs, Dr. G. C. Caldwell (Ithaca, N.Y.), Prof. W. H. Jordan (Orono, Me.), Mr. Clifford Richardson (Washington, D.C.); dairy products, Dr. H. W. Wiley (Washington, D.C.), Dr. S. M. Babcock (Geneva, N.Y.), Prof. H. P. Armsby (Madison, Wis.).

ARTIFICIAL RUBIES.

The subject of artificial gems is at the present moment of considerable interest, not only financially, but also as furnishing an example of the manner in which the microscope is constantly called into use by almost every profession. Early this summer the Syndicate des diamants et pierres precieuses were informed that certain stones which had been sold as rubies from a new locality were suspected to be of artificial origin. They were put upon the market by a Geneva house; and it was surmised that they were obtained by the fusion of large numbers of small rubies, worth at the most a few dollars a carat, into one fine gem worth from $1,000 to $2,500 a carat.

Some of these artificial stones were kindly procured for me by Messrs. Tiffany & Co. I was not, however, permitted to break them for analysis, to observe the cleavage, or to have them cut so that I could observe the optical axes more correctly. I would at any time have detected the artificial nature of this production with a mere pocket-lens, as the whole structure is that peculiar to fused masses. Examination elicited the following facts. The principal distinguishing characteristic between these and the genuine stones is the presence in

Fig. 1. — Spherical cavities in artificial ruby as seen at one time (enlarged 75 diameters).

Fig. 2. — Spherical and irregular cavities in artificial ruby as seen at one time, evidently from the lower part of the crucible (enlarged 25 diameters).

Fig. 3. — Acicular crystals in sapphire (enlarged 100 diameters).

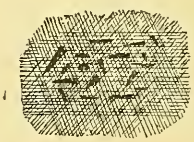


Fig. 4. — Cuneiform crystals in ruby and sapphire (enlarged 200 diameters).

them of large numbers of spherical bubbles, rarely pear-shaped, sometimes containing stringy portions showing how the bubbles had moved. These bubbles all have rounded ends, and present the same appearance as those seen in glass or other fused mixtures. They are nearly always in wavy groups or cloudy masses. When examined individually, they always seem to be filled with gas or air, and often form part of a cloud, the rest having the waviness of a fused mixture. Some few were observed enclosing inner bubbles, apparently a double cavity, but empty. In natural rubies the cavities are always angular or crystalline in outline, and are usually filled with some liquid, or, if they form part of a 'feather,' as it is called by the jewellers, they are often arranged with the lines of growth. Hence the difference in appearance between the cavities in the natural gem and those in the fused gem is very great, and can readily be detected by the pocket-lens. I have failed to find in any of the artificial stones even a trace of any thing like a crystalline or angular cavity. Another distinguishing characteristic is that in many genuine rubies we find a silky structure (called 'silk' by the jewellers), which, if examined under the microscope or under a $\frac{4}{10}$ to $\frac{8}{10}$ inch objective, we find to be a series of cuneiform or acicular crystals, often iridescent, and arranged parallel with the hexagonal layers of the crystal. When in sufficient number, these acicular and arrow-shaped crystals produce the asteria or star effect, if the gem is cut in *en cabochon* form, with the centre of the hexagonal prism on the top of the cabochon. I have failed to find any of them in the stones under consideration, or even any of the marking of the hexagonal crystal which can often be seen when a gem is held in a good light, and the light allowed to strike obliquely across the hexagonal prism. Dr. Isaac Lea has suggested [1] that these acicular crystals are rutile, and interesting facts and illustrations have been published by him. From my own observations on many specimens, I believe there is little doubt of the truth of this hypothesis.[2] My explanation is, that they were deposited from a solution, either heated or cold, while the corundum was crystallizing, and I doubt very much whether they will ever be found in any substance formed by fusion.

The hardness of these stones I found to be about the same as that of the true ruby, 8.8 or a trifle less than 9, the only difference being that the artificial stones were a trifle more brittle. The testing-point used was a Siamese green sapphire, and the scratch made by it was a little broader but no deeper than on a true ruby, as is usually the case with a brittle material. After several trials, I faintly scratched it with chrysoberyl, which will also slightly mark the true ruby.

The specific gravity of these stones I found to be 3.93 and 3.95. The true ruby ranging from 3.98 to 4.01, it will be seen that the difference is very slight, and due doubtless to the presence of the included bubbles in the artificial stones, which would slightly decrease the density. As a test, this is too delicate for jewellers' use; for if a true ruby were not entirely clean, or a few of the bubbles that sometimes settle on gems in taking specific gravities were allowed to remain undisturbed, it would have about the same specific gravity as one of these artificial stones.

I found, on examination by the dichroscope, that the ordinary image was cardinal red, and the extraordinary image a salmon red, as in the true ruby of the same color. Under the polariscope, what I believe to be annular rings were observed. With the spectroscope, the red ruby line, somewhat similar to that in the true gem, is distinguishable, although perhaps a little nearer the dark end of the spectrum.

The color of all the stones examined was good, but not one was so brilliant as a very fine ruby. The cabochons were all duller than fine, true stones, though better than poor ones. They did not differ much in color, however, and were evidently made by one exact process or at one time. Their dull appearance is evidently due in part to the bubbles. The optical properties of these stones are such that they are evidently individual or parts of individual crystals, and not agglomerations of crystals or groups fused by heating.

In my opinion, these artificial rubies were produced by a process similar to that described by Fremy and Feil (*Comptes rendus*, 1877, p. 1029), — by fusing an aluminate of lead in connection with silica in a siliceous crucible, the silica uniting with the lead to form a lead glass, and liberating the alumina, which crystallizes out in the form of corundum in hexagonal plates, with a specific gravity of 4.0 to 4.1, and the hardness and color of the natural ruby, the latter being produced by the addition of some chromium salt. By this method, rubies were formed, that, like the true gem, were decolorized temporarily by heating.

It is not probable that these stones were formed by Gaudin's method (*Comptes rendus*, xix. p. 1342), — by exposing amorphous alumina to the flame of the oxyhydrogen blowpipe, and thus fusing it to a limpid fluid, which, when cooled, had the hardness of corundum, but only the specific gravity 3.45, much below that of these stones. Nor is it at all likely that they were produced by fusing a large number of natural rubies or corundum of

[1] Proc. Philad. acad. sc., Feb. 16. 1869, and May, 1876.

[2] Paper on star garnets, N. Y. acad. sc., May, 1886.

small size, because by this process the specific gravity is lowered to that of Gaudin's product. The same also holds good of quartz; beryl, etc.

The French syndicate referred the matter to M. Friedel of the Ecole des mines, Paris, supplying him with samples of the stones for examination. He reported the presence of the round and pear-shaped bubbles, and determined the hardness and specific gravity to be about the same as of the true ruby. On analysis, he found them to consist of alumina, with a trace of chromium for the coloring-matter. The cleavage was not in all cases distinct; and the rough pieces given to him as examples of the gem in its native state had all been worked, so that nothing could be learned of their crystalline structure. When properly cut according to axes, they showed the annular rings. The extinction by parallel light was not always perfect, which he believed to be due to the presence of the bubbles. He states that he himself has obtained small red globules with these inclusions by fusing alumina by oxyhydrogen light; and, although having no positive evidence, he believes these stones to be artificially obtained by fusion.

On the receipt of M. Friedel's report, the syndicate decided that all cabochon or cut stones of this kind shall be sold as *artificial*, and not precious gems. Unless consignments are so marked, the sales will be condsidered fraudulent, and the misdemeanor punishable under the penal code. All sales effected thus far, amounting to some 600,000 or 800,000 francs, shall be cancelled, and the money and stones returned to their respective owners.

The action taken by the syndicate has fully settled the position which this production will take among gem-dealers, and there is little reason to fear that the true ruby will ever lose the place it has occupied for so many centuries. These stones show the triumphs of modern science in chemistry, it is true; and although some may be willing to have the easily attainable, there are others who will almost want, what the true ruby is becoming to-day, the unattainable. One will be nature's gem, and the other the gem made by man.

I presented this paper at the meeting of the New York academy of sciences, Oct. 4.

GEO. F. KUNZ.

A DULL BOOK.

WITH the exception of the members of the Royal geographical society, perhaps no body of men has done more to advance our knowledge of the geography of the earth's surface than the American missionaries taken as a class. Explorer after explorer has acknowledged his indebtedness to them for the most important successes of his exploration. Yet how little they have written, and how worthless, comparatively speaking, is that little! The present volume is no exception to this rule. The author had abundant opportunity to see and learn, and he undoubtedly saw and learned a great deal. Every page of the volume attests his knowledge of the country of which he is writing; but somehow he has not told of the things one wishes to know, while he has encumbered his book with facts that have little or no interest, and, what is more to be regretted, he has said what he has said in the most wretched English.

There are a few interesting passages in the volume, especially one where he describes the harem, or shrine, of the Imam Reza at the city of Khorasan, more often called Mashad. Singularly enough, he did not see the shrine itself, and got his description second-hand, from an artist whom he employed to paint a representation of it for him. The book further contains the most recent description of the government and social state of Persia that we have: it therefore has a value not dependent on the amount of interest one feels in its perusal. There are, in addition, good accounts of his journeyings in the region between the Black and Caspian seas; but, unfortunately, these regions have been so recently described by more entertaining, though not more competent writers, that this portion of the work lacks the charm of novelty, to say the least.

One other objection to the volume is to be found in the new and fantastic spelling of proper names adopted by the author. He says in his preface that in the orthography of Persian and Arabic names he "endeavored to adhere to the Persian and Arabic forms. In some instances this, however, did not seem to be expedient." One wishes that he had more often retained the more usual spelling. The best feature of the book, and one which goes a good way towards giving it a value at the present time, is the good map of Persia and its border regions, prepared by the author. In its preparation, special attention was given to the details of the eastern border. In conclusion, we are heartily sorry that the book was not published eighteen months ago, when it would have received more attention.

Persia, the land of the Imams. By JAMES BASSETT. New York, *Scribner*, 1886.

NOTES AND NEWS.

ONE of the tasks, says *Nature*, Sept. 23, undertaken by the British museum since printing has taken the place of writing in the Catalogue, is the publication of certain important sections of the Catalogue in separate parts. Thus the entries under America, Cicero, Luther, London, and many others, have already appeared. The last of these is one of special scientific interest: it is a reprint of that part of the Catalogue which is classified under the head 'Academies.' The definition of academies for the purpose is, 'learned and scientific societies.' The entries fill five parts, making a thick folio volume of about one thousand pages. In the great written Catalogue, which is well known to all readers, twenty-eight volumes were given to this one subject. The headings have been thoroughly revised, and the names of a number of societies have been expunged, to be placed under more appropriate headings. Thus, agricultural societies, schools, political clubs, etc., which had crept into the Catalogue by degrees in course of time, have all been omitted. As it is, the total number of entries is about 32,000. 'London' is the longest sub-heading: it fills nearly 200 pages, with about 6,500 entries. Paris, St. Petersburg, and Berlin have about 3,000 entries each; Vienna and Amsterdam, about 1,000. Towns are used for sub-headings, and under these are arranged alphabetically the names of the societies issuing the publications. The old sub-headings of countries have been abolished. Formerly the sub-headings would read thus: 'Academies, etc., — Great Britain and Ireland, — London, Royal society.' The towns are now arranged alphabetically, regardless of countries. Only completed series are fully entered: works in progress are, according to the rule of the museum, catalogued with the date of the first volume, and the words 'in progress.' The work covers the greater part of the scientific literature of the world. When the catalogue of 'periodical publications' is finished, there will be little relating to science which cannot be found under appropriate heads in one or the other. It seems like looking the gift-horse in the mouth, but we cannot refrain from observing that the value of these five volumes would be enormously increased if some approximation to a subject index could be added to them. It would be a simple task to have headings, 'Chemistry,' 'Microscopy,' 'Geology,' etc., under which were given the names of the towns where societies on these subjects are to be found. The student would then have before him at a glance the names of all the societies on the globe working at any particular subject. Instances will present themselves to every student in which the first name of a society, and that by which it has to be sought in the Catalogue, does not always indicate the sphere of work.

— Two valuable papers, — 'The six inner satellites of Saturn,' and 'Observations for stellar parallax,'— the results of recent work with the 26-inch equatorial, have just been published by Professor Hall as Appendices I. and II. of the Washington observations for 1883.

— The statue of Liberty on Bedloe's Island, New York bay, when completed, will be illuminated at night in a decidedly novel manner. The torch of the statue will contain eight electric lamps, of six thousand candle-power each, the light from which will be thrown directly upward, making a powerful beam and cloud illumination. Four or eight lamps, of six thousand candle-power each, will reflect their light upon the statue, illuminating it, and causing it to shine forth in bright relief.

— The reduction of aluminium by means of the electric current, now carried on by the Cowles company of Cleveland, O., is not effected by the voltaic arc, as is generally supposed. In the Cowles process, a connection is established between the carbon terminals through the medium of a mass of finely pulverized carbon and other materials, the terminals being drawn some distance apart after the circuit has been established. By this system the intense heat of the arc is modified, and diffused through a large area of minute particles, keeping them at a constant incandescent heat, thereby effecting the reduction of the most refractory materials.

— The Journal of the Society of arts states, that, from an official report lately issued, it appears that the production of manganese in Russia is steadily increasing. The exports for the first four months of this year amounted to 9,000 tons, as against 4,500 tons for the corresponding period of 1885. This is shipped principally from Poti, where it is conveyed by the Trancaucasian railway from the mines, in order not to interfere with the petroleum trade of the neighboring port of Batoum. Owing to the bad condition of the conveyance used in transporting it from the mines at Tchiatoor to the Transcaucasian railway, large lumps of ore only can be carried, the result being that the smaller pieces, which are equal to two-thirds of the total quantity extracted, are wasted, although equal in quality to that exported.

— From one ton of ordinary gas-coal may be produced 1,500 pounds of coke, 20 gallons of ammonia water, and 140 pounds of coal-tar. By destructive distillation the coal-tar will yield 69.6 pounds of pitch, 17 pounds of creosote, 14 pounds heavy oils, 9.5 pounds of naphtha yellow, 6.3 pounds naphthaline, 4.75 pounds naphthol, 2.25 pounds alazarin, 2.4 pounds solvent naphtha, 1.5 pounds phenol, 1.2 pounds aurine, 1.1 pounds benzine, 1.1 pounds aniline, 0.77 of a pound toluidine, 0.46 of a pound anthracine, and 0.9 of a pound toluene. From the latter is obtained the new substance known as saccharine, which is 230 times as sweet as the best cane-sugar, one part of it giving a very sweet taste to a thousand parts of water.

— Pleuro-pneumonia is reported to be raging with unprecedented violence among cattle in Montgomery county, Penn. Eighteen cases have occurred in one township.

— Recent evidence obtained in one of the ice-cream poisoning cases in Michigan, known as the Lawton case, confirms the views expressed by Dr. Vaughan, that it was due to tyrotoxicon. It appears that the cream was frozen in an old wooden building, which had been previously used as a meat-market, but had been unoccupied for some time, and was in a most unsanitary condition, admirably adapted to pollute the cream and render it poisonous.

— Cholera appears to be on the increase in southern Europe. Our last report announced its presence at Pesth, where, since that time, numerous cases have occurred. Sardinia is now said to be infected.

— At a recent meeting of the state board of health of Michigan, an analysis was presented of five hundred deaths, at ages between eighteen and sixty-five, which occurred in the Michigan mutual life-insurance company during eighteen years. The chief causes of death, in order of frequency, were lung consumption, pneumonia, typhoid-fever, apoplexy, heart-disease, cancer, Bright's disease, and quick consumption. The average age of the decedents from typhoid-fever was 38.5 years; from lung consumption, 40.17; from apoplexy, 51.10; from cancer, 48.90; and from Bright's disease, 54.50. Those who died from consumption were of more than average height, of light weight, and had a small expansion of chest. The average height was 5 feet 11 inches, while the weight was but 139.45 pounds, and the expansion of the chest but 2.93 inches. This character of organization should lead its possessor to great care in his mode of life and surroundings. While, of course, it does not necessarily denote a tendency to tuberculous disease, it is at least a suggestion which is well worth attention and consideration.

— Some faint idea of the prevalence of small-pox in London last year can be gained by the statement that eleven thousand persons suffering with this disease or recovering from it were transported by steamer between London and Purfleet, where the floating hospital was located. This hospital had at one time four hundred patients within its walls for treatment, and not infrequently a hundred would seek admittance, being carried from the city by one of the three steamers which were assigned to this service.

— The Massachusetts state board of health reports that their chemist has found the following adulterations: milk, adulterated by the addition of water and coloring-matter, and by the abstraction of cream; spices, addition of starch and other foreign powders; cream-of-tartar, substitution of starch, gypsum, and other cheaper substances; baking-powders, alum; honey, substitution of cane-sugar and glucose; molasses, addition of glucose and presence of tin; maple sugar and sirup, presence of glucose; confectionery, terra alba, poisonous coloring-matter, fusel oil, and arsenical wrappers; canned fruits, vegetables, and meats, presence of metallic poisons. Opium, cinchona, and other drugs have also been found adulterated. Since 1882, when the law was passed providing for the inspection of food and drugs, one hundred and seventy-five complaints have been made to the courts for violation of its provision.

— Prof. W. H. Pickering and assistants witnessed the eclipse of the sun, Aug. 29, at Grenada; and of that event the professor writes, "The eclipse passed off successfully, and we lost only 45 seconds out of the 226 through clouds. I had eighteen assistants selected from the islanders, and they all did very well. I think my results will be very satisfactory."

LETTERS TO THE EDITOR.

****Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The source of the Mississippi.

IN the issue of *Science* for Sept. 24, Mr. Pearce Giles, in advocating Captain Glazier's claim to the discovery of the true source of the Mississippi, says,—

"There is nothing to be found in Schoolcraft's narrative to show that he penetrated south of Itasca. He speaks of an inlet to Lake Itasca leading from a smaller lake to the south, but clearly did not visit that smaller lake, and hence did not 'discover' it. Nor was it known to exist by Mr. Nicollet, who came after him. The latter explorer states that there are five creeks falling into Itasca. Captain Glazier discovered six, the sixth originating in a lake (not a lakelet) about five miles to the south of Itasca. This lake was not known to Nicollet. It lies nearly due south of the western arm of Itasca. He visited the others (which are mere ponds), but missed the most important one, probably owing to difficulty of access, the soil around it and for some distance from it being extremely swampy, and its inlet to Lake Itasca completely hidden by the densest vegetation. Such an inlet could not have been known to exist, except from the information of the Indian whose hunting-ground was in the immediate neighborhood. The 'infant Mississippi' flows from this lake, unknown until Captain Glazier forced his way into it in 1881."

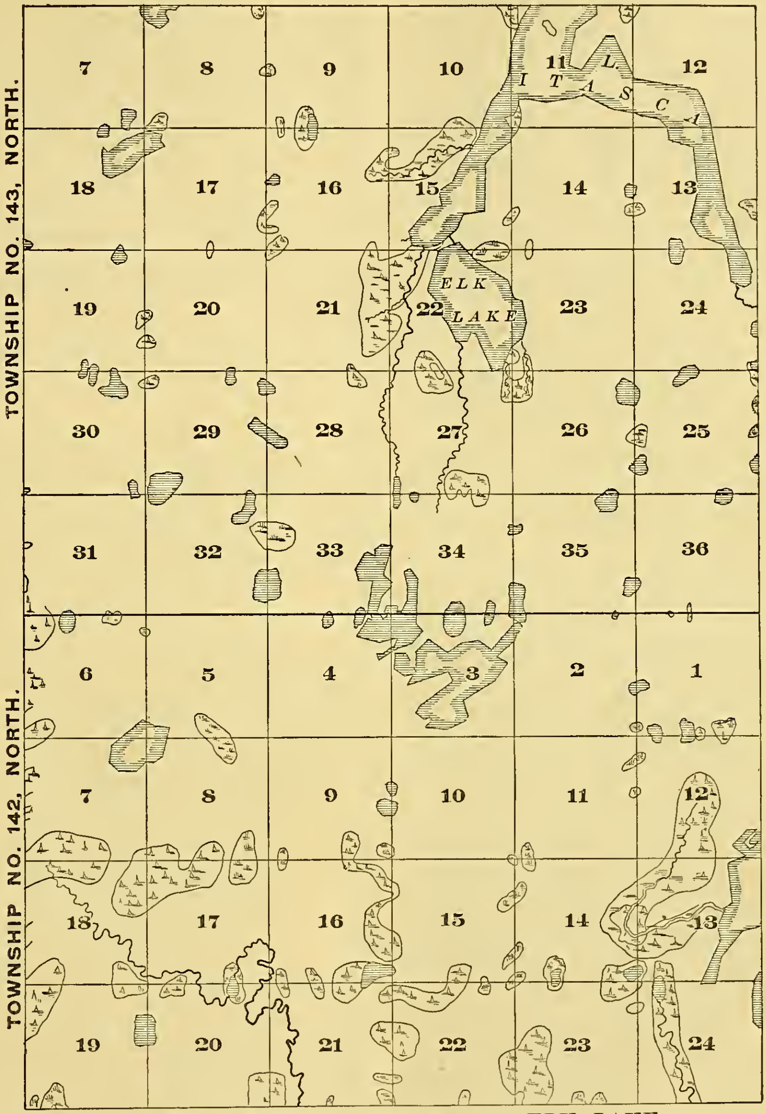
Elsewhere Captain Glazier has told us that this lake is "about a mile and a half in greatest diameter, and would be nearly oval in form but for a single promontory which extends its shores into the lake."

Then we are to look for Lake Glazier at the head of a stream about five miles long, and lying nearly due south of the western arm of Itasca.

Now, will Mr. Pearce Giles be so kind as to point out on the accompanying map the exact location of Lake Glazier, and also trace for the readers of *Science* the course of the 'infant Mississippi' between Lake Glazier and Lake Itasca?

This map is a copy of the maps of two townships deposited in the government land office at Washington. They were drawn from surveys made by Mr. Edwin S. Hall and assistants, who were in these two townships alone for over four weeks in September and October, 1875, six years before Captain Glazier stopped over night (July 21–22, 1881) in township

RANGE No. 36, WEST, 5th MERIDIAN.



MAP OF LAKE ITASCA AND ELK LAKE,
AND VICINITY.

Reduced from fac-simile tracings of maps of the surveys made in October, 1875, and deposited in the General Land Office at Washington, February, 1876. Edwin S. Hall and Assistants, Surveyors.

143, and spent a few hours the next day in making his great explorations. The accuracy of this map was fully verified by the late Mr. O. E. Garrison, who went carefully over the ground in July, 1880, in the service of the tenth U. S. census and of the Minnesota geological and natural history survey. Mr. Garrison travelled from south to north over the very line of Mr. Pearce Giles's 'infant Mississippi,' but he failed to find it; nor did he find any other stream flowing northward from any point more than two miles south of Itasca. The map is also certified to be correct by the land and timber agents of the Northern Pacific railroad, who have been over every quarter-section of these townships repeatedly since the official survey in 1875. I have now before me a copy of a letter from one of these hardy and intelligent woodsmen, written in October, 1875, describing a trip over this very ground, right on the heels of the government surveyors; and his report, while fully describing Elk Lake and Lake Itasca, makes no mention of any such lake or stream as Mr. Pearce Giles describes above.

The scale of the map is certainly adequate for Mr. Pearce Giles's use. Each small square represents a square mile, and the map thus shows us a stretch of fully seven miles south of Itasca.

It is due to "the majority of American geographers and map-makers," who, according to Mr. Pearce Giles, "now recognize Lake Glazier as the primal reservoir of the Great River," that he or Captain Glazier point out the exact location of his lake, since so many official and unofficial expeditions have failed to find it.

But really is not Mr. Pearce Giles claiming too much for Captain Glazier, in view of what has already been published by the captain and members of his party? This is the way one of the party, Mr. Bartlett Channing Paine, described the 'infant Mississippi' and 'Lake Glazier' in a letter to the St. Paul *Pioneer press*, dated Aug. 8, 1881: —

"We started for the upper end of the lake [Itasca] early next morning, finding when we reached it that it terminated in bulrushes and what seemed to be a swamp. Our guide, however, took us through the rushes, and we found that a small but swift stream entered here, up which with difficulty we pushed our canoes. *This stream is about half a mile long*, and flows from one of the prettiest lakes we have seen on our trip. The shores are high rather than marshy, and covered with verdure; and the lake, which is nearly round, its regularity being broken by but one point, has a greatest diameter of a mile and a half, or perhaps two miles. Into this lake flow three small streams which rise in marshy ground from a mile to three miles from the lake. Having previously estimated the volume of water flowing into Itasca by all the streams contributing to it, and found the one from this lake much in excess of that of others, we held a little meeting on the point, and unanimously voted to call the new-found body of water Lake Glazier, in honor of the head of our party."

Every reader of this letter will agree with me in saying that Mr. Bartlett Channing Paine is describing, not a new-found Lake Glazier, but simply Elk Lake of the government survey of 1875, — that and nothing else. Further, Captain Glazier's own map, a facsimile of a part of which is here given, agrees with Mr. Paine, and shows Lake Glazier, as measured by the scale, less than a mile south of Lake Itasca. It is evident that Captain Glazier may have really thought that he was the first white man to visit Elk Lake.

But that was not to be wondered at. People generally did not know about Elk Lake, and Captain Glazier had won a little temporary fame, which might be considered nothing worse than laughable. He might have acknowledged his blunder, and gone on making money lecturing on the 'Heroes of Mississippi exploration,' of whom he had ceased to be the chiefest and last. This, however, does not seem to suit the captain and his friends, and they are making a last desperate effort to distort the facts of geography to suit their ambitions and conceits. The worthlessness of their actual discoveries being shown, they now propose to strike out five miles to the south over the crest of the heights of land, and locate a new Lake Glazier to suit themselves, which no mortal has ever set eye upon. Until water can be made to flow up hill, this latest Lake Glazier will not answer its purpose. The crest of the heights of land is only about three miles from the southern extremity of Lake Itasca. Yet Captain Glazier would have us believe that above Lake Itasca he found five miles of 'infant Mississippi,' one and a half miles of 'Lake Glazier,' and inlets of the latter reaching a mile or two farther south, — in all, a continuous water-course flowing into Lake Itasca from a point eight or nine

miles about due south from the western arm of that lake. To state the case is to prove its absurdity. So much for Mr. Pearce Giles's latest version of 'Lake Glazier.' HENRY D. HARROWER.

753 Broadway, New York.

Glaciers and glacialists.

Mr. James D. Dana, in *Science* for Aug. 20, says, "the memoirs of the Museum of comparative zoölogy, founded by Mr. Alexander Agassiz, and not by his father." In 1863, Prof. Louis Agassiz got a first grant of ten thousand dollars from the legislature of Massachusetts for the publication of those memoirs. The first paper is by Theodore Lyman, and was issued in March, 1865. The title is "Memoirs of the Museum of comparative zoölogy, at Harvard college," vol. i., Cambridge, 1864–65, 4° ; contents, illustrated catalogue, etc. More than twelve volumes have been issued, the first three during Louis Agassiz's life.

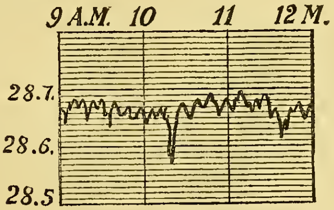
As to the accusation of 'Mr. Marcou's charge against Mr. Alexander Agassiz,' etc., it is almost superfluous — at least for those who have read my paper — to say that I have made no charge of any sort against Mr. Alexander Agassiz, and that his name is not even referred to. JULES MARCOU.

Cambridge, Sept. 11.

[The series was commenced as 'Illustrated catalogue,' and not as 'Memoirs,' each number independently paged ; these numbers were not collected into volumes until after Louis Agassiz's death, when the closing number (9) of the second volume, published in 1876, was entitled 'Memoirs,' and the titles to the first three volumes (the third volume consisted of Nos. 7 and 8) first printed and distributed. — ED.]

Barometer exposure.

In accordance with 'Gan's' suggestion in *Science*, viii. p. 255, I herewith present a copy of the barograph record of Blue Hill observatory for the three hours from 9 A.M. to 12 M. of Feb. 27, 1886.



The barograph from which this is taken is a Draper barograph, and multiplies three times. Its readings usually differ less than one one-hundredth of an inch from the readings of an adjacent standard Hicks barometer, with which its readings are compared every day. The barograph is situated in the lower room of a two-story tower. The air passes freely from this lower to an upper room, through a register-opening. In the top of this upper room is a trap-door opening out on the roof. The roof is flat, with a low turret around it, and the trap-door opens a little to the north of the centre. A picture of the observatory will be found in *Science*, v. p. 440.

The wind movement during the three hours given on the diagram was 55, 60, and 64 miles respectively, as shown by a Draper anemograph. The wind-velocities were quite large all day of the 27th ; and the portion of the curve given in the above diagram is but a sample of the whole barograph curve of that date, only the oscillations at an earlier hour, when the wind-velocity was greater, are more rapid and slightly larger, excepting the sharp depression at 10.20 A.M. This portion of the curve was selected in order to exhibit this sharp depression, which was coincident with the opening of the trap-door in the tower. The barograph was observed immediately before and immediately after the opening of the trap-door. The exact interval between opening the trap-door and observing the barograph is not known, but was probably less than a minute ; and I feel no doubt whatever of the coincidence of the fall of pressure with the opening of the trap-door.

Several similar depressions, though not so decided, because the wind-velocity was less, were noted at a later date, when one observer watched the barograph while another opened the trap-door ; and the fall of pressure coincident with opening the door was undoubted. The depression shown on the diagram at 11.35 A.M. is found to be coincident with a marked increase in the wind's velocity, lasting several minutes, followed by a more permanent increase after noon.

The following note was written on the barograph sheet of the 27th, immediately after it was removed from the instrument : "The sharp depression at 10.20 A.M. was caused by opening hatch on tower ; the other sharp depressions correspond with severe gusts of wind." On this date the up-and-down oscillations of the mercury in the standard Hicks barometer were so rapid that it was almost impossible to set the vernier accurately. Mr. F. V. Pike informs me that he had the same difficulty in reading his standard barometer at Newburyport, Mass. Such oscillations of the barograph as those on the diagram are quite common on Blue Hill. They begin to be noted with wind-velocities of about thirty miles, and increase in range with increased velocity of the wind, though winds from certain directions seem to have more influence in producing them than from other directions. This is probably owing to the position of the apertures. A rapid increase or decrease of the wind's velocity as much as ten miles is, I think, always accompanied here by a corresponding decrease or increase of pressure, which leads me to believe that even small wind-velocities affect the barometer readings ; but the small oscillations spoken of above do not occur, because the difference between the velocity of a gust and of a succeeding lull is not great enough to produce them. I see no reasons for believing that the barometer is any more affected by the wind here than elsewhere. 'Gan's' statement that he found small oscillations of the barograph with wind-velocities of about twenty miles, a similar statement by Mr. E. B. Weston of Providence, R. I., and the statement of Mr. Pike that he had found rapid oscillations of his barometer during the high wind of Feb. 27, convince me that the effect of the wind on the barometer is universal. H. HELM CLAYTON.

Blue Hill meteor. observ., Sept. 23.

These serrations furnished by Mr. Clayton are certainly very extraordinary. It will be noticed that the trap-door is not upon a broad, flat roof, and also that there is only one of the effects which can be regarded as .05 below the general trend of the pressure trace. It seems probable that the barometer suspended by long steel springs has a tendency to magnify the effect. If it can be shown that the total effect here given is due to the actual formation of a partial vacuum produced by the wind blowing across the trap-door, and not to a fault in the barograph, I will accept it. Certainly any such effect as this could have been easily learned long ago by the watching of an ordinary barometer. I have watched the barometer, both mercurial and aneroid, in very high winds, and have never seen any thing at all like this effect. GAN.

Oct. 1.

Constitution of the earth.

Reading yesterday the address of the president at the British association for the advancement of science at the recent meeting in Birmingham, it seemed to me, that, in discussing the geology of the Atlantic and the constitution of the earth, too much is ordinarily attributed to original action of sedimentary deposition.

In the *Scientific American* of June 19, 1885, is a section of the earth on a scale of five inches to its diameter. Upon this, in a greatly exaggerated vertical scale, are figured the heights of mountains and the depths of the ocean. But in a smaller figure the author shows that the thin line used to describe the circumference would, in its thickness alone, include the whole of the departures of the mountain-peaks and deepest seas from the true circle or ellipse which should represent the outline of the globe. If we suppose a five-inch globe of terra-cotta (red and well-burned clay) to be dipped for a few moments into a muddy ditch, when it comes out with a film of water adhering to its surface, this thinnest film filled with animalcules, adhering but so quickly evaporating, will, on this scale, represent all the water contained in all the oceans and lakes; and the small quantity which the slightly porous terra-cotta globe has absorbed will represent a greater quantity of water than all that is contained, or ever has been contained, in the depths and caverns and fissures of the earth itself.

The microscopic Desmidiaceae, Pleurosigmae, wriggling vibriones and bacilli, so well known to modern science, and playing such important parts in life and death of man, will, swimming in the adherent film, be greatly magnified representations of the huge monsters which crawled in the slime of morasses, and swam in the oceans of primeval chaos, when the earth first took form, and ceased to be void. The almost infinitesimal film of water will represent all the water that ever constituted a part of this world in which we live: for science tells us that no violence has ever been able to project a stone beyond the sphere of the earth's attraction, and that no vapor of water, no gas, can float in the thin ether which surrounds or penetrates our fifty miles of atmospheric depth. What part, then, in the constitution and formation and changes of the matter forming the depths of the earth can this very small proportion of water's sedimentary deposits play in the general construction of the globe? To us infinitesimal bodies, the surrounding rocks are immense. Seen from the planet Mars in connection with the whole mass of the earth, what are they? A skin, an envelope, thinner than the model's adhering watery film. Certainly we are more directly interested in the superficial strata which we can see and feel than in the deep masses of which we can learn so little that we speculate as to whether they are solid or fluid without reaching certainty. But the depths in the general plan and constitution of matter far outweigh the surface formations. And fire (for they are certainly hot) has had much more to do in moulding the earth than water and its sediments. M. C. MEIGS.

Washington, D.C., Sept. 25.

The excessive voracity of the female Mantis.

A few days since, I brought a male of Mantis carolina to a friend who had been keeping a solitary female as a pet. Placing them in the same jar, the male, in alarm, endeavored to escape. In a few minutes the female succeeded in grasping him. She first bit off his left front tarsus, and consumed the tibia and femur. Next she gnawed out his left eye. At this the male seemed to realize his proximity to one of the opposite sex, and began to make vain endeavors to mate. The female next ate up his right front leg, and then entirely decapitated him, devouring his head and gnawing into his thorax. Not until she had eaten all of his thorax except about three millimetres, did she stop to rest. All this while the male had continued his vain attempts to obtain entrance at the valvules, and he now succeeded, as she voluntarily spread the parts open, and union took place. She remained quiet for four hours, and the remnant of the male gave occasional signs of life by a movement of one of his remaining tarsi for three hours. The next morning she had entirely rid herself of her spouse, and nothing but his wings remained.

The female was apparently full-fed when the male was placed with her, and had always been plentifully supplied with food.

The extraordinary vitality of the species which permits a fragment of the male to perform the act of impregnation is necessary on account of the rapacity of the female, and it seems to be only by accident that a male ever escapes alive from the embraces of his partner.

Westwood quotes from the *Journal de physique*, 1784, an instance in which the female of the European species — Mantis religiosa — decapitated the male before mating; but I know of no record of a similar occurrence with M. carolina, nor of the further mutilation described above.

Riley, in his 'First monthly report,' p. 151, says, "The female being the strongest and most voracious, the male, in making his advances, has to risk his life many times, and only succeeds in grasping her by slyly and suddenly surprising her; and even then he frequently gets remorselessly devoured."

In Packard's 'Guide,' p. 575, we find, "Professor Sanborn Tenney tells me he has observed the female after sexual union devour the male."

L. O. HOWARD.

Washington, D.C., Sept. 27.

A mummified frog.

My letter which appeared in your issue of Sept. 24, describing the specimen of a mummified Hyla, contained an error, which I here wish to correct. The frog was taken from the McLean county coal-shaft of Illinois, and not of Pennsylvania, as stated, and the newspaper account was published in Burlington, Ill. There is, however, a McLean county in Pennsylvania, and it was through this fact that the slip in question occurred. R. W. SHUFELDT.

Fort Wingate, N. Mex., Sept. 29.

SCIENCE.—SUPPLEMENT.

FRIDAY, OCTOBER 8, 1886.

HISTORY AND POETRY IN GEOGRAPHICAL NAMES.

At a meeting of the Scottish geographical society held the 23d of July, Professor Miklejohn read a paper on the above subject. Professor Miklejohn first reminded his hearers of the poverty-stricken treatment of geography now in vogue in our schools, and after pointing out how geography, if taught intelligently, might be made fresher and of more interest, he treated the special question of his paper as follows : —

Is there any possible source of interest in the mere names which geography presents to us with such irritating profuseness? Do the names themselves constitute one of the tentacles that may catch the attention and entangle the interest of an awakening mind? Will some knowledge of what names really are and mean throw light upon geography, and will geography throw light upon them? For, in any school subject, it is clearly the educational duty of the teacher to employ every possible source of interest, provided this does not compel him to wander from the subject itself. I think we shall find, after a very short inquiry, that there lies in the names alone a most fruitful and legitimate source of interest, and one that lends additional attractions to the study both of geography and history. As things are at present, geographical names are treated as finalities, behind which you cannot go, — as what the old school of philosophers used to call 'ultimate facts,' inquiry into and analysis of which are entirely useless.

Let us see. There was in the beginning of the seventh century a prince of Northumbria in this island, who was very successful in his campaigns, and who pushed his frontier line as far north as the river Forth. He found there a high rock (a hill-fort or *dun*), and to it he gave the name of Dunedin. Later on, the growing city took the Teutonic name of a fortified place (*burg* or *borough*), and was henceforth known to the world as Edwinburgh or Edinburgh. Let us contrast this with a borough in the south, — with *Canterbury*. The name *Canterbury* contains within itself a whole history of England written small. First of all, there is the Celtic prefix *cant*, which seems to be the southern form of the Gaelic *ceann* (a head or point), — names which we find in *Cantmore*, *Cantire*, *Kinross*, and many others. The *t* is an inorganic addition, put there for a rest, as in the Worcestershire *clent* for *glen*. The *er* looks like a quite meaningless suffix to *cant*. But it is far from being only that. It is the pared-down form of an important word, — of the old Anglo-Saxon or Old-English genitive plural *wara*. The full form of *Canterbury*, then, is, *Cantawarabyrig*, or 'the borough of the men of Kent.' The flattening of *Kant* into *Kent* may be compared with that of *bank* into *bench* ; of *Pall Mall* into *pell-mell* ; and of many other doublets. The lighter and easier ending in *y* points to the fact that the southern Teuton got rid of his gutturals at an earlier date than the northern Teuton did; and this fact is recorded in the ending *gh*, which was no doubt sounded in the throat — boroug*h* — up to a comparatively late date in Scotland.

I was travelling in Staffordshire the other day. The name *Stafford* has probably a meaning; but it does not present itself at once to the reader. The train ran along a clear shallow stream, which flowed through green meadows, — a stream called the *Sow* (a name probably the same as that of the *Save*, which runs into the Danube), and the train came to a station on the river, called *Stamford*. Here there was a set of stones, placed at regular distances for crossing the river. The next station was *Stafford*, — the ford where there were no stones, but a *staff* was required for crossing.

There is a little country in the north of Europe — much cut down of late years by the growing encroachments of Germany — which we call *Denmark*. This name looks as final and as meaningless as any ordinary surname we happen to know. But the word *mark* is the name for the germ — the family unit — of Teutonic civilization; and, if we were to follow out its history in Germany and in this country, we should be able to read in it the origin and the rise of local freedom and of municipal liberties. Denmark is the *mark* or *march-land*, or district of the Danes, as Brandenmark is the mark of the Brandenburgers, and Finmark of the Finns. We have the same word softened in *Mercia*, the land which marched with all the other kingdoms of Saxon England, and in *Murcia*, the march-land between the Moorish kingdom of Granada and the other kingdoms of Christian Spain.

These are but a few stray instances of the light that may be thrown upon geographical names by a very slight examination and a little inquiry.

But let us now take a rapid survey of the kinds of names in the United Kingdoms of Great Britain and Ireland, and see what supplies of interest and of illustration lie ready to the hand of the geographical teacher as he introduces his pupils to those places and natural features which fall into the scheme and method of his course of teaching.

We are, first of all, met by the obvious, and indeed salient fact, that the names of most of the natural features — rivers, mountains, and lakes — have been given to them by the old and great but decaying race whom we call Celts. There is hardly a single river-name in the whole of Great Britain that is not Celtic. Men come and go, towns rise and decay; even the sites of the towns disappear and are forgotten: but the old river-names remain — they are more lasting than the names of the eternal hills, just as the rivers are more lasting than the so-called eternal hills themselves. The two commonest words for *water* or *river* are the Celtic words *avon* and *esk* or *uisge*. They were at first generally common nouns. From common nouns they became either proper names or meaningful suffixes; and we find *avon* or *ab*, in all parts of India and Europe, as the name for a stream. There are, I think, thirteen Avons in England alone, five or six in Scotland, and about ten in Ireland. The word itself is cut down and transmuted in the most curious manner. It becomes *Inn* in Fife and in the Tyrol; it becomes a mere *n* in the names of the French rivers Seine, Aisne, and Marne; and it becomes *ana* in the Spanish *Guadiana*, which is our word *avon* with the Moorish or Arabic prefix of *wadi*. In Hindostan the name appears as *ab*, as in the country of the five rivers or *Punjab*, in the country of the two rivers or *Duab*; and, last of all, it appears as *ub* in the *Danube*.

There is, on the other side of the Firth of Forth, a village called *Aberdour*, which means the place at the mouth of the river *Dour*. This last part of the word is the Celtic or Cymric word *der* (water); and this root is found in forty-four names of rivers in Italy, Germany, France, and Britain. There is *Dour* in Fife, in Aberdeen, and in Kent; we find *Doare* in Spain; an *Adour* and a *Durance* in France; and in many parts of England it takes the simple form of *der* at the end of the word, as in *Rother* (the red water), *Calder* (the winding water), in *Dniester*, and in *Derwent* (which means the clear water). To trace the similarity in all of these and many more differences — to find out the underlying identity in the varied diversity — is one of the mental exercises which combine the interest of hunting with the quiet and self-controlled use of the practical judgment, and which we have a right to call, on this account, educational in a very high degree.

Let us take another example of a similar nature. The Gaelic and Erse word for *water* is *uisge*; and this name appears in the most protean forms in several scores, perhaps in hundreds, of river-names in Germany, Italy, France, Spain, Ireland, and Great Britain. The following are only a few of its transmutations: Esk and Ex; Usk, Ugg, and Ux; Ock, Oke, and Ox; Use and Ouse; Ax and Iz; Eska, Esky, and Esker; Oise, Issa, and Issy; Isère and Isar; Isen and Etsch. And many of them give us the names, and with the names the positions, of such towns as Exeter and Exmouth; Axbridge and Axminster; Uxbridge, Oxford, and Bannockburn.

If the teacher knows the old Celtic word for *mountain*, — as, indeed, every one does, — he can go a pretty long way in throwing some light upon some geographical names. Not to insist too much on the historical conclusions drawn from the fact that we find the Gaelic-Celtic form *Ben* in the west and north, while the Cymric-Celtic form *pen* is found only in the east and south, the teacher can point to the identity of *pen* and *ben*, and show how *pen* appears in Pennine and Apennine, in Grampian and Pentland, in Pennigant and Penrith, in the Spanish Pentra and the Greek mountain Pindus. Then, again, we have the same root in *pin* and *pinnacle*, in *pine* and *spine*. The Gaelic form, *Ben* is found in *Benan* (the hill of birds), *Benledi* (the mount of God), *Benvrachie* (the spotted mountain), *Benmore* (the great mountain), and many others.

Again, *Aber* and *Inver* are two dialectic forms of the same word, the *n* in *inver* being probably inorganic. Both words mean 'the mouth of a river.' *Aber* is found repeatedly in Brittany, about fifty times in Wales, about twenty times in middle Scotland, three or four times in England, but never in Ireland. We know the position of such towns as Aberconway, Aberystwith, Aberdeen, Aberwick or Berwick, Aberbrothock or Arbroath, the moment we utter their names; and the same may be said of the towns at the mouths of the Ness, the Leithen, the Aray, and the Ury; that is, Inverness, Innerleithen, Inveraray, and Inverury.

Take another minor point from a Celtic language. *Ard* is the Gaelic for *point* or *height*, and we find it in Ardnamurchan, Ardwich-le-Street (the high town on the great Roman road), and many other names. But if we go down to the south coast of England, — to Hampshire and Devonshire, — we find that a small projecting point used by sailors to land their boats at is called a *hard*, with the southern breathing attached; and the name was most probably left there by the oldest Britons.

If, moreover, the teacher knows that *Llan* and *Kil* mean a church, *Tor* a height, *Innis* or *Ennis* or *Inch* an island or water-girt peninsula; that *Linn* means a pool, as in *London* and *Lincoln;* that *Nant* means a valley, as in *Nantwich,* — if he knows the meaning of these and a few other Celtic words, he can put into the hands of his pupils a key which will enable them to unlock the meaning of hundreds of names, not only in Great Britain and Ireland, but on the continent of Europe.

Let us next take a very quick glance at the earliest Roman contributions to our names of British places. These are only six, and they were given to Britain and British times. They are *castra*, *strata* (*strata via*), *fossa*, *vallum*, *portus*, and *colonia*. One or two examples will be enough for our purpose. There were in early British Britain no roads worthy of the name; and, as soon as the Romans made up their minds to hold this island, they set to work, and drove several splendid roads through it from south to north. First of all, from Richborough, near Dover, they made a road, called *Watling Street*, through Canterbury and London, by Stony Stratford, on to their standing camp on the Dee, — the Castra of the northern Roman army, which is still called simply *Chester*. This road ran on through Westmoreland, across the top of a mountain, which is called *High Street* to this day. Ermin Street ran from London to Lincoln; Icknield Street, from Norwich to Exeter; and there were several other great roads. But the point for the geographical learner is, that these splendid works can still be traced, partly by their actual remains, and partly by the names of the Saxon towns that were of necessity built upon them, and nowhere else. The word *street* enters into the names of these towns in the character either of a suffix or of a prefix. Thus we have Streetham, Stretton, and Stratton; Stretford and Stratford; Chester-le-Street and Ardwich-le-Street; and a great many others.

The corresponding word in Scandinavian languages is *gate*, which is a derivative of *go*, and the Low-German form of the High-German *gasse*. This word, however, we now find restricted to *streets;* that is, roads in towns or cities. Thus Edinburgh has its Cowgate and Canongate; Dundee, its Overgate and Nethergate (which some weak persons wished to change into Victoria Street and Albert Street); York, its Michlegate, Jubbergate, Castlegate, Fishergate, and sixteen others. But the geographical inquirer, looking abroad, finds a much wider application for the word. The name indicates not merely a street in a town, but also a street through lines of hill or cliff; and in this sense we have it in Reigate (which is Ridgegate), Margate, Sandgate, and the Ghauts of India (which are either passes through ranges of hills, or passages down to the banks of the rivers). This by the way.

But the Latin word which contains for us the largest amount of history is *castra*. And it not only contains a great deal of Roman history: it contains also a considerable amount of English history. This word we find generally as a suffix to our names of towns, and we find it in three different forms, — *caster*, *chester*, and *cester*. In the Anglican kingdoms of the north it appears in the form *caster;* in the Saxon kingdoms it takes the form of *chester;* and in Mercia, which was mainly Anglican, but under Saxon influence, we find the intermediate form of *cester*. But in the district north of the Tees, the Saxon form *chester* re-appears; and we find such names as Ribchester, Chesterholm, Rutchester, and others. The two forms *Castor* and *Chester* stand right opposite to each other at one point in England. The river Nen divides Northamptonshire, which is Danish, from Huntingdonshire, which is purely Saxon; and on the opposite banks, standing on either side of the river, we find two villages, both with the same name, but the one called *Castor* and the other *Chesterton*. The main point, however, for the young inquirer to notice, is that all these places were at one time Roman camps; and from the number of these he can himself easily judge as to the military character and social intensity of the Roman occupation.

We now come to the third layer of civilization in this island, — the layer which was deposited by the Teutons, who immigrated into this country from the northern part of the land which we now call Germany. This deposit began to be laid down in Great Britain in the middle of the fifth century; and the character of this contribution to British habits is best indicated by Mr. Isaac Taylor in his 'Words and places.' He says, "England is pre-eminently the land of hedges and enclosures. On a visit to the continent, almost the first thing the tourist notices is the absence of the hedgerows of England. The fields, nay, even the farms, are bounded only by a furrow." And he points to the universally recurring terminations *ton*, *ham*, *worth*, *stoke*, *fold*, *park*, and *bury* — all of which convey the notion of enclosure or protection — as proof of the seclusiveness of character of the Anglo-Saxon, of how strongly "imbued was the nation with the principle of the sacred nature of property, and how eager every man was to possess some spot which he could call his own."

Now, if the learner is armed with the knowledge and the meanings of these words, and with some power of tracking them under their different forms, he has the power of fixing upon the chief Anglo-

Saxon settlements in Britain and in other countries. We have, for example, the name *Haddington*, as the town of the sons of Haddo; *Symington* and *Thankerton; Campbelton* and *Hartington; Boston*, which is St. Botolph's town; *Northampton* and *Southampton;* and many more. But the suffix *ton*, as the most common local termination of our British local names, is worth a little more examination. The word is the Low-German form of the High-German *zaun* (a hedge); and the word *tun* or *ton* meant in the older times a place surrounded by a hedge, or fortified by a palisade. In this sense it indicated a croft, a homestead, or a farm; and this sense it still retains in Scotland. Thus the isolated *ton* might become the nucleus of a village, the village might grow into a town, and the town into a city with millions of inhabitants.

In the same way, a *stoke* is a place stockaded, a place surrounded and guarded by stocks and piles. The word takes the four different forms of *stock, stoke, stow*, and *stol*. We have it in Stockbridge, the suburb at the bridge over the Leith; in Stockholm and Woodstock; in Stoke-upon-Trent; in Stow; and in Bristol, which was in the oldest English *Briegstow*.

Another highly significant suffix is *burgh, borough*, or *bury*, which comes from the old verb *beorgan* (to shelter or cover). The last is the distinctively Saxon form; the two first are Anglican or Norse. But, indeed, the root has spread itself over many countries; and we find it in Spain in the form of Burgos; in France, as *Caesar's burg*, or Cherbourg; in Asia Minor, in the shape of Pergamos. We have it also in Germany in Augsburg (that is, the city of Augustus), in Hapsburg or Habichtsburg (the stronghold of the Austrian hawk), in Edinburgh and in Musselburgh. The forms Shrewsbury, Shedbury, Glastonbury, and other such names, are, as I said, found mostly in the northern parts of Britain. One of the oldest and strongest forms of the root exists in the word *Burgundians*, who were among the first dwellers in burgs, burghs, or fortified towns.

While it is interesting to trace the existence of Anglo-Saxon names in Germany and other parts of the continent, it is curious to find them in considerable numbers in the north-west of France. Mr. Isaac Taylor points out that "in the old French provinces of Picardy and Artois there is a small, well-defined district, about the size of Middlesex, lying between Calais, Boulogne, and St. Omer, and fronting the English coast, in which the name of every village and hamlet is of the pure Anglo-Saxon type." The French people, we know, have a marvellous knack of contorting English words; and we have seen in their languages such forms — which cannot be called *parcè detorta* — as *redingote, doggart*, and *boule-dogue*. In the same way, in this north-western French district, we find the English names *Holbeach, Warwick, Applegarth, Sandgate*, and *Windmill*, appearing as *Hollebecque, Werwich, Appegarles, Sangatte*, and *Wimille*.

Passing from names of towns to names of counties and kingdoms, it gives some indication of the past history of the island to find that Cumberland is the land of the Cymry; that Sussex, Essex, Wessex, and Middlesex were the kingdoms of the south, east, west, and central Saxons; that Surrey was the Sodereye, or south realm; and that Cornwall or Cornwales was the kingdom of the Welsh or strangers, who dwelt on the *horn* or peninsula.

The word *Welsh*, which appears as a word, as a prefix, and as a suffix, is one of considerable importance in the history and the geography of Europe. All Teutonic peoples call other nations by the general name of foreigners, *wealhas, Wälsch*, or Welshmen. In this sense England has its Wales, and, indeed, two of them; France has its Wales; Germany has its Wales; and so has Scotland and even Ireland. The word appears in many forms. In German and in English it is found as *wal* in *wallen* (to wander) and *Waller* (a pilgrim); in *walk*, in *walnut*, and other names. A German calls French beans *Welsh beans*, and speaks of going into France or Italy as going into Welshland. The Bernese Oberlander calls the French-speaking canton that lies to the south of him *Wallis;* and the Celts of Flanders are called *Walloons* by their Teutonic neighbors. *Walloons* probably means 'very great strangers indeed;' just as *balloon* is a big ball, while *ballot* is a little ball. In Old English, Cornwall was called *Cornwales*, the country inhabited by the Welsh of the Horn.

The fourth deposit of local names was made by the next horde of incursionists who made their way to these shores from the continent. The Northmen, Norsemen, or Normans have left their mark on many parts of Scotland, England, and Ireland.

One of the most striking tokens of their visit is contained in the fact that we call the north-east corner of this island by the name of *Sutherland*. Such a name must evidently have been given by a people — a conquering people — who lived to the north of Great Britain. And this was so. Sutherland was the mainland to the south of the great jarldom of Orkney. Here, accordingly, we find the Norse names for *island, town, valley*, and *farm*, — *oe* in Thurso, *Wick, dale* in Helmsdale, and *saetir* or *stir*. In the Shetlands every local name, without one exception, is Norwegian. We have *Sanda* (the sand island), *Stronsa* (the island in the stream or current), *Westra* (the western island), etc. The Norsemen called the Orkneys the *Nordreyjar;* the Hebrides, the Southern Islands or *Sudreyjar*, a name which has been compressed into the odd dissyllable *Sodor*. The two sees of the Sudreyjar and the Isle of Man were combined in the twelfth century, and put under the Archbishop of Trondjhem, who appointed the Bishops of Sodor and Man down even to the middle of the fourteenth century. But, more, the enormous number of Norse names bears witness to the fact that the Shetlands, the Orkneys, the Hebrides, and the Isle of Man were not most useful dependencies of the Scottish crown, but jarldoms attached to the kingdom of Norway. And this was the case down to 1266. The test-word for the Norse settlements in Great Britain is the ending *by*. This appears in our language as *byre* (a cow-house), and in France as *bue* or *boeuf*. In the Danelagh, which lay between Watling Street and the river Tees, the suffix *by* has pushed out the Saxon *ton* and *ham;* and to the north of Watling Street we find six hundred instances of its occurrence, while to the south there is scarcely one. In Lincolnshire alone there are a hundred names of towns and villages which end in *by*. We find this ending in hundreds of names in Jutland and in Schleswig: in the whole of Germany there are not six. In Scotland we have the names *Lockerby* and *Canonby*, both in Dumfriesshire; in England we have *Grimsby*, *Whitby*, *Derby*, and many more; in Wales we have *Tenby*, and many other Norse names on the fiords that branch out of Milford Haven; while in France — that is, in Normandy — we have *Criqueboeuf* (or crooked town), *Marboeuf* (or market town), *Quitteboeuf* (or Whitby), *Elboeuf* (or old town), and many others.

The Norsemen have left their names on our capes, our arms of the sea, and our islands, as well as on our towns. *Ness* or *naze* is their favorite word for *cape;* and we have it in Fifeness, Sheerness, Foulness, Whiteness; the Naze in Essex; Dungeness, or Cape of Danger; Skipness, or Ship-Headland; Blancnez and Grisnez, on the coast of France; and a great many more. A *ford*, or fiord, is the Norwegian name for an arm of the sea up which ships can go, just as *ford* is the Saxon name for a passage across a river for men or for cattle. Both words come from the old verb *faran* (to go), the root of which word is found in *far*, *fare*, *welfare*, *fieldfare*, etc. We find the Norse meaning of *ford* in Wexford, Waterford, and Carlingford, in Ireland; in Milford and Haverford, in Wales; and in Deptford (the 'deep reach') on the Thames, and Oxford in England. Besides the Norse names for islands which we find in Scotland, in Thurso and Staffa (which is the island of staves), we can discover many in England, generally with the spelling *ea* or *y*. Thus Anglesea is the Angles' Island; Battersea, St. Peter's Isle, in the Thames; Chelsea, the isle of chesel or shingle; and Ely is the Isle of Eels. But the most common form of this Norse word is simply *a*, and it is found in greatest abundance in Scotland. The Norse vikings were in the habit of retiring to one of the small islets off the coast during the winter months; and, when summer returned, they issued forth from them to resume their piratical cruises. These small islands still bear Norse names, while the local names on the mainland are Celtic. We have scores of those names ending in *a*, as Scarba, Barra, Ulva, Jura, Isla, Ailsa, Rona, etc.

Just as we saw that *ford* had two meanings, — one from its Norse, the other from its Saxon users, — so the name *Wick* has two meanings, each testifying to the different habits of the two nations. With the Saxon a *wick* was an abode on land, — a house or a village; with the Norsemen it was a station for ships, — a creek, an islet, or bay. The Norse vikings, or 'creekers,' lay in the *vicks* or *wicks* they had chosen, and sallied out when they saw a chance of a prize. The inland *wicks* are Saxon, and the abodes of peaceful settlers; the Norse *wicks* fringe our coasts, and were the stations of pirates. Of the latter kind we have Wick, in Caithness; Lerwick; Wyke, near Portland; Alnwick, Berwick, in Northumberland and Sussex; and Smerwick, or Butter Bay, in Ireland.

The parliaments of the Norsemen were called *things*, and this name they have left in several parts of Great Britain. A small assembly was a *Housething*, — a word we have in our own *hustings;* a general assembly of the people was an *Althing;* and the Norwegian parliament is to this day called the *Storthing*, or great council. These *things* met in some secluded spot, — on a hill, an island, or a promontory, — where no one could disturb the members. In the Shetland Isles we find the names *Sandsthing*, *Delting*, *Nesting*, etc., — the seats of local *things;* while the spot for the general council of the island was called *Tingwall*. In Ross-shire, too, we find a *Dingwall*, and in Cheshire a *Thingwall*. In Essex the word takes the softened and flattened Saxon form of *Dengewell*. In the Isle of Man the meeting-place was called *Tynwald Hill;* and the old Norse *thing* (name and thing) has survived, without a break in its existence, since the time of the Old Norse kings, but the institution has died out in Iceland and in Denmark. The Three Estates of the Isle of Man meet every year on Tynwald Hill, and no laws are valid in the island until they have been duly proclaimed from the summit.

We can, moreover, trace the identity of the Norwegian occupation by the number of local Norse names, and the contrasts are sufficiently striking. In Lincolnshire there are about three hundred Norse names; in Yorkshire, about three hundred; in Bedford and in Warwickshire, only half a dozen.

So much for history in our local names, and one might have easily said a hundred times as much on the subject. But there is interest, for both young and older hearers, in details and in points that are of much smaller importance.

The open-eyed and open-minded teacher, who is always on the lookout for whatever will bring into connection and interest with his lessons, will not disdain even the slight assistance he will gain from the relative positions of places, and the names that have come from this. He tells his pupils, for example, that another name for the German Ocean is the North Sea; but he will surely go a step further than this, and show him that there is a South Sea also, which the Dutch call Zuyder Zee. Another step, and he will point out that the Germans call the Baltic the East Sea, and that the West Sea must of necessity be the Atlantic. In the same way, the Weser or Veser is the West River. In China this use of names of direction seems to reach its height: for there we have Pekin and Nankin, the northern and southern coasts; Peling and Nanling, the northern and southern mountains; Peho and Nanho, the northern and southern rivers; and Nanhai, the Southern Sea.

Even the simple epithets *old* and *new* lend some interest to the teacher's work in geography. The word *old* takes many forms: it appears as *alt*, *elt*, *al*, and *ald*, in Althorp, Eltham, Albury, Aldborough. *New* is an epithet, which, like every other thing on earth, must itself grow old. Thus New Forest is one of the oldest forests in Great Britain; New college is one of the oldest colleges in Oxford, for it was founded in 1386; New Palace Yard, in Westminster, dates from the eleventh century; and the fifty-two New Streets in London are among the oldest in that vast wilderness of houses. There are in England 120 villages with the name of *Newton*, 10 towns called *Newcastle*, and 17 called *Newbiggen*. It is interesting, too, to observe the forms that the word *new* may take; as *Neuf* in Neufchatel, *Nov* in Novgorod, *Ne* in Neville, and *Na* in Naples or Neapolis.

Color, too, gives some interest to our geographical names. Thus Cape Verde is 'the cape fringed with green palms.' The local name for the Indus is the *Nilab* (or Blue River); and the mountains in the south of India are called the *Nilgherrie* (or Blue Mountains), — a name which we find also in Virginia. The city of Atria or Adria, from which the Adriatic took its name, is 'the black town,' because it was built upon the black mud brought down by the Padus. The Himálaya, or, as we call the range, the Himaláya, is 'the abode of snow;' and Lebanon means 'the white mountain.' The word *Apennines* means 'the white heads;' Mont Blanc, Sierra Nevada, Ben Nevis, Snowdon, Sneehalten, Snaefell, and many other mountains, all have the same meaning. The word *alp* itself, being a form of *albus*, gives us the same indication; and connected with it are Albania, Albion, and Albany, which was the old name of Scotland.

With pupils of a more advanced age, it would be useful to show the identity of the Hindostani *abad* and the Hebrew *beta* with the English *bottle* (we have it in Newbattle and Bothwell) and *bold*, with the Slavonic *Buda*, and with the Cymric *bod* in Bodmin and Boscawen. Allahabad is 'the house of Allah;' Bethany, 'the house of dates;' Bethlehem, 'the house of bread;' and Bethel, 'the house of God.'

We have seen that names throw light upon history, and that history throws light upon names; but names also throw light upon physical changes, and on the variations of climate that have taken place in this island. Thus we have in different parts of England places and parts of towns called *Vineyard*, where no vines can nowadays grow. Mr. Thompson, the eminent gardener, tells us that when he was a boy the island of Mull had many orchards of excellent apples, while now the whole surface of the island is not adequate to the production of a single eatable apple. He tells us, too, that at Hatfield, near London, — the seat of Lord Salisbury, — there used to be fourteen hundred standard vines, which produced the grapes that found the house in its supplies of wine; whereas now there is not a single grape produced except under glass. The name *vineyard* in Britain is therefore nowadays a name, and nothing more.

There is, not far from Loch Maree, in Ross-shire, a farm that bears the name of *Kinloch Ewe*; that is, the head of Loch Ewe. But Loch Maree, or Mary's Loch, was, geologists tell us, at one time only one of the upper reaches of Loch Ewe; and this conclusion of geologists is borne out by the name *Kinloch Ewe*, which is not on Loch Ewe at all, but about a mile above the upper end of Loch Maree. But there can be no doubt that this farm marks the point to which the older Loch Ewe at one time extended.

Local names, too, give us evidence of animals that are now extinct in this island. The existence of the wolf and the bear in England is marked by such names as *Wolfeslow* in Herefordshire, and *Barnwood* in Gloucestershire. The wild boar, or eofer, was found at Eversley, Evershot, and Everton; and the presence of the beaver is indicated by such names as *Beverly*, *Beverstone*, and *Bevercoates*.

Changes in our customs, too, are to be traced in old names. Two of the strongest marks of the importance of a town are to be found in the existence of a market, or the possession of a bridge over the neighboring stream. The Old-English verb *ceapian* (to buy) gives us the words *cheap*, *goodcheap*, *dogcheap*, *chapman*, *chaffer*, *horse-couper*, and *chop;* and it also gives us the prefixes *chipping*, *chep*, and *kippen*. Cheapside and Eastcheap were the old market-places of London; and into Cheapside, even to this day, run Bread Street (where Milton was born), Milk Street, and the Poultry. In the north of Europe we find Copenhagen, which means 'Chipping or Market Haven;' Nordkioping, which means 'North Market;' and many others.

Even the mistakes in names are full of suggestion. The readers of Sir Walter Scott's 'Pirate' know Fitful Head in Shetland as the abode of Norna. But Fitful Head, though a quite appropriate name, is a mere corruption, undoubtedly by mistake of the old Scandinavian name *Hvit-fell* (or White Hill). Cape Wrath, again, has in its oldest meaning nothing to do with storm, but, in its old Norse form of *Cape Hvarf*, simply indicates a turning-point, — the point where the land trends in a new direction; and it contains the same root as the words *wharf* and *Antwerp*.

Many similar corruptions are to be found in England. The walk from Buckingham Palace to Westminster is now called *Birdcage Walk*, which is only a meaningful corruption of *Bocage Walk; Chateau Vert*, in Oxfordshire and in Kent, has been altered into *Shotover Hill*, and a legend about Robin Hood and Little John has been attached; *Beau Lieu*, in Monmouthshire, has grown into *Bewley; Grand Pont*, in Cornwall, into *Grampound;* and *Bon Gué* (the good ford), in Suffolk, has been, too, naturalized into *Bungay*.

So far, we have seen that history and philology become the loyal servants of the teacher. Shall we be able to say the same of poetry? How shall the most brilliant outcome of the human intellect, the most inspired expression of the mind, the product of the noblest faculties, strengthened by and intertwisted with the deepest emotion, help our much study of the world?

To some extent it has already done so. Longfellow has produced for us a geographical library in thirty-two volumes, which he calls 'Poems of places.' Four of them have been republished by Messrs. Macmillan & Co. in this country; but the whole thirty-two volumes ought to be in the library of every large school and college. Such a collection contains, and must contain, a great deal of what is good, of what is indifferent; and we know that neither gods nor nor men columns tolerate the indifferent in poetry.

But let us choose that which is good, and hold fast to it. How does Longfellow introduce Edinburgh to us? We who know the city, and have loved it long, know that it is a poet's dream in stone, watched by the everlasting hills, looked in upon by the eternally-during sea, bowered in trees, intermingled with rocks and crags and cliffs, and possessing a history that no taint of doubt or cowardice has ever sullied.

How does Burns describe this world-famous city? —

"Edina, Scotia's darling seat,
All hail thy palaces and towers,
Where once beneath a monarch's feet
Sat Legislation's sovereign powers!
. . . .
"Thy sons, Edina, social, kind,
With open hand the stranger hail;
Their views enlarged, their liberal mind,
Above the narrow, rural vale."

Sir Walter Scott sings of the city in other scenes, and with the thought of war in his mind: —

"Nor dream that from thy fenceless throne
Strength and security are flown;
Still, as of yore, queen of the north,
Still canst thou send thy children forth.
Ne'er readier at alarm bell's call
Thy burghers rose to man thy wall,
Than now, in danger, shall be thine,
Thy dauntless voluntary line;
For fosse and turret proud to stand,
Their breasts the bulwarks of the land."

Not inferior are the lines of Alexander Smith, whom many of us still remember: —

"Edina, high in heaven wan,
Towered, templed, Metropolitan,
Waited upon by hills,
River, and widespread ocean, tinged
By April light, or draped and fringed
As April vapor wills,
Thou hangest, like a Cyclop's dream,
High in the shifting weather-gleam.
"Fair art thou, when above thy head
The mistless firmament is spread;
But when the twilight's screen
Draws glimmering round thy towers and spires,
And thy lone bridge, uncrowned by fires,
Hangs in the dim ravine,
Thou art a very Persian tale, —
Or Mirza's vision, Bagdad's vale."

Not less true, not less adequate, is the sonnet written by A. H. Hallam, the early-lost friend, in sorrow for whom Tennyson wrote his 'In memoriam:' —

"Even thus, methinks, a city reared should be —
Yea, an imperial city, that might hold
Five times a hundred noble towns in fee,
And either with the might of Babel old,
Or the rich Roman pomp of empery,
Might stand compare, highest in arts unrolled,
Highest in arms: brave tenement for the free,
Who never crouch to thrones, or sin for gold,

> *Thus* should her towers be raised, — with vicinage
> Of clear bold hills, that curve her very streets,
> As if to vindicate, 'mid choicest seats
> Of Art, abiding Nature's majesty;
> And the broad sea beyond, in calm or rage,
> Chainless alike, and teaching liberty."

But this side of the question would carry us too far. What I am driving at is a humbler aim. All through this statement I have been trying to insinuate, —to suggest that the teacher should bring into all his lessons on geography the maximum of connection; that he should try to make the map *live* before his pupils; that in education, as in a statue, there should be no dead matter; and that the satisfaction of the day's curiosity, or mental appetite, should be followed by the growth of a stronger appetite still. I think that we who live in this latter part of the nineteenth century may congratulate ourselves on the immense amount of young active intellect that has thrown itself into education, and on the better methods that, with this youth and activity, have been imported into our schoolrooms. It is not so long ago that boys were kept for years over the *As in praesenti* and the *Propria quae maribus* before they were able to form a first-hand acquaintance with even the easiest Latin author: nowadays a boy does not learn a new word or a new inflection without being asked at once to build his new knowledge into an interesting sentence. Not long ago children were taught lists of names without seeing a picture, a diagram, a model, or a map, and this was called geography: now we have the geographical societies, both of Edinburgh and of London, working steadily for them, and showing them all that there is of beautiful and wonderful, and strange and thoughtful, in the life of man upon this remarkable planet.

Another point before I have done. The path of education is the path of discovery; it is not the dead-beaten road upon which you can sow no new seed, it is not the region of the second-hand, the fossilized thought, the mere traditionary and repetitional idea. If, then, the teacher is to make those old times live again, — those old times that have left ineffaceable marks in our names of places, just as the underlying rocks have left traces of themselves in our soil, — he must excite the curiosity of his pupils, and set them hunting for new examples of old names; must ask them to find the old in the new, and the new in the old. It is as true of education as of life, — and the one is only an epitome and compressed symbol of the other, — that for us all it is

> "Glad sight whenever new and old
> Are joined through some dear home-born tie:
> The life of all that we behold
> Depends upon this mystery."

The passion of hunting is the strongest passion in human nature: can we gratify this passion in the schoolroom? I think we can; and geography is one of the happy hunting-grounds in which we may be able to gratify it.

Dr. Charles A. Powers of New York contributes an article to the *Medical record*, giving the results of his treatment of twenty-one cases of injury by the toy pistol, and states that two deaths this year from this cause have come to his knowledge. In by far the greater number of cases the palm of the hand was the seat of the injury, although some had received injuries to the fingers, the eyelid, or the abdominal wall. The wounds varied in depth from one-quarter of an inch to two inches, and were due to wads from the blank cartridges or to pieces of the percussion caps which were blown into the tissues. The injured parts became inflamed, pus formed, and in many cases a septic condition of the blood followed, eventuating in some cases in tetanus and death.

— The official returns of the minister of education in Prussia show that the number of students in philology, philosophy, and history, in this home of the philosophical sciences, has been steadily declining from Michaelmas, 1881, to Easter, 1885; the numbers for the six sessions being 2,522, 2,535, 2,504, 2,398, 2,311, 2,258, 2,181. In three years and a half the decline in the number of philosophical students is thus fourteen per cent.

— Instances are not infrequently recorded in medical journals of the passage of needles and pins from one part of the body to another. In a recent case a needle one inch and a quarter long, which had been swallowed some months before, was removed from the arm of a bricklayer.

— A woman in Russia recently consulted a physician on account of a peculiar deformity from which she suffered. It consisted of a projection at the lower end of the spine which formed a tail two inches long, and half an inch wide. It contained two vertebrae, and these were covered with fat, hair, and skin.

— Russian newspapers state that prospects are good for the speedy construction of a canal between the White Sea and Lake Onega, thus affording water communication between the White and Baltic seas.

— John Ericsson, the well-known inventor, who is now eighty-three years of age, is still hale and hearty, and works as steadily, and as many hours per day, as he did twenty years ago.

SCIENCE.

FRIDAY, OCTOBER 15, 1886.

COMMENT AND CRITICISM.

SCHOOLS FOR THE TRAINING of nurses are being organized in every city, and the value of such skilled help is being more and more appreciated by the physician, who, in his busy professional life, cannot make the observations as to the temperature, pulse, and respiration of his patient as often as he would like, or as the welfare of the patient demands. In all these methods, nurses are now trained, and their services are well-nigh indispensable. A trained nurse is, however, an expensive luxury, three dollars a day being the usual price paid them; so that only the rich can enjoy their educated aid. What is greatly needed in our cities is an organization which will supply such succor to the poor, by whom such services are in reality more needed than by the rich. Every physician whose practice has taken him into tenement-houses has felt the great need of some one to nurse his patients, when, through ignorance or poverty, neither they nor their friends can do any thing to aid him. In Philadelphia a district nurse society has been formed for the care of the sick poor who cannot be sent to the hospital. A trained nurse is provided by this society to visit and attend the sick. Bed-linen and other necessaries are also furnished. For these services a charge of five cents a day is made, except when the patient or his relatives cannot afford to pay any thing, in which case every thing is furnished without recompense. The motive which underlies this system is an admirable one, and we shall watch the working of the plan with great interest.

THE BEST METHOD for the disposal of garbage has been a subject of discussion among sanitarians for many years. There is no one system which is equally applicable to all places. In small villages it may with safety be utilized as food for hogs, if proper facilities for the keeping of these animals exist; but, where there is a population of any considerable magnitude, pig-keeping should be discouraged, and, if need be, prohibited. In small families the kitchen refuse can be burned in the range; but in large families, hotels and restaurants, this method of garbage disposal is usually not feasible. Under such circumstances, it must be removed from the house; and this is properly the work of the municipal authorities. Boston has undoubtedly the best system for this purpose; but this is in a large measure due to the favorable construction of the city, by which each block or square is divided by an alley-way, into which the garbage-collector can go, and remove the refuse from the rear of the buildings, and thus avoid carrying the offensive material through the dwelling. In New York and Brooklyn such an arrangement of streets does not exist, and the garbage must therefore be brought through the hallways of the houses. In New York garbage and ashes are placed in the same receptacle, and removed together. In Brooklyn they are removed separately. One of the most disagreeable sights in these two cities is the long line of ash-barrels which line the streets on 'ash days.' Brooklyn is about to make this still more disagreeable by compelling the householder to place his garbage-vessel, usually a soap-box or a tin pan, on the sidewalk in front of his dwelling, there to remain until the proverbially dilatory 'swill-man' comes along to collect it. As this is to be done twice and three times a week, according to the season, the Brooklyn streets will be any thing but attractive to the foot-passenger. There can certainly be but one advantage claimed for this plan, and that is the reduced cost; but, unless we are much mistaken, the nuisance which will result will make a change imperative.

WE HAVE ALREADY REFERRED to the new objective invented by Professor Abbé of Jena. The German government appropriated fifteen thousand dollars for experimental purposes; and after five years of work, Professor Abbé produced this new objective, which, it is claimed, more perfectly corrects spherical and chromatic observation than any hitherto manufactured. Some of the lenses in the combination are of siliceous glass, while the others contain borax and phosphorus. The mechanical part of the work was done by Zeiss. We extract the following description of the objective from the *Journal de micrographie*, by Dr. van Heurck: "The objective is homogeneous immersion, of a focal distance of three millimetres, or about one-eighth English measurement. It is not arranged for cover-glass correction, as this is not necessary, that function being obtained by means of the sliding tube of the body. It contains five lenses, and has a numerical aperture of 1.4, which is a trifle less than has been obtained in England and America (1.5); but, so far as its optical qualities are concerned, it is far superior to any thing ever before made, the new glass permitting the absolute correction of all aberrations. The field is perfectly flat, the minutest object in the extreme edge of the field showing as sharply and clearly as though it were in the centre. With the vertical illuminator, an amphipleura (silvered) is resolved into pearls, — not merely in spots, but over the entire frustule, — and with such clearness that these pearls can be counted. In the study of other diatoms, I have found details which have hitherto escaped notice. As to the bacteria, details of structure are shown that have never before been seen, — details that will without doubt serve to differentiate them by ocular means. Accompanying the objective are three eye-pieces, — two for direct use, and one for photography. They are also made of the new glass and by entirely new formulae."

THE HEALTH COMMISSIONER of Chicago has prohibited the removal of milk from the cow-stables of that city which are infected with contagious pleuro-pneumonia. As was to be expected, the owners rebel, and, unless closely watched, will doubtless smuggle the milk into the market. The New York health authorities are inspecting the beef which comes to the city from Chicago in refrigerator-cars. Thus far no unwholesome meat has been detected. This inspection is of value, as some carcasses may be so diseased as to be detected; but unless the inspection is made at the slaughter-houses, where the viscera can also be examined, no guaranty can be given that the meat is that of a healthy animal. The last report indicated that three thousand animals were under quarantine in Chicago.

THE RECENT DEATH of two persons in a New York hotel from the inhalation of illuminating-gas draws attention again to the dangers connected with this service. Just how the accident occurred has not yet been satisfactorily explained; but it is probable, that, as the victims were city residents, they did not resort to the method of extinguishing the light usually adopted by strangers from the country, namely, by blowing it out. It is more than likely that the flame was a small one, which was either blown out by a current of air, or extinguished by a change of pressure within the pipes. In many occupied buildings the old-fashioned gas-cocks, those without stops, still exist; and it not infrequently happens, that, by an incomplete closure of the outlet, gas escapes into the room, sometimes to a dangerous degree. It would be a valuable improvement in the management of our cities and towns, if it was made the duty of some of the municipal departments to periodically inspect the gas pipes and fixtures of all buildings occupied as residences, with power to compel the owners to provide the most perfect apparatus, or, failing so to do, to be liable to a fine, which could be used by the authorities to do the necessary work themselves. In recent years valuable laws have been passed, regulating the construction and drainage of dwellings, and the same supervision could be advantageously exercised over the arrangement and quality of the gas-pipes and faucets.

THE GERMAN ASSOCIATION OF NATURALISTS AND PHYSICIANS.

THE meetings of the Association of German naturalists and physicians closed this afternoon, very successful according to German, but hardly so according to American notions. The association is a curiosity in itself: for although it now has held its fifty-ninth meeting, and has been in existence since 1822, it has no permanency whatever, but dissolves at the close of every meeting, after it has appointed a president, a vice-president, and a secretary for the next year, and has selected the next meeting-place, which must be the residence of the first and third officer. Into the hands of these gentlemen is given every thing pertaining to the following gathering, which always commences on Sept. 18. The Association of German naturalists and physicians has no corporate existence, owns no property whatever, and meets for the avowed purpose of facilitating acquaintances among the members. Scientific discussions are of secondary importance. For instance: that which a section apparently considers first is, "Where shall we drink our *Früh-schoppen*, and which shall be our *Stamm-kneipe?*" And in the 'Stamm-kneipe,' behind the beer-glass, discussions are held often more profound than those at the official meetings. The advocates of the often-quoted assertion that beer is always injurious will have to acknowledge themselves defeated, when they see about five thousand professors, doctors, and students, who gathered here during the past week, all hale and hearty, although many of ripe old age, all of whom drink beer in larger or smaller quantities ; and as for the statement that he who 'drinks beer thinks beer,' it is a well-known fact that German thought leads the world in more than one branch of science.

Every naturalist and every physician who has published something in scientific or in medical journals is eligible to membership on the payment of a certain fee : here in Berlin it was placed at fifteen marks. Those who are interested in science, but have not published any thing, can, on payment of the same sum, become associates, but not members ; i.e., they are entitled to attend all meetings and entertainments, but are not allowed to vote. No election of members is held : only a simple announcement of the facts, and payment of the fees, are needed to obtain a membership card ; and so great and so just is the confidence which these gentlemen place in the applicants' honesty, that cases where membership certificates have been obtained under false pretences are so very few during all these years, that they can be ignored entirely.

The sections, to the number of thirty, have no permanent officers. At every meeting a chairman and a secretary are elected, although the latter generally remains in office during the whole week, because it is his duty to make the necessary report, and collect the abstracts of the papers read before the section, for the 'Tageblatt' of the next day. This Tageblatt is a very commendable institution, and takes the place of the 'Daily programmes' of the American association in a very decidedly improved form. It is issued every morning, at about nine o'clock, and contains the membership list, announcements, programme of the day, and *abstracts of all the papers read before all the sections* on the preceding day. This year's Tageblatt forms a small quarto volume of four hundred pages.

The registry shows 2,214 members, 1,914 associates, and 1,475 ladies, who are classed by themselves. The position of the ladies in the Association of German naturalists and physicians can, in part at least, be defined by the reproduction of a short abstract from one of the numbers of the Tageblatt : —

"His majesty the emperor has been pleased to order a special performance at the Royal opera, as well as at the Royal theatre, exclusively for the entertainment of the Association of German naturalists and physicians. . . . Ladies are not admitted !"

In view of the large numbers present, there was nothing wrong in this decree, according to German notions at least ; but in view of the fact that at least one-third of the members were natives of Berlin, who could have visited either of the theatres at any other time, it would have been more just if these gentlemen had been excluded. But they were all there as 'invited guests of the emperor' (nothing small, indeed) ; and many of those who had perhaps travelled from the farthest point of Germany had to take a back seat, and, in addition, leave their wives at the hotels or stay away altogether.

The large number of social entertainments furnished by the local committee as well as by the city government were as complete and elaborate as possible. Excursions, exhibitions, regattas, suppers, balls, etc., gave an abundant opportunity to comply with § 2 of the very short constitution : "The aim of the association is to offer an opportunity to the naturalists and physicians of Germany to form a personal acquaintance."

Pohlman.

THE MOUNTING OF MUNGO.

The common practice in mounting large mammals is to first make the legs, and, having fastened them securely to a backbone of plank, to pack the remainder of the body with loose filling. While this does well enough for long-haired animals, whose muscles are concealed, for those that are scantily clad some other methods must be adopted in order to reproduce correctly form and features.

To build up an animal that will be lank and flabby is the height of taxidermic art, and a brief description of the manner in which the elephant Mungo was mounted at the national museum will show the methods by which such results may be obtained.

Mungo was an African elephant about six years old, belonging to Forepaugh's menagerie, that thoughtfully selected Washington as the place of his demise. Mr. William T. Hornaday, the distinguished taxidermist, saw in this event an opportunity of putting the new principles of mounting into practice.

The first step in the process of mounting was to take a series of careful measurements of the body, showing its length, height, and girth at various points, and the dimensions of the limbs and the trunk. These were supplemented by sundry drawings, and by plaster casts of the head and of the limbs of one side. The more care was necessary in this, owing to the fact that the entire skeleton was to be mounted separately, and thus no guide left to the position of the joints. This done, the skin was removed, and transferred to a bath

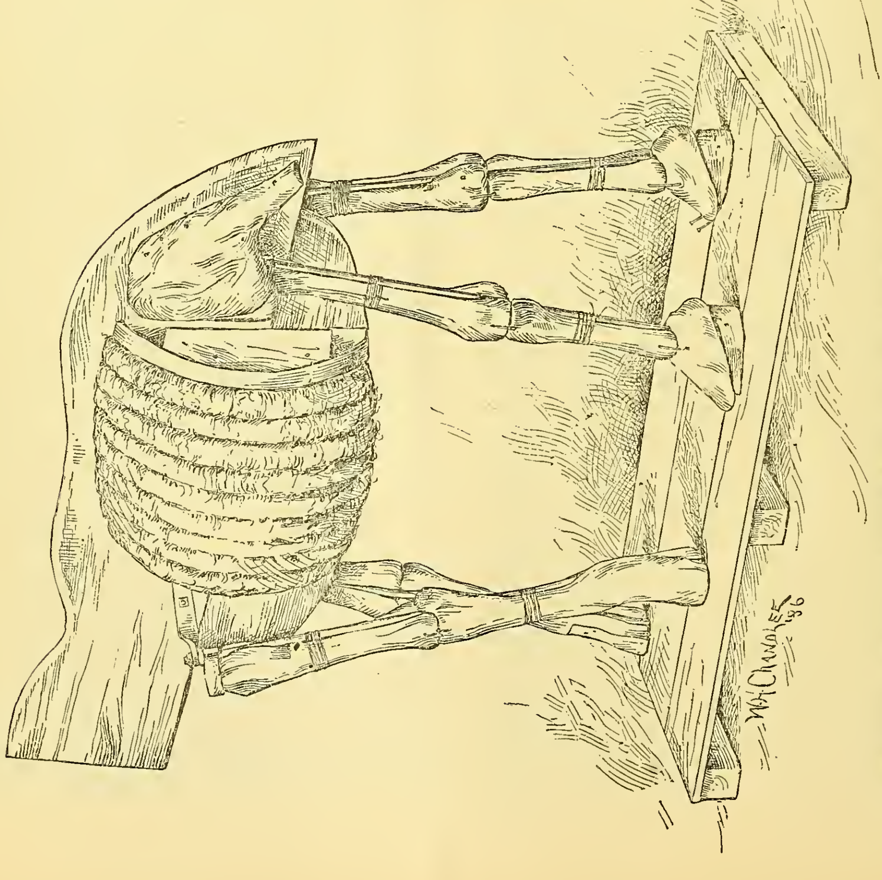


Fig. 1.—Skeleton of wood and iron for Mungo, the body wrapped with ropes of tow.

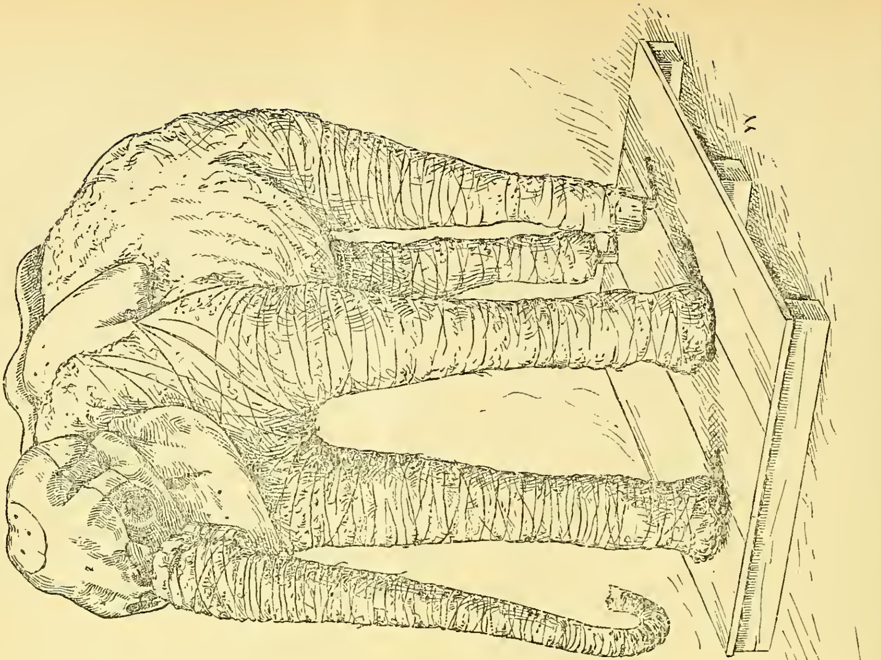


Fig. 2.—Skull, backbone, and scapula of wood, and wrapping of excelsior.

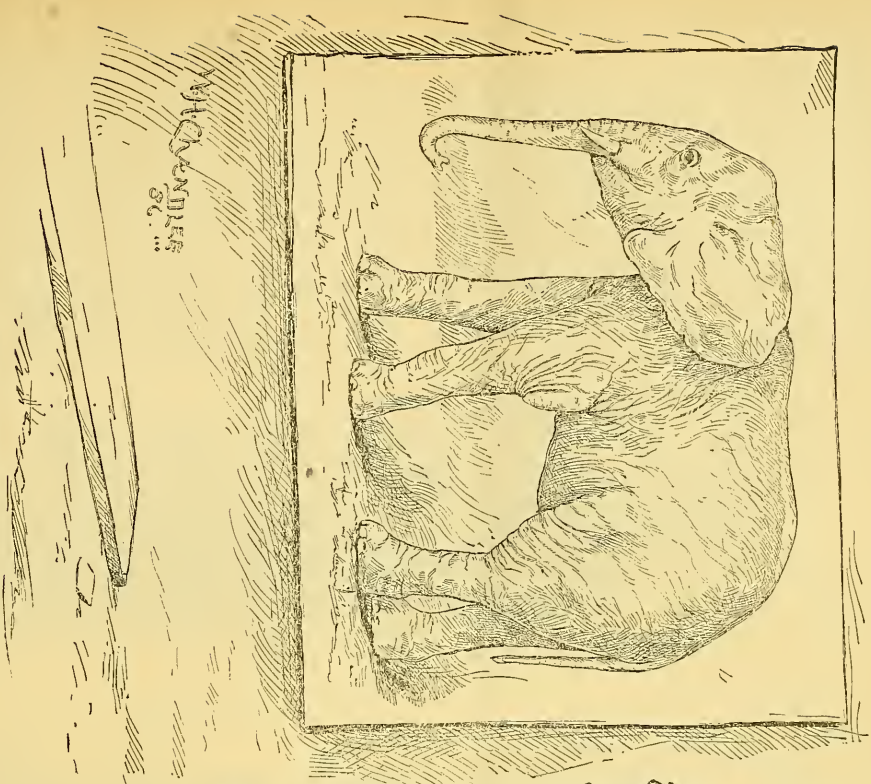


FIG. 4.—MUNGO FINISHED.

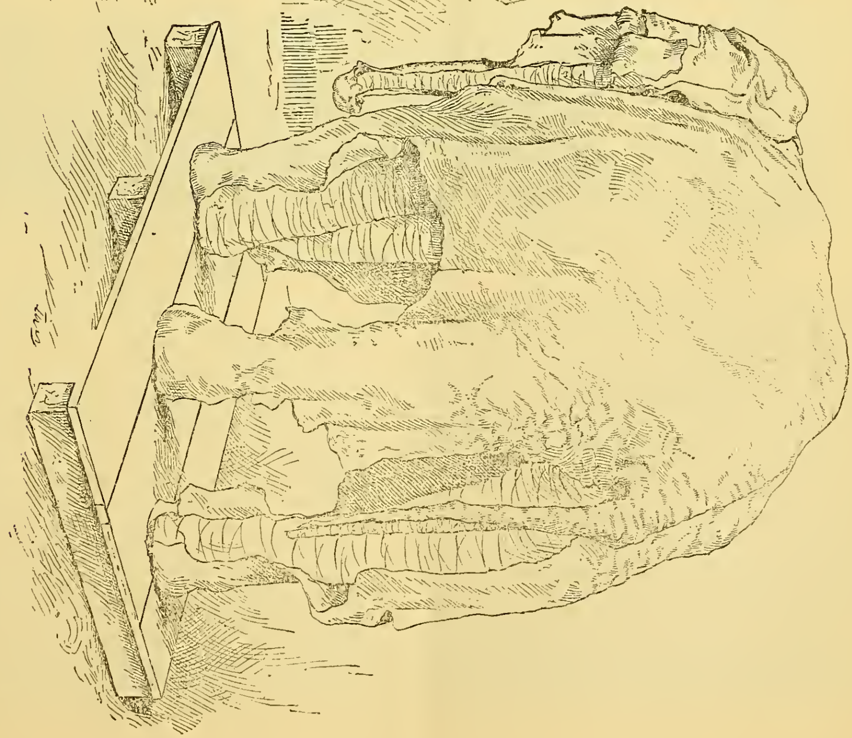


FIG. 3.—TRYING ON THE SKIN.

of salt and alum, there to lie until its false body should be ready.

The backbone of this false body (fig. 1) consisted of a broad two-inch plank, the upper edge of which was carefully cut into an exact copy of that dorsal outline which is so characteristic of the African elephant. To this the legs were attached by heavy angle-irons, the iron that formed the axis of the leg running through a hole in the free arm of the L. The legs themselves were formed of excelsior solidly wound around roughly hewn wooden bones.

The accuracy of the work was proved by frequent reference to the measures taken from the dead animal, due allowance being made for the fact that the finished piece would be somewhat larger than its supporting framework. The broad overhanging pelvis was next added; and then the skull, with its massive jaw, was built on, the more salient portions being carved with care from the plaster model, while those buried deeply in the flesh were more roughly copied.

The long ribs of the original were represented by bands of iron wrapped in tow, fastened above to the plank backbone, and below to a second plank shaped to the outline of the under side. A neck of laths, covered with excelsior, joined the head to the body. Wooden shoulder-blades were now put in place, the tail and trunk added, and then, following the diagrams and accompanying measurements, the vacancies existing between the upper parts of the legs and adjacent portions of the body were carefully filled out (fig. 2). Like Mother Rigby's Feathertop, the elephant at this stage stood forth a creature of wood and tow, only waiting for the final metamorphosis which should fill the blank wooden orbits with twinkling eyes, and endow the entire framework with the semblance of life. The thick, stiff skin was now removed from the bath, and carefully thinned down until it had lost half its substance, and become — for an elephant — soft and pliable.

As a careful tailor tries on a partially completed coat to assure himself that the finished garment will be a success, so the skin of Mungo was hung upon the manikin (fig. 3). The trial proving satisfactory, the skin was poisoned with arsenical soap, and all was ready for the last act. The skin having been replaced and secured along the back, first one side, then the other, was covered with a thin coating of clay mixed with chopped tow, and the body section sewed up. One by one the legs, trunk, and tail were similarly treated, the skin being covered each night with wet cloths to preserve it moist and flexible throughout. The sewing having been finished, the wrinkles indicated in the skin were followed over with a pointed modelling-tool, thus impressing them deeply in the moist clay, while the deepest wrinkles or thick folds of the trunk, elbows, and flanks, were

Blocks of uniform depth.

Clean sand bottoming.

Concrete foundations.

Sub-grade earth.

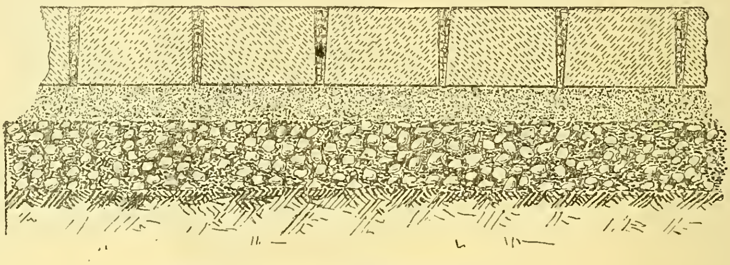


Fig. 1. — Pavement as contracted for.

Grade line.

Paving-blocks as laid.

Sand and gravel bottoming.

6-in. concrete foundation.

Sub-grade earth.

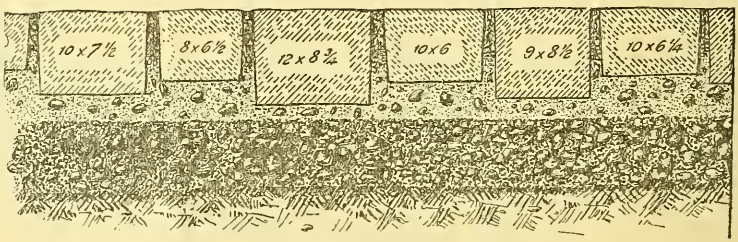


Fig. 2. — Pavement as laid.

secured by wires or twine to hold them in place until dry. Great pains were taken in inserting the eyes, — made from a color-sketch of the originals, — and marking in their surrounding lines, on which depended the expression of the face. After thoroughly drying, all seams were filled with *papier-maché*, while a slight but careful use of color restored the skin to its original aspect (fig. 4).

Thus was Mungo reconstructed, and thus did Mr. Hornaday successfully solve the problem of so mounting an elephant that his hide should appear loose and wrinkled, instead of, as is too often the case, smooth and swollen. Mungo was exhibited at the Washington meeting of the Society of American taxidermists, and received the special medal 'for the best piece in the entire exhibition.' This elephant may be said to represent the beginning of the new and better class of taxidermy at the national museum ; and although four years ago he stood, as regards quality, almost isolated, he is to-day surrounded by so many pieces of equal merit that we may look hopefully forward to the time when the mounted mammals of the national museum shall be unsurpassed.

Frederic A. Lucas.

A FEW WORDS ABOUT PAVEMENTS.

A recent report to the commissioners of accounts of this city, prepared by Col. George T. Balch, and relating to a pavement now being laid in Fifth Avenue, shows clearly the difference between pavements scientifically constructed and those with which New-Yorkers are more familiar. The value of the report is enhanced by the judicious use of engravings, some of which are reproduced herewith. Fig. 1 is a transverse section through a pavement constructed in accordance with the specifications prepared by the city authorities. The agreement between the city and the contractor called for sound granite blocks, approximately uniform in size, rammed solidly down upon a bed of sharp, clean, dry sand ; the spaces between the blocks to be filled with clean, dry, hard gravel, free from sand, over and through which should be poured hot coal-tar cement. The sand bedding was to rest upon a concrete foundation at least six inches thick, laid upon a well-tamped road-bed. Were the provisions of the agreement carried out, Fifth Avenue would have a pavement nearly perfect of its kind. But, according to Colonel Balch's report, nearly every

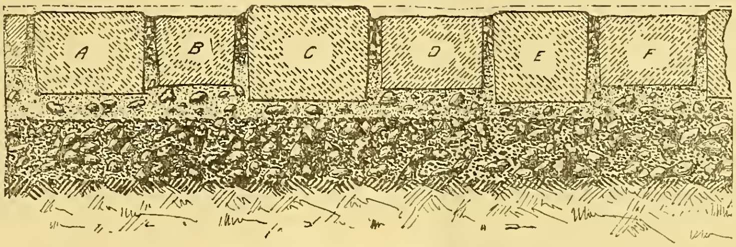


Fig. 3. — Pavement after heavy traffic.

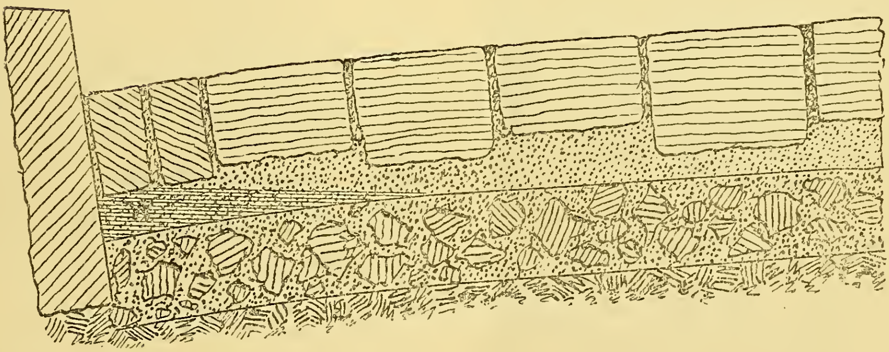


Fig. 4. — Effects of wet sand and leakage.

provision of the agreement has been violated, and the result is a pavement such as shown in transverse section in fig. 2. The road-bed, or subgrade of earth, was not excavated to the proper depth, leaving the surface of the pavement at the centre of the street three inches higher than the established grade, making a steepness of crown or arch between curbs detrimental to traffic as compared with a flatter surface, and actually dangerous in icy weather. The surface of the road-bed was not tamped; the concrete ranges in thickness from the stipulated six inches down to three, and in some places even two inches; it was not properly mixed, laid, or tamped; and the materials of which it is composed are inferior in quality. The granite blocks vary greatly in size, and are bedded in a mixture of sand and gravel. They are laid with the broadest edge upward, instead of the reverse; the filling between them is a mixture of sand and gravel; and the paving cement, instead of filling the interstices to the bottom of the block, extends only an inch or two below the surface. In fact, so imperfect are both material and workmanship, that, after a short period of heavy traffic, the pavement will present the appearance shown in fig. 3. All sand and gravel used should have been free from moisture, artificially dried if necessary, and the joints between the blocks should be water-tight. These conditions were violated, and the collection of water at *W* in fig. 4 shows the effect of damp bedding and leaking joints. As a result, the tremendous pressure due to the expansive force of the freezing of this water in cold weather may be expected to rupture the pavement at the point where the water collects.

ST. PETERSBURG LETTER.

RUSSIAN science has sustained a heavy loss by the death of A. M. Butlerow, the celebrated chemist, in August last: it is the greater, as he was yet in the prime of life. His chemical work is well known abroad, but it may not be known that he had a second specialty: he was an eminent apiculturist. The progress in bee-keeping made in the last years in Russia owes much to his untiring efforts, especially to his manuals and papers. By his death the second chemical seat is made vacant in the Academy of sciences; and various surmises are made as to whether this learned corporation will persist in its opposition to the election of the greatest of Russian chemists, Professor Mindeleff.

Professor Mindeleff has twice visited the petroleum district near Baku, on a mission of the Ministry of finance, principally with a view to ascertaining if the wells were rapidly giving out or not. He has not yet returned from his last journey. Great progress is said to have been made in the distillation of petroleum oils by G. W. Alexeyew.

It being now early in the season, news about geographical expeditions is yet scarce. Prjevalsky is still at his country-seat, working at the report of his last journey, which is to be ready in August next. The special reports on botany, different parts of zoölogy, and probably also geology, it will take a long time to complete. The only special report which is to appear sooner is that on meteorology. The observations during the last expedition will be printed *in extenso*, together with those made during the Lob-Nor and the second Tibet expeditions of the same traveller, and the itineraries of the same. The work is to be supervised by Prof. A. Woeikof, who will add to it a work on the climate of the countries traversed, and High Asia in general.

The Russian polar commission has printed the observations of the first year (1882–83) of the Lena expeditions, which comprise meteorology only. The work of the second year, as well as the calculation of the magnetical observations, is in preparation. The work of the Lena expedition is of the highest character, and does the greater honor to its members, as it was done under the most serious difficulties.

Great progress in meteorological work in the south of Russia has been made. Professor Klossowsky, in Odessa, has succeeded in establishing quite a number of rainfall and thunder-storm stations in the government of Kherson, one of the most extensive in the south, and will issue a monthly report. This year was remarkable for heavy rains, especially in the southern part of the government. The rains have also extended to the central and eastern parts of Russia, and seldom have so heavy rainfalls been experienced on one day in this country. Till this year, over one hundred millimetres fell on one day at but two places in the plains of European Russia, — 145 in the southern part of the government of Tula, July 12, 1882; and over 120 at Yelisavetgrad. This summer we had 132 at Kharkow, June 24; 102 at Lgow (government of Koorsk), July 30–31 (of these, 51 in one hour); 99 at Moscow, Aug. 9–10; 93 at Kamishin, July 28. The rain of Aug. 9–10 was very heavy over a great district, and caused high water in the right tributaries of the Moskwa and Oka. The railroad-bridge over the Lopassnja was washed away.

Captain Makarow, I.R.N., has published an important work, "On the interchange of waters of the Black and Mediterranean seas." By the use of an instrument called a 'fluctometer,' and invented by him, he could determine the velocity of currents irrespective of their direction. This instrument showed him that in the Bosphorus and Dardanelles the velocity decreased from a little below the surface, became 0 at a certain depth, and then increased again. As the surface current is from the Black Sea to the Sea of Marmora, and from the latter to the Mediterranean, the lower currents must be in the opposite direction; i.e., bringing the salter and warmer water of the Mediterranean to the Black Sea. This was also proved by determinations of specific gravity of the water, which considerably increased once the lower current was reached: for example, five miles from the Black Sea, in the Bosphorus, at 20 fathoms depth, the specific gravity was 1.0146; at 22 fathoms, 1.0225. In the Black Sea, in the vicinity of the Bosphorus, he found water with a temperature above 11° C., even at the depth of 140 fathoms; and 10.5° at 260 fathoms. The observations of Professor Lapschine off the east coast of the Black Sea (latitude 43°–44½°) give a temperature of 10° at 200 fathoms, and 8° at 490 fathoms. O. E.

St. Petersburg, Sept. 25.

NOTES AND NEWS.

THE Alert returned to Halifax Oct. 10, after an absence of nearly four months. This was the final trip of the Alert to the Hudson's Bay region, all the observing stations being dismantled, and the observers, their instruments, and other property brought back to Halifax. She sailed from Halifax on June 24, and proceeded direct to Nachvak station. On arrival off the station, the ice was so thick that the steamer could not get in to the coast. She then pushed on to the entrance to the straits, and, after encountering much trouble from ice, a clear entrance was found near the north side. No ice was encountered again until North Bluff was reached, and in making from that point to Diggs seven or eight days were occupied. At Diggs the Alert remained a couple of days, making repairs and receiving a general overhauling. During this time the propeller, from which a blade had been lost in the ice, was fixed. On the fourth day the expedition was continued to Churchill, that point being reached at the end of July. Churchill harbor was surveyed, and was found to be a splendid harboring-place, with not less than twenty-four feet of water at dead low spring tide. York Factory was reached two days after leaving Churchill, the length of the trip being occasioned by delays by a thick fog. Here a reconnaissance survey was made of the estuary of the Nelson River. The water was so shoal at such a distance from land, that a vessel could be in only five fathoms of water, and at the same time land could not be sighted from her deck. The roadstead affords a very unsafe anchorage, and the channel of the river is narrow and tortuous. From this place the steamer returned to Churchill, and then proceeded over to the west coast of the bay and Marble Mountain, arriving at the latter place in the middle of August. After observations on the west side of the bay and island, a determination was made of the position of Cape Southampton, and it was found that the cape is placed on the charts six or seven miles too far south and east. On arriving back at Diggs Island, an inner channel, apparently affording a mode of access clear through to the bay, was discovered. From Diggs Island the Alert went to Nottingham, and thence to North Bluff and Stupart's Bay. At the latter a party was sent to make a general observation of Prince of Wales Sound. Observer Payne, who was stationed here, reported finding some relics of very ancient guns. There were four altogether, two of them about the size of nine-pounders of the present day, the other two the size of the four or six pounders. They are of cast iron which is covered with rust; and so old are they, that the year-marks have rusted out, and it is impossible to estimate their age. The two smaller guns were brought home, the others being left behind. Inquiries concerning the guns were made among the Eskimo, but they could tell nothing whatever about them. They were undoubtedly some of the very earliest attempts at cast-iron ordnance. The steamer left Stupart's Bay in the middle of September for Port Burwell. On the way north from Port Burwell, soundings were taken, and the water to the east and south of Cape Chidley found to be very shoal. One bank, where there is less than one hundred fathoms all over it, extends seventy-five miles into the sea; while in the centre of the straits, between the Buttons and Cape Best, there is a depth of over two hundred and fifty fathoms. Returning to Nachvak, the station that could not be reached before, the observers were taken on board, and the Alert was headed homeward. The returned observers are all in excellent health, and all save one fared excellently during their exile. At most places game of various kinds was so plentiful that the men rarely tasted the salted or preserved beef.

— Trübner & Co. announce for the coming season, 'Luck or cunning, as the main means of organic modification,' by Samuel Butler; 'The life and works of Giordano Bruno;' 'The prehistory of the north,' by the late J. J. A. Worsaae (translated, with a brief memoir of the author, by

H. F. Morland Simpson); 'Sources of the Etruscan and Basque languages,' by Robert Ellis; 'Greeko-Slavonic literature, and its relation to the folk-lore of Europe during the middle ages,' by M. Gaster; 'Garibaldi, recollections of his public and private life,' by Elpis Melena (translated from the German by Charles Edwardes); 'Air analysis,' by J. A. Wanklyn and W. J. Cooper; 'For happiness,' by Alexander Calder; 'The Indian empire, its people, history, and products,' by W. W. Hunter; 'Miscellaneous essays on subjects connected with the Malay peninsula and the Indian Archipelago,' edited by R. Rost; 'Manava-dharma-castra, the code of manu,' by J. Jolly; 'The life of Hiuen Tsiang,' by the Shamans Hwui Li and Yen-Tsung, with a preface containing an account of the works of I-Tsing by Samuel Bael; 'A sketch of the modern languages of Oceanica,' by R. N. Cust; 'Phantasms of the living,' by Edmund Gurney, Frederick W. H. Myers, and Frank Podmore; 'Al Beruni's India,' and translation of the above into English, by Edward Sachau; 'The social history of the races of mankind,' by A. Feathermann; 'A dictionary of the Targumin, the Talmud Babli and Yerushalmi, and the Midrashic literature,' compiled by M. Jastrow; 'Dictionary of the Kongo language as spoken at San Salvador, the old capital of Congo,' with an introduction by R. N. Cust, and 'A grammar of the Kongo language,' by W. Holman Bentley; 'South-African butterflies,' by Roland Trimen; 'Reports of the archaeological survey of southern India,' by James Burgess; 'The imperial gazetteer of India,' by W. W. Hunter; 'Shall Russian treachery win the day?' by James Samuelson; 'Shropshire folk-lore,' edited by Charlotte Sophia Burne, from the collections of Georgina F. Jackson; 'Language, as illustrated by Bible translation,' by Robert Needham Cust; 'The church and the stage,' by William Henry Hudson; 'A condensed Russian grammar,' by F. Freeth; 'A B C dictionary to the United States, Canada, and Mexico,' by B. Bradshaw; 'Dorn's code for commercial telegrams,' compiled by Felix Dorn; 'A Romanised Japanese reader,' by Basil Hall Chamberlain; 'The Sinhalese hand-book in Roman characters,' by C. Alwis; 'The tropical agriculturist,' compiled by A. M. and J. Ferguson; 'Indian poetry,' by Edwin Arnold; 'Colloquial Portuguese, or, The words and phrases of every-day life,' by Alexander J. D. D'Orsey; 'Elementary bandaging and surgical dressing,' by Walter Pye.

— Messrs. Ticknor & Company announce for publication on Wednesday, Oct. 13, 1886, 'Self-consciousness of noted persons,' by Hon. J. S. Morrill. The senator from Vermont has in this work condensed the fruits of years of research in an unfamiliar field. A small edition was privately printed some time since, and met with such praise, that Senator Morrill has since revised it for publication. They also announce 'The Virginia campaign of General Pope in 1862,' being vol. ii. of papers read before the Military historical society of Massachusetts; and 'The house at High Bridge,' by Edgar Fawcett.

— From the Cambridge University press the following new publications are announced: 'A history of the theory of elasticity and of the strength of materials, from Galilei to the present time,' vol. i. ('Galilei to Saint-Venant, 1639–1850'), by the late I. Todhunter, edited and completed by Karl Pearson; 'Lectures on the physiology of plants,' by S. H. Vines; 'Travels in northern Arabia in 1876 and 1877.' by Charles M. Doughty (with illustrations); 'The scientific papers of the late Prof. J. Clerk Maxwell,' edited by W. D. Niven.

— Three persons in one family were poisoned in Brooklyn last week by eating unwholesome cheese. It is reported that cheese obtained from the same factory has caused sickness in two other Brooklyn families. The matter is now being investigated by the board of health.

— Another death occurred recently in a Brooklyn dentist's office while ether was being administered. The dentist has been brought to court, and the case will be judicially investigated next week.

— The New York state board of health has found two samples of cream-of-tartar adulterated with oxalic acid. The entire stock of the article has been seized in both the stores where the samples were found, and, if the manufacturers can be found, they will be prosecuted.

— *Nature* states that the International geodetic conference will assemble in Berlin on Oct. 20. Its principal business will be to deliberate on the best method of executing the resolutions arrived at at Rome and Washington in 1883 and 1884, respecting the actual measurement of a degree on the earth's surface, and likewise in reference to a scientific survey of the European continent. The adoption by all nations, of Greenwich as the first meridian, in accordance with the decision taken at Washington, is to be strictly enforced in practice. The introduction of international normal time, on the other hand, has had to be postponed, owing to insuperable practical difficulties connected with ordinary business life. In order to promote the project of any international survey of the entire globe, it is proposed to establish a central geodetic office in Berlin.

— Prof. William Ferrel, recently connected with the signal service, has resigned his position, and removed to Kansas City, Mo.

— It is proposed to hold a meeting of the various scientific societies in Australia and New Zealand in 1888 (the one hundredth anniversary of the foundation of those colonies) upon the lines of the British association meetings, and to form an Australian association for the advancement of science with similar aims and objects. There are some twenty scientific societies in the Australasian colonies, and the number of members is between twenty-five hundred and three thousand. The sections proposed are, A, astronomy, mathematics, physics, and mechanics; B, chemistry and mineralogy; C, geology and paleontology; D, biology; E, geography; F, economic and social science and statistics; G, anthropology; H, medical and sanitary science; I, literature and the fine arts; J, architecture and engineering. In addition to the general and sectional meetings for reading and discussing papers, etc., it is proposed that excursions should be organized to various places of interest, such as the various mining districts, the Jenolan, Wambeyan, and other caves, the Blue Mountains, and similar places of interest to geologists and others. A preliminary circular signed by A. Liversidge of the University of Sydney has been issued.

— The September number of the *Political science quarterly* is largely devoted to economics. Prof. Henry C. Adams of Cornell has a learned article on 'American war financiering,' in which he criticises, from a theoretical stand-point, Secretaries Gallatin, Dallas, and Chase. Hon. Alfred E. Lee writes very clearly and strongly concerning 'Bimetallism in the United States,' showing in a way that even 'cheap money' advocates should be able to understand the real status and effect of our silver coinage. Prof. Richmond M. Smith of Columbia, who described the state bureaus of labor statistics in an earlier number of the *Quarterly*, now reviews favorably the first annual report of the national commissioner of labor. Dr. Bowen continues his interesting account of the conflict in Egypt, and Dr. C. B. Spahr discusses the 'Taxation of labor.' The department of book reviews is unusually full; and the notices of Gneist's 'Das Englische parlament' by Mr. Goodnow, of von Treitscke's 'Deutsche geschichte im neunzehnten jahrhundert' by Prof. Munroe Smith, and of a group of books on constitutional law by Professor Burgess, are of more than passing value.

— Dr. Shakespeare of Philadelphia has just returned from Europe, where for a year he has been investigating cholera. He has studied the disease in Spain, France, and Italy. During his absence, he also visited India to observe the disease in its home. As Dr. Shakespeare was sent out by the President, his report will be made to him, and forwarded to congress at its next session. From the little that we have been able to learn of Dr. Shakespeare's opinions, we infer that he agrees in the main with Koch and his German collaborators, and that he regards the comma bacillus as a diagnostic sign of the existence of cholera.

— The next meeting of the National academy of sciences will be held in Boston at the Institute of technology, to begin Tuesday, Nov. 9, at noon.

LETTERS TO THE EDITOR.

⁂ *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Education and the cost of living.

I AM glad that your timely comment on education and the cost of living (*Science*, viii. 313) seconds the proposed abolition of tuition-fees at Columbia college, in the case of graduate students, as 'a step in the right direction,' — one which 'we trust . . . will be taken, . . . and followed by other institutions.' It is but just to add, that Cornell, possibly first and alone among our great universities, has the honor of having already taken this step, 'lo, these many years;' that even in her days of poverty, as now in her prosperity, her library, laboratories, and lecture-rooms have been open to all college graduates who would make good use of them; and there has been no charge except for breakage and for supplies consumed.

But the Cornell experience apparently confirms your thought, that "more efficient and advantageous . . . is the foundation of numerous graduate scholarships and fellowships." We have had here such fellowships for more than two years; and, though there are only eight, their effect in raising the standard of both graduate and undergraduate work is, I think, quite marked.

If the proper busine s of a university be to improve the community's intellectual and educational ideals by developing in young people that have already some general culture the power of independent, well-directed investigation, of course the presence of earnest graduate students can hardly be too much encouraged. J. E. OLIVER.

Cornell university, Oct. 11.

The genesis of the diamond.

I send you the following abstract of a paper read by me at the Birmingham meeting of the British association for the advancement of science, September, 1886, in the hope that it may interest your readers.

The discovery of diamonds at Kimberley, South Africa, has proved to be a matter, not only of commercial, but of much geological interest. The conditions under which diamonds here occur are unlike those of any other known locality, and are worthy of special attention.

The first diamond found in South Africa was in 1867, when a large diamond was picked out of a lot of rolled pebbles gathered in the Orange River. This led to the 'river-diggings' on the Orange and Vaal rivers, which continue to the present time.

In 1870, at which time some ten thousand persons had gathered along the banks of the Vaal, the news came of the discovery of diamonds at a point some fifteen miles away from the river, where the town of Kimberley now stands. These were the so-called 'dry diggings,' at first thought to be alluvial deposits, but now proved to be volcanic pipes of a highly interesting character. Four of these pipes or necks, all rich in diamonds, and of similar geological structure, were found close together. They have been proved to go down vertically to an unknown depth, penetrating the surrounding strata.

The diamond-bearing material at first excavated was a crumbling yellowish earth, which, at a depth of about fifty feet, became harder and darker, finally acquiring a slaty blue or dark green color and a greasy feel, resembling certain varieties of serpentine. This is the well-known 'blue ground' of the diamond miners.

It is exposed to the sun for a short time, when it readily disintegrates, and is then washed for its diamonds. This blue ground has now been penetrated to a depth of six hundred feet, and is found to become harder and more rock-like as the depth increases.

Quite recently, both in the Kimberley and DeBeers mines, the remarkable rock has been reached which forms the subject of the present paper. The geological structure of the district, and the mode of occurrence of the diamond, have been well described by several observers.

As Griesbach, Stow, Shaw, Rupert Jones, and others have shown, the diamond-bearing pipes penetrate strata of carboniferous and triassic age, the latter being known as the Karoo formation.

The Karoo beds contain numerous interstratified sheets of dolerite and melaphyr, also of triassic age, the whole reposing upon ancient mica schists and granites. The careful investigations of Mr. E. J. Dunn demonstrate that the diamond-bearing pipes enclose fragments of all these rocks, which fragments show signs of alteration by heat. Where the pipes adjoin the Karoo shales, the latter are bent sharply upwards, and the evidence is complete that the diamond-bearing rock is of volcanic origin and of post-triassic age.

The diamonds in each of the four pipes have distinctive characters of their own, and are remarkable for the sharpness of their crystalline form (octahedrons and dodecahedrons), and for the absence of any signs of attrition. These facts, taken in connection with the character of the blue ground, indicate, as Mr. Dunn has pointed out, that the latter is the original matrix of the diamond.

Maskelyne and Flight have studied the microscopical and chemical characters of the blue ground, and have shown that it is a serpentinic substance containing bronzite, ilmenite, garnet, diallage, and vaalite (an altered mica), and is probably an altered igneous rock, the decomposed character of the material examined preventing exact determination of its nature. They showed that the diamonds were marked by etch figures analogous to those which Prof. Gustav Rose had produced by the incipient combustion of diamonds, and that the blue ground was essentially a silicate of magnesium impregnated with carbonates.

The blue ground often contains such numerous fragments of carbonaceous shale as to resemble a breccia. Recent excavations have shown that large quantities of this shale surround the mines, and that they are so highly carbonaceous as to be combustible, smouldering for long periods when accidentally fired. Mr. Paterson states that it is at the outer portions of the pipes where the blue ground is most heavily charged with carbonaceous shale that there is the richest yield of diamonds.

Mr. Dunn regards the blue ground as a decomposed gabbro, while Mr. Hudleston, Mr. Rupert Jones, and Mr. Davies regard it as a sort of volcanic mud. Mr. Hudleston considers that the action was hydrothermal rather than igneous, the diamonds being the result of the contact of steam and magnesian mud under pressure upon the carbonaceous shales, and likens the rock to a 'boiled plum-pudding.'

The earlier theories as to the origin of the diamond have, in the light of new facts, quite given way to the theory that the diamonds were formed in the matrix in which they lie, and that the matrix is in some way of volcanic origin, either in the form of mud, ashes, or lava.

The exact nature of this matrix becomes, therefore, a matter of great interest. The rocks now to be described are from the deeper portions of the DeBeers mine, and were obtained through the courtesy of Mr. Hedley. They are quite fresh, and less decomposed than any previously examined. Two varieties occur, — the one a diamantiferous, the other free from diamonds, — and the lithological distinction between them is suggestive. The diamantiferous variety is crowded with included fragments of carbonaceous shale, while the non-diamantiferous variety is apparently free from all inclusions, and is a typical volcanic rock.

Both are dark, heavy, basic rocks, composed essentially of olivine, and belong to the group of peridotites. Both are of similar structure and composition, differing only in the presence or absence of inclusions. The rock consists mainly of olivine crystals lying porphyritically in a serpentinic ground-mass.

The olivine is remarkably fresh, and occurs in crystals which are generally rounded by subsequent corrosion. The principal accessory minerals are biotite and enstatite. The biotite is in crystals, often more or less rounded, and sometimes surrounded by a thin black rim, due to corrosion. Similar black rims surround biotite in many basalts. The biotite crystals are usually twinned according to the base. The enstatite is clear and non-pleochroic. Garnet and ilmenite also occur, the latter often partly altered to leucoxene. All these minerals lie in the serpentinic base, originally olivine. This rock appears to differ from any heretofore known, and may be described as a saxonite porphyry.

The diamond-bearing portions often contain so many inclusions of shale as to resemble a breccia, and thus the lava passes by degrees into tuff or volcanic ash, which is also rich in diamonds, and is more readily decomposable than the denser lava.

It seems evident that the diamond-bearing pipes are true volcanic necks, composed of a very basic lava associated with a volcanic breccia and with tuff, and that the diamonds are secondary minerals produced by the reaction of this lava, with heat and pressure, on the carbonaceous shales in contact with and enveloped by it.

The researches of Zirkel, Bonney, Judd, and others, have brought to light many eruptive peridotites, and

Baubree has produced artificially one variety (lherzolite) by dry fusion, but this appears to be the first clear case of a peridotite volcano with peridotite ash.

Perhaps an analogous case is in Elliot county, Kentucky, where Mr. J. S. Diller has recently described an eruptive peridotite which contains the same accessory minerals as the peridotite of Kimberley, and also penetrates and encloses fragments of carboniferous shale, thus suggesting interesting possibilities

H. Carvill Lewis.

The eccentricity theory of the glacial period.

I desire to add a supplementary note to my letter of Aug. 16, published in the issue of *Science* for Aug. 27.

In that letter I called attention to the contrast between the northern and the southern hemisphere in respect of glaciation, as tending to show, that, other things being equal, a climate of means (mild winters and cool summers) is more favorable to the accumulation of snow and ice than a climate of extremes (cold winters and hot summers). The bearing of this proposition upon the eccentricity theory is pointed out in my letter.

I now wish to call attention to another well-known geographical fact, which seems to confirm the conclusion that glaciation is favored by a climate of means rather than by a climate of extremes. I refer to the altitude of the snow-line in torrid, temperate, and frigid zones respectively. At the equator the snow-line falls below the annual isothermal plane of 32° F.; while, as we recede from the equator, the snow-line rises above the plane of 32°. So far does the snow-line rise above the isothermal plane of 32°, as we go polewards, that, while the latter plane reaches the sea-level not far from 60° latitude, it has been doubted whether in the northern hemisphere the snow-line anywhere reaches the level of the sea. According to J. D. Forbes, "the mean temperature at the snow-line near the equator is 34.7°; in the temperate zone it is 25.3° ; in the arctic regions, about 21°" (Johnston, *Physical atlas of natural phenomena*, Edinburgh and London, 1856, p. 33). While all such numerical statements of the temperature of the snow-line in different latitudes can be considered only rough approximations, there can be no doubt of the general law that (apart from local abnormalities) the temperature of the snow-line falls as we go from the equator towards the poles. Now, it is also true that the annual range of temperature increases from the equator to the poles. At the snow-line near the equator, the extreme summer temperature is but little above the freezing-point ; while at the snow-line in the arctic regions, though the mean temperature for the year falls several degrees below freezing point, the extreme summer temperature rises far above it. The comparison of the zones of climate leads, accordingly, to the same conclusion as the comparison of the northern and southern hemispheres. The existence of perpetual snow is shown by both comparisons to depend less upon cold winters than upon cool summers.

A very simple *a priori* consideration suggests the probability of the same conclusion which we have drawn from geographical facts. It seems probable, *a priori*, that extreme winter cold cannot greatly increase the amount of snow-fall. So long as the temperature of any place keeps below 32°, the precipitation will be all in the form of snow ; and this will be the case when the temperature is but little below 32°, as truly as when it falls far below zero.

Cooling a mass of air from 32° to a lower temperature can produce but little additional precipitation, since the maximum vapor tension at 32° is very little, and the change of maximum vapor tension corresponding to changes of temperature in the lower part of the thermometric scale is very slight. The influx of warm and moist air bearing supplies of vapor is not favored by extreme winter cold, since such extreme cold tends to increase barometric pressure over the area affected. On the other hand, every degree that the summer temperature rises above 32° shows an effective increment of the melting-power of the summer sun. The inference would seem to be justified, that, in any place where the annual mean temperature is below or not much above 32°, the more nearly the extreme summer and winter temperatures approach the annual mean, the greater will be the tendency (other things being equal) to the accumulation of perpetual snow. This *a priori* inference seems to be in exact accord with the geographical facts referred to in this and in my former letter.

William North Rice.

Wesleyan university, Oct. 8.

The theory of utility.

In connection with the suggestive article in *Science* of Oct. 1, on 'Launhardt's Mathematical economics,' I would like to offer a new theory of utility, or, rather, to discuss it from a new standpoint, and indicate what I consider to be the error in Jevons's main premise.

Utility, or usefulness, is the satisfying of desires. Desires are always in the present, though many, perhaps the most of them, have a prospective nature. Usefulness is not the capacity or capability of being useful : it is the state or quality of *being* useful. It involves, not a possible, but an actual satisfying of desires : e.g., on a certain day a loaf of bread would have possessed utility for Robinson Crusoe in satisfying his hunger ; a second loaf would have possessed utility, not in satisfying the hunger of the morrow, but in satisfying his desire to have the possible wants of the future provided for.

If utility be defined as a capacity to serve man or to satisfy his desires, and by this is meant something quite different from the actual satisfying, it serves no purpose of distinction, for with this definition, when affirming utility to be an attribute of any thing, we must always add, 'under certain circumstances ;' and there is probably not a thing in existence but what, under certain circumstances, possesses this capacity.

The confusion prevailing as to the nature of utility has arisen from the fact, that, in discussions upon the subject, the provident trait in man's character has been entirely neglected ; for from this trait spring desires which are, indeed, of a prospective nature, but whose satisfaction involves utility as indubitably as does the satisfaction of his physical needs.

Utility being of the present moment, time is not one of its dimensions, as the theory of 'final degree of utility' necessarily presupposes. When Jevons ('Theory of political economy,' p. 51) declares that "utility may be treated as a *quantity of two dimensions*, — one dimension consisting in the quantity, and another in the intensity of the effect produced upon the consumer," — it is clear that the supposed dimension of quantity does not have reference to the mass simply, but to the duration of the commodity. to the time elapsing while it is being consumed.

The theory of varying degrees of utility seems to have its origin in the fact, that, assuming the provident trait to be perfectly developed, the intensity of our desires of a prospective nature varies with our estimate of probable utility, the probability decreasing as the length of time estimated to ensue before the anticipated satisfaction increases ; Jevons's chapter on the 'Theory of utility,' with the necessary changes in phraseology, would furnish an excellent discussion on the subject of desires of a prospective nature, which *do* have two dimensions, — one the estimated intensity of the anticipated satisfaction, the other its probability as affected by the length of time to elapse before its estimated occurrence.

But when we enter upon discussion as to the sources of desires, and how desires may be modified, we must say, with Pascal, "C'est un cercle infini, dont le centre est partout la circonference nulle part."

A. E. ROGERS.

Orono, Me., Oct. 5.

Earthquake sounds.

Does any one attempt to offer an explanation for the sound that preceded and accompanied the late earthquake, or earthquakes in general, where the sounds are noticeable ? I supposed it was presumable that they were due to the commotion in the earth's crust caused by the radiating waves. But how can that be, when the earth-waves move six to eight times faster than sound-waves ? If that be so, would it not appear as if the sound-waves ought in part to come up after the shock has passed ? I was asleep when the first and heaviest shock first reached this place (six miles west of Greensborough, in Guilford county), so I cannot tell to what extent the sound preceded the shock. There were two subsequent shocks which were preceded by low roaring and rumbling, so that we predicted the coming of the earth-waves. I said to my wife, 'Now we will have another shake ;' and we waited probably three seconds after I had spoken, when the house began to rock. I do not expect you to write me personally, as you will not likely have time, but, if my question should be worthy of note, perhaps some of the geologists of your company could give us a line through *Science*. JOSEPH MOORE.

New Garden, N.C., Oct. 6.

Unexplained noises.

Your comment on mysterious noises in *Science* for Oct. 1 recalls to my memory a very remarkable instance of the transmission of sound and motion.

On the 14th of February, 1862, I was working with my father in his sugar orchard ten miles west of Madison, Ind., and five miles north of the Ohio River. During the entire morning, which was warm, cloudy, and calm, we heard most distinctly the discharges of heavy artillery. The reports would often follow in quick succession. I, as most lads would have been in similar circumstances, became thoroughly alarmed. I felt quite sure that the whole confederate army was close upon us, since the source of the cannonading seemed to be no farther south than the river.

I finally prevailed upon my father to go home, where we found the inmates of the house greatly alarmed at the noises and the rattling of the windows. The shocks, as I remember them, were much like the slight earthquake disturbances experienced lately in different parts of the country. For several miles along the river these noises were heard and the shocks felt. Nevertheless the day passed, and no invading foe appeared. The morrow brought the news of the bombardment of Fort Donelson.

When it is remembered that Fort Donelson is more than two hundred miles from the locality just described, it is certain that these concussions could not have been carried through the air.

I have been told that the limestone formation coming to the surface along the right bank of the river in Jefferson county, Ind., is the same as that on which Fort Donelson rests. The cannonading which was heard so distinctly that day by hundreds of people in Indiana occurred at Fort Donelson, and the sound-waves were conveyed entirely across Kentucky, and probably at a considerable depth below the surface, by a continuous ledge of limestone. I have thought the phenomena above described worthy of record in your columns. H. W. WILEY.

Fort Scott, Kan., Oct. 8.

How astronomers may work.

In your editorial of Sept. 24, referring to Professor Pickering's plan for making the Harvard college observatory useful to all other observatories, and to astronomers all over the world, you also notice a plan of my own, which I formulate as follows : —

"We mean to put the large telescope (of the Lick observatory) at the disposition of the world by inviting its most distinguished astronomers to visit us one at a time, and by giving to them the use of the instrument during certain specific hours of the twenty-four. In this way we hope to make the gift of Mr. Lick one which is truly a gift to science, and not merely one to California and to its university."

Your comment on this plan is that you suspect that Professor Holden 'was hard-pressed to devise it.'

I trust that your impression will not be shared by Professor Young, if he remembers the discomforts of his expedition to Sherman ; or by Professor Langley, if he recalls the hardships of his own to Mount Whitney ; or by Dr. Huggins, when he recollects the hundreds of failures which have come in his delicate researches in spectroscopy and photography from the London climate ; or by Mr. Burnham, when he remembers how many of the double stars which he discovered at Mount Hamilton with a six-inch telescope were 'difficult' in Chicago with one of eighteen inches. Not to mention any other names, I am sure that these astronomers will feel a sense of gratitude when the facilities of the Lick observatory and the opportunities of its climate are put at their disposition, and will attribute the offer to a generous desire to forward science, and not to a scheme to eke out a scanty income. As a matter of fact, I have directed the policy of the observatory since 1874, and it is a pleasure to me to be able in 1886 to announce a plan which has been constantly in my thoughts for more than ten years, and which seems to me to be a long step in the true direction. I trust it will also seem to be such to my fellow-astronomers. It would have been natural to have looked for the same view from the editor of *Science ;* but, as long as the plan commands their respect and my own, it will be carried out. You will have to look to its results to see if it may not eventually command your own also.

EDWARD S. HOLDEN.

Berkeley, Cal., Oct. 2.

SCIENCE.—SUPPLEMENT.

FRIDAY, OCTOBER 15, 1886.

WASHINGTON'S SIGNATURE.

DR. PERSIFOR FRAZER recently published in the Proceedings of the American philosophical society a paper on composite photography as applied to handwriting. One of the most interesting results is that he obtained with the signature of Washington, the facsimiles of which we here reproduce. The difficulties of the process, and the peculiarities of composite signatures, were pointed out in *Science* of Jan. 22.

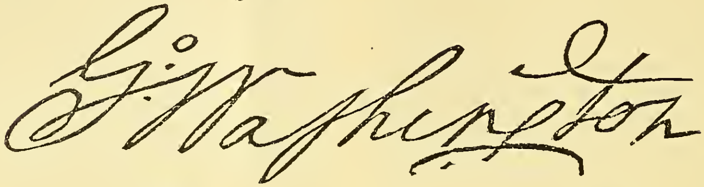
George Washington's signature was one of the first to suggest itself for the purpose, because many persons were familiar with it, and there are numerous well-authenticated documents in existence which bear it: but it has proved to possess other advantages which were not known when it was selected. As in every thing else, Washington was deliberate, painstaking, and uniform in his method of writing his signature, and the consequence is that it makes an excellent composite for illustration.

In writing his signature, Washington put pen to the paper five times. First he wrote the *G W* in one connected line. Second, he raised his hand and made the small *o* between the upper parts of the *G* and *W*, and the two dots which appear in all but signature No. 7. Third, his hand and arm were placed in position to write *ashing*, these six letters occupying a breadth of almost exactly $1\frac{3}{4}$ inches in every signature except the third, when they are extended to $1\frac{13}{16}$ inches. This is about as much of the arc of a circle (of which the centre is the elbow pivoted on the table) as one with a fore-arm of average length can cause to coincide with the tangent, or the straight line across the paper which the lower parts of the letters follow, unless unusual effort be made, and a great deal more movement be given to the fingers. The *g* ends in a curved flourish, of which the convex side is turned upwards below the right centre of the name. The lower loop of the *g* in all the signatures and in the composite was cut off in preparing the plate. Fourth, he wrote the final *ton*. Fifth, he added the very peculiar flourish above the right centre of the name, with the object of dotting the *i* and crossing the *t* at the same stroke.

In examining the composite, the effect of these various separate movements becomes manifest in its strengthened portions. It is hardly possible that any one, during the period of sixteen years which these signatures represent, or from 1776 to 1792, should have so schooled his hand to write a long name that the first inch or so of the writing should always occupy the same relative position to the body of the signature. It would take at least that much action for the hand and arm and pen to be brought into normal signature-writing condition; and especially is this so when this part of the writing is accompanied by flourishes, as it is in the case we are considering. The *G W*, and the little *o*, and the dots at the top, were the prelude, after which the arm was moved into position to write the main body of the signature, or the *ashing*. Of course, from the manner of making the dots, and the extremely small space they cover, their re-enforcement of each other in the composite was almost impossible, and, in fact, like other subordinate characters, they disappear almost completely. This latter is the part of the name which one would have expected to exhibit the greatest amount of uniformity, as in point of fact it does, with the exception of its terminal *g*, which shows more variation than any of the other letters, because at this point the limit of coincidence between the tangent line of the writing and the curve, of which the right fore-arm was the radius, had been passed, and a freer movement of the fingers was compensating for the increasing divergence. It is likely that Washington sometimes raised the hand between the end of the long *s* and the beginning of *h*, but he does not appear to have moved the elbow. All but the second signature are consistent with this view, and in the first, third, and fifth it is plainly indicated. In the others, as in the flourish above the sixth signature, the pen may not have marked. The fourth separate act of the penman was the formation of the *ton* after a movement of the arm. The breadth of the space occupied by these three letters is from $\frac{5}{8}$ to $\frac{7}{8}$ of an inch, or considerably within the range of coincidence of the curve and straight line before referred to; and owing to this fact there is only a moderate degree of re-enforcement of the letters in the composite, because these letters might fall into the first or last parts of the 2-inch space which was the limit of movement with a fixed elbow. It is worthy of note that even in this case the middle letter of the three is darker in the composite than either of the outside letters. The fifth and last movement was the flourish which dots the *i* and crosses the *t* by one stroke. This was done in the freest of free

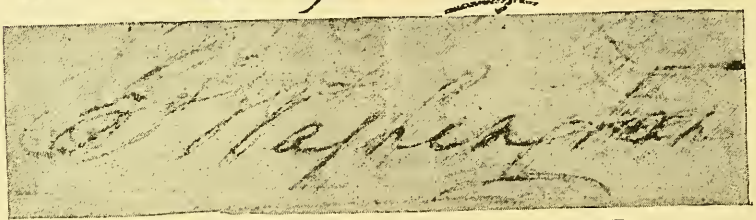
1

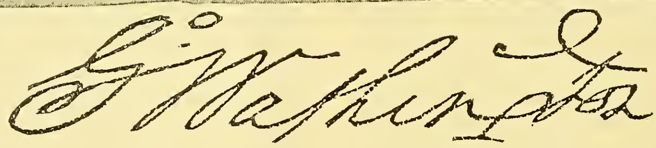
G: Washington

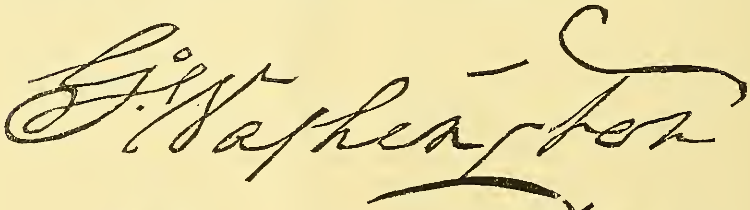
2

G: Washington

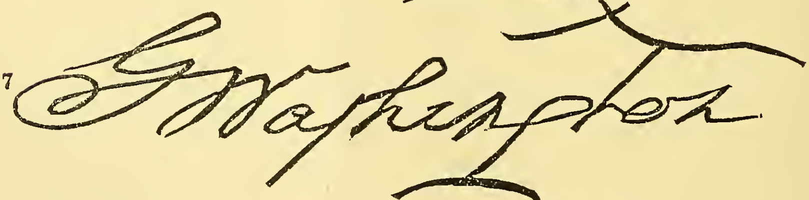
3

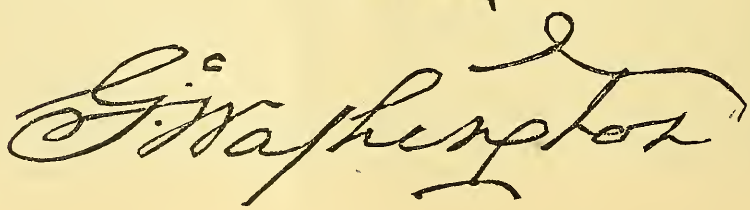
G: Washington

4


5

G: Washington

6

G: Washington

7

G: Washington

8

G: Washington

hands; often, as it seems probable, without resting hand or arm on the table at all. Therefore there is no coincidence of the lines in this part of the composite, and the *region* of variation is wider than that of any other part of the signature.

All the signatures used in the accompanying plate (seven in number) are unquestionably genuine. With the exception of one, which is the property of Dr. Frazer, they were carefully chosen from a number of authenticated signatures in the possession of the Historical society of Pennsylvania.

No. 1 is on a letter dated Dec. 18, 1776, from near the Falls of Trenton, and addressed to Washington's brother Samuel.

No. 2 is on a letter dated Headquarters, Nov. 4, 1777, and is addressed to Lieut.-Col. Persifor Frazer, then a prisoner of war in Philadelphia.

No. 3 is on a letter dated Sept. 27, 1777, and is to William Henry of Lancaster.

No. 4 is the composite of all the rest.

No. 5 is on a letter dated Headquarters in Morristown, Feb. 22, 1777. The person to whom the letter was addressed is not stated.

No. 6, dated Sept. 26, 1793, is affixed to the commission of David Lenox.

No. 7, of the same date, is affixed to David Lenox's appointment as agent for the relief and protection of American seamen.

No. 8, dated May 24, 1799, closes a letter to Thomson Mason.

THE PSYCHOLOGY OF FEAR.

IF a true psychology is physiological, and if the physiological furniture of the world is largely the result of a vast series of experiments of which only the most successful ones have survived, it ought to be possible to find an important useful significance in the thought-habits, the instincts, the will-mechanisms, the emotions of animals, and more especially of man. It was this conviction that set Darwin to work on his 'Expression of the emotions in man and animals.' Among these emotions there is one, very wide-spread in the animal kingdom, as Dr. Romanes has shown ('Mental evolution in animals'), very important to the welfare of the animal, and typical of the suggestive conceptions resulting from the positing of a comparative and a physiological point of view, — the emotion of fear.

M. Charles Richet (*Revue de deux mondes*, July, 1886, pp. 73–118) considers it an apt time for presenting the subject in a popular manner; and it may be equally worth while to give a short account of the scientific conception of fear, following in the main the article of M. Richet.

Emotions may be considered under two heads, according as they attract or repel the object by which they are called up. The three chief emotions of the latter class are pain, disgust, and fear. Each of these emotions has a physical and a psychical aspect. We use the word 'pain' to mean the sensation resulting from a cut finger, and the emotion caused by the death of a friend. We can be disgusted by a nauseous concoction, and also morally disgusted at the mean conduct of a supposed friend. There is the paralyzing effect caused by the sudden appearance of a lion, and the dread of a coming examination. As in the other emotions connected with a definite disturbance of the nervous system, there appear in the animal scale and in human development all shades, from the simplest physical reflex to the most elaborated, consciously willed action. But the emotion itself — the fear — can be readily detected in all these varying modes of expression.

Repelling emotions are protective in their function. Pain gives us tidings of the condition of the organism, and thus demands the needed remedy, and averts injury. Disgust warns us of noxious substances. The object of fear is to advertise and escape danger to life. It would not do to leave the danger to be avoided by a reasoned action: there would be no time to form syllogisms. Nature puts the emotion first, and the reasoning afterwards. The chickens would soon disappear if they had not an instinctive fear of the fox. There is, then, a simple form of the emotion which expresses itself by an unreasoned, involuntary reflex action. These effects are well shown by the typical picture of terror, — the pale features, the limbs fixed powerless to move, trembling, chattering of teeth, altered heart-beat, gasping breath, cold perspiration, etc. These paralyzing effects of fear may reach a dangerous intensity, and produce death by arresting the activity of the heart. The story told by Dr. Lauder Brunton, of an instructor who had made himself obnoxious to the college students, and, after being blindfolded, was subjected by them to a process imitating death by decapitation, and found to be really frightened to death, is a case in point. It is said that condemned criminals are often nearly dead with fright before the instrument of death is applied. These physical effects of fear are best seen in the lower animals. The fear most commonly felt by us shows itself in what may be called a psychic reflex. In this case the sense stimulus is interpreted, and then the reflex expression of fear follows. If during a performance the rope of a trapeze breaks, the sensations by which that fact is made known are at once interpreted as a threatening danger, and by the force of sympathy fear will possess the spectators as well as the performer. Of course, this is not a natural stimulus.

It has already been noticed that the effect of fear may be of two kinds, — either exciting or paralyzing. The process by which this paralyzing is effected is inhibition. The spinal cord ministers to the reflex acts of the organism; the brain, to the voluntary and automatic. A stimulation of the higher centre may arrest the function of the lower. This probably is to some extent the normal condition, for the reflexes of a frog are more intense if the brain is removed. The will can delay or inhibit reflexes. We can keep back a cough or a cold. Over other reflexes the will has less control. Few can refrain from winking when a body is moved towards the eyes (Pliny records that gladiators were tested in this way). This psychic reflex is characterized by the fact that its intensity depends little on the intensity of the stimulus (as pain, for instance, does), but almost exclusively on the individuality of the subject. The person with a timid temperament is more readily and intensely frightened. Women, children, nervous persons, are disposed to fear. So, too, animals whose only defence is a rapid flight (hares, rats) are naturally timid, while aggressive beasts of prey are brave. Even the momentary condition, whether before or after dinner, will vary the intensity of fear. There are two psychic agencies which, *par excellence*, increase fear: they are imagination and attention. The man of vivid imagination who walks along a dark road will have many more frights than his prosaic companion. The fixation of the attention which expectation causes increases the fear. The ghost expected just at midnight is more terrible than an unexpected visitor. The emotion of fear depends, thus, on individual organization, and is not under the control of the will. What the will can do is to restrain the expression of the emotion. Courage is power of inhibition. The soldier cannot help being frightened, but he can help running away. The martyr is a hero, because he can inhibit that strongest of instincts, self-preservation.

To return to the teleological point of view, it may be asked to what extent the natural reflexes are useful. What are the best ways of escaping danger? One way is evidently by fleeing. To this corresponds the exciting effects of fear, which furnish the best conditions for speed and activity. Another way is to avoid observation by restraining movement. This is accomplished by the paralyzing effect of fear. The action is seen in its highest development in the death-feigning instincts of certain insects. The explanation of trembling is rather difficult: it certainly seems to be a hurtful action. M. Richet suggests that it is the result of an attempt to arrest motion, but of an attempt not entirely successful. The cry of fear is perhaps an attempt to startle, and thus give a chance for escape.

Lastly, what are the excitants of fear? One group centres about the fear of death, of pain, and of disfavor. The first is the strongest; the second is active in small affairs; the last is of a more distinctively psychic nature. It is shown in stage-fright, where it may be accompanied by all the physical characteristics above described. Here, too, belong the peculiar sensations of vertigo to which some persons are subject to a pathological extent. It is impossible for them to cross a plank that bridges over a height. Even the bravest are subject to this feeling. That it is mental in its nature is shown, for example, by the fact, that, if a railing be set on the plank, even if too slight to be of any use in case of accident, the feeling may largely subside. It acts as a moral support. Another class of fears is inspired by the unfamiliar, by darkness, and by solitude. What is unfamiliar may be noxious. Caution is a useful trait. The savage and the child typically show this dread of something strange. The fear of ghosts also comes in this category. Darkness doubles fear: it makes things unfamiliar by preventing the use of that sense by which chiefly we recognize objects. Nobody feels perfectly at home in a strange dark room. Animals are more subject to fear at night. Man is naturally a social animal. Solitude is abnormal: it makes protection impossible. This feeling may become pathological: it has received the name of 'agoraphobia,' or the dread of open places.

A word on the power of habit over fear. M. Richet relates how he had occasion to pass frequently through a forest at night. He entered it boldly; but after a few steps the feeling came on, and he felt highly relieved when he saw the clear sky again. Each night he was able to keep up his bold step for a longer and longer distance, until finally the fear was almost overcome. Habit is the only method of removing fear. Workmen in powder-mills know they are in constant danger, but have no fear. To educate a child to be brave, the habit of not fearing darkness and solitude, and so on, must be gradually taught. J. J.

GEOLOGY OF LONG ISLAND.

THE current volume of Annals of the New York academy of sciences contains an article on the 'Geology of Long Island,' by F. J. H. Merrill, giving much definite and historical information. Mather first described it in the State natural history survey, 1842; Upham studied its moraines, in connection with those of Cape Cod, in 1879; Lewis has at various times examined its fossil-bearing sands and its curious topography, one element of the latter being the continuation of certain of its water-courses southward under the sea for a little distance from shore; and Russell has confirmed the suggestion that the streams cut their right banks more than the left, as if in obedience to von Baer's law. Merrill briefly refers to the archaean rocks at the western end of the island, and devotes more space to sections of the probably cretaceous and tertiary clays and sands of the northern shore, and to the drift. He emphasizes the thinness of the till at many points along the range of hills or 'backbone' of the island, and ascribes a good part of their height to the upheaval of the bedded deposits, which largely compose them, by the thrust of the ice. Thus marine fossils may be lifted to greater elevation above the sea than can be ascribed to continental emergence. All along the north shore of the island, the bedded gravels, sands, and clays are found upheaved, and thrown into a series of distinct folds at right angles to the line of glacial advance. On Gardiner's Island the folds are remarkably prominent in the form of numerous parallel ridges, trending east-north-east. This recalls Johnstrup's explanation of the distortion of cretaceous beds on the Danish islands of Möen and Rügen by the thrust of Scandinavian ice, and the observations of Credner and others on the distorted subglacial beds of northern Germany. The bays on the northern side of Long Island are thought to be excavations made by lobes of ice projecting for a time beyond the general line of glacial front. The highest hills of the 'backbone' are in line with these bays, as if gaining in height by the excess of pressure there; and channels, also in line with the bays, break through the hills, as if they had been kept open by the discharge of water from the ice.

ELY'S LABOR MOVEMENT IN AMERICA.

That curiously heterogeneous mass of circumstances and events which is included under the general designation 'labor movement' has given rise to a large literature, much of it polemic, some historical and critical, some constructive. It has engaged the attention and study of many scholars, and perhaps of all the more progressive students and teachers of economics and political science. Among the latter, none has been more painstaking in his research, nor more frequent in his writings, than Prof. Richard T. Ely of Johns Hopkins university. During the past few years, numerous articles and several books have issued from his pen; and the book before us is partly the outgrowth of its predecessors, and partly the forerunner, as the author tells us in his preface, of a larger work, to be entitled 'History of labor in the new world.'

The labor movement in America. By Richard T. Ely. New York, *Crowell*, 1886. 12°.

It immediately occurs to us to ask, What does Professor Ely mean exactly by the labor movement, what is his attitude toward it, and what does he tell us about it? Fortunately, the style and tone of the book, as well as its definite statements of opinion, permit us to answer all these questions clearly. Stripped of its accessories, the labor movement, in its broadest terms, is 'the effort of men to live the life of men' (p. 3). This sententious aphorism might mean a great many things, inasmuch as it affords great latitude of interpretation. But Professor Ely sharpens it to a point, and interprets it as having an economic significance truly, but, beyond and including that, an ethical import. "It is for self and others. It is the realization of the ethical aim expressed in that command which contains the secret of all true progress, 'Thou shalt love thy neighbor as thyself.' . . . It is an attempt to bring to pass the idea of human development which has animated sages, prophets, and poets of all ages, — the idea that a time must come when warfare of all kinds shall cease; and when a peaceful organization of society shall find a place within its framework for the best growth of each personality, and shall abolish all servitude, in which one 'but subserves another's gain'" (pp. 3, 4).

In contemplating this ideal state, a veritable heaven, Professor Ely grows very enthusiastic, and well he may. On studying the details of the movement which he says has this laudable end in view, however, we are forced to pause, and inquire whether the tendency is really what Professor Ely thinks it is. We are tempted to believe that he has committed the not uncommon scientific error of reading his theory into the facts, instead of deducing it from them. He tells us that the socialist and anarchist organizations have cast off Christianity, and indeed religion generally, yet he preaches Christian ethics as the remedy for the wrongs of which they complain. While not overclear on this point, yet he seems to uphold the extremists in their contention that all the evils of the present state of society are due to private property and the lack of proper co-operation in production and distribution. But Aristotle, somewhat unfashionable nowadays perhaps, saw deeper than that, and said plainly that the evils ascribed to the institution of private property really flowed from the wickedness of human nature (*Politics*, Jowett's translation, p. 35). And just here we would ask all these labor agitators, sincere and insincere, and their allies among professed economists, to consider whether their suggested remedies for industrial evils really reach the root of the trouble. We strongly incline to the belief that they do not, and that the social, political, economic, and ethical elevation of men at large and the human nature that is in them is what is wanted, and not either the regeneration or the extinction of a class.

Professor Ely's facts are very full, and, to the best of our knowledge. generally accurate. After a hasty sketch of early American communistic societies, he takes up in detail the various labor organizations of any importance, and pictures their growth and present condition. Their growth he divides into two periods, — 1800–61 and 1861–86. During the first of these periods, "an increasing number of local unions is formed; at times unions of artisans of various trades in a certain section join hands for common action; gradually the skilled laborers, pursuing the same trade, form the idea of national unions, urged on, doubtless, by the increased facilities of transportation and communication," which caused competition to become national, and not merely local. Since 1861, of course the growth has been much greater: in fact, all the principal labor organizations have arisen since that time; the Grangers having been organized in 1866, the Knights of labor in 1869, and the Federation of organized trades and labor unions in 1881. Professor Ely admits (p. 89) the impossibility of even approximately estimating the number of organized laborers in the United States, at the present time, but considers one million a conservative estimate. Admitting the accuracy of this figure, he cannot fail to recognize the fact, so clearly and so frequently proven during the past year, that their demands are not for the laboring class at large, but for themselves, the small fraction of the whole that is banded together. Furthermore, they have not infrequently trampled under foot men quite as competent and quite as deserving as themselves, simply because they did not belong to the 'union.' It is this selfish feature in the labor organizations that has drawn down upon them opposition and contempt where often they would have had aid and sympathy. 'Individualism run mad' may be bad, but organization run mad is worse.

Professor Ely can hardly be willing to subscribe to all the political aims of the Knights of labor, and indeed expressly says (p. 159) that he is not. Yet he tells us (p. 76) that they are organized for 'the attainment of beneficent public and private reforms.' Their financial programme would only be a reform in the direction of disaster; their denunciation of convict labor is either pure ignorance or else an invitation to the tax-paying population to support criminals in idleness; and the expediency of their scheme for government control of railways and telegraphs is at least open to serious question, even if not to be absolutely condemned.

What Professor Ely means by his statement (p. 161) that it is not true that laborers work peacefully and contentedly until a mischievous agitator comes along and stirs them up, we do not understand. He certainly must know that numbers of just such cases happened during the spring of the present year. The case of the 'walking-delegate' from Troy stopping a silk-factory in Paterson, and that of the Broadway car-drivers in New York leaving work because an unknown individual snapped his fingers, are perhaps the best known.

We have taken pains to touch upon these seemingly minor points in Professor Ely's book, because it seems to us a book likely to be widely read, both by the laboring classes and by the reading public generally, and for that reason erroneous statements otherwise minor become important. We had marked several other statements for correction, but lack of space compels us to mention but one of them. On p. 286 we read that our "laboring population consists chiefly of men and women of foreign birth or foreign parentage." This is given as the reason why the socialistic societies are composed principally of foreigners, and is presumably intended as a reply to the statement often made, that socialism and communism have no place in the United States, and appeal to very few citizens who are not foreigners by birth. But, as a matter of fact, the census statistics do not uphold Professor Ely's assertion. In 1880 there were engaged in twenty selected occupations 17,392,099 persons. Of this number, 13,897,452 were of native birth, and 3,494,647 of foreign. Moreover, there were only 6,679,943 foreign-born men, women, and children in the country in 1880, and only 5,758,811 of those one or both of whose parents were foreigners.

While criticising these points in Professor Ely's book, we can commend it as a good, clear, and fairly accurate statement of what our labor organizations have done and are doing. Its account of their literature in this country is the best we have seen anywhere. But it must be read with caution; for the author is somewhat of an idealist and a *doctrinaire*, and often lets the demands of his theory blind him to the true nature and tendency of the facts of which he treats.

His insistence on the necessity for an ethical bond in society as well as an industrial one, and for an ethical end toward which all true progress must move, and his sharp condemnation of violence and force in effecting social and industrial changes, are two of the best features of the book.

Somebody — whether author, publisher, or both, we do not know — is to be severely censured for allowing a book so full of facts and statistics to appear without any index whatsoever. It lessens its value one-half. N. M. B.

FORNANDER'S POLYNESIAN RACE.

THE third volume, recently published, completes this remarkable work, which has a decided and peculiar value, in a scientific sense. This value, however, is not that for which the author himself is most disposed to claim credit. The ethnological and linguistic speculations which occupy his third volume, and on which he has evidently bestowed much labor, will not commend themselves to the judgment of students familiar with such inquiries. But the portions of his work devoted to the history, traditions, and ancient usages of the Hawaiian people, have great interest. The many legendary chants which the author has preserved possess no mean poetical merits. But their chief value is historical ; and the conclusions to which they lead have an importance extending far beyond the limits of the field to which the legends relate. One of the most notable results of Mr. Fornander's work, and the one for which it will be perhaps most cited hereafter, is the clear proof which it affords that traditions going back for several centuries may, under certain conditions, be accepted as authentic history. No one who reads these volumes can have any doubt that the Hawaiian annalists are able to give an account of events which have occurred in their islands during a period of at least nine hundred years, and to relate these events with sufficient fulness and accuracy to enable the compiler to make out of them a fair chronological narrative. The genealogies go back some centuries further, but with fewer details and greater uncertainty. The authentic history must be restricted to less than a thousand years ; but even within this limit it upsets completely some assumptions which have been confidently maintained by writers of considerable eminence. The notion that no unwritten tradition which goes back more than a century can be trusted is shown to be wholly unwarranted. Those who have maintained it have failed to discern the distinctions which make such traditions trustworthy or the reverse. Much, as we now see, depends upon race. There are races and tribes in whom the historical instinct is strong, as we find it in the Chinese and the Arabians. There are others, like the Hindoos, in whom it seems almost entirely lacking. The test of its presence appears to be the disposition to preserve genealogies. As among the Arabian tribes, so in all the Polynesian groups, the pedigrees of noted chiefs and of reigning lines are preserved with great care. They are usually thrown into the form of metrical chants, which are easily retained in the memory. The three names of each generation — father, mother, and child — make a verse of the chant. The child whose name concludes one verse is the father (or mother) in the next. In this manner a series of catch-words is maintained throughout, making it impossible to derange the order of the pedigree, and easy to keep the chant in memory. Thus, for example, the later descents of the British royal family, recorded in the Hawaiian fashion, would run as follows : —

George the Third the father, Charlotte the mother, Edward of Kent the child ;
Edward of Kent the father, Victoria the mother, Victoria the child ;
Victoria the mother, Albert the father, Albert Edward the child ;

and so on. It is evident that any one who could learn by heart a hundred lines of verse would easily learn and remember a hundred generations in this singsong. Compared with the Homeric catalogue of ships, it would be a trivial effort of memory ; and, where such a chant was known to many persons, any mistake of one reciter would be promptly corrected by others.

Every island and every large district of the Hawaiian group had the pedigree of its ruling family carefully retained and often repeated by the priests and other dependents of the family, as well as by the chiefs themselves. As intermarriages were frequent, these genealogies confirm one another, in a manner which leaves no doubt of their correctness. The more important chiefs of each line have special traditions attached to their names, and recorded frequently, though not invariably, in metrical form. Sir George Grey and other inquirers in New Zealand, and the missionaries in almost every important island of Polynesia, have found similar customs prevailing, and have been able to trace back the histories of the various islands with unquestionable exactness for periods varying from two hundred to a thousand years. The data supplied by Mr. Fornander far exceed in number and value those collected by any other investigator. Their abundance, and the exactness insured by the compiler's habit of judicial scrutiny, make his work the highest authority on this subject, and indispensable to any historical writer who desires to satisfy himself or his readers in regard to the credibility of unwritten traditions, when preserved under certain favorable circumstances.

An account of the Polynesian race : its origin and migrations; and the ancient history of the Hawaiian people to the times of Kamehameha I. 3 vols. By ABRAHAM FORNANDER. London, *Trübner*, 1878-86. 8°.

Mr. Fornander has also brought to light the evidences of an interesting series of movements which began in the Polynesian Islands about the commencement of the eleventh century of our era, and continued for two or three hundred years. During that period, as he shows us, "the folk-lore in all the principal groups becomes replete with the legends and songs of a number of remarkable men, of bold expeditions, stirring adventures, and voyages undertaken to far-off lands." For seven or eight generations the navigators of the leading groups, from the Sandwich Islands in the north to the Society group in the south, and from the Friendly Islands in the west to the Marquesas in the east, were accustomed to interchange visits, and to voyage freely to and fro, with far more assurance and better seamanship than were displayed by the early Greek and Italian sailors in the Mediterranean. Yet the distances thus traversed sometimes exceeded two thousand miles, and crossed both the north and the south trade-winds and the equatorial belt. These surprising feats of seamanship were performed by people who were still in the stone age, and so far back in that age, in the industrial sense, that they had not even arrived at the invention of pottery. Such facts show, that, in accounting for the movements of population in primitive times, mere distance and difficulties of navigation need hardly be taken into account.

The author has traced with much care the history of the Hawaiian people from the close of that era of unrest and adventure in the thirteenth century, down to the time, in the early part of the present century, when Kamehameha, with the help of foreign arms and auxiliaries, succeeded in uniting all the islands under one government. The whole of this portion of the work is of great interest. The industry and judgment displayed in collecting and sifting evidence secure the reader's confidence. The details which are given concerning the primitive customs and social arrangements of the people have much ethnological value. In passing from this section of the work to that in which the author sets forth his views respecting the origin and affiliations of the Polynesian race, a serious disappointment is experienced. The undoubted success achieved in dealing with the native traditions and other local matters, which were familiar to the writer, deserts him when he ventures into this wider and less-known field. The student of philology, however, will be able to extract even from this portion something that will be useful to him. Ethnologists, while they will find the author's archeological theories and his peculiar etymologies fanciful and unsatisfying, will not allow these minor defects to blind them to the great and indeed unique value of his work as a treasury of local traditions and customs and a trustworthy historical record.

PACKARD'S FIRST LESSONS IN ZOÖLOGY.

This is an abridgment of the larger works by the same author, and is intended for the use of beginners. It contains about two hundred and ninety pages, including glossary and index. It differs from the larger works in the same series in treating of fewer forms, containing much less anatomy, and the general, by no means entire, omission of the embryonic development of the different groups. The general plan of the book, and allotment of space to the different types and classes, is good, although some important groups have been, perhaps necessarily, slighted. Thus only four pages are devoted to vermes. There is the same lack of clearness and exactness in definition so characteristic of the larger text-books in the same series. Thus the definition of 'Coelenterata' contains no reference to the radiate structure of the animals, to tentacles or thread-cells, or to the use of the same cavity for digestion and circulation. Most of these points have indeed been noticed in the general description, but, in summing up the essential characteristics of the type, they are all omitted. The same definition, too, leads us to infer that all Coelenterata pass through a medusoid stage. The definition of 'echinoderms' is hardly more accurate. Those of the higher types are somewhat better, sometimes good. The forty pages devoted to insects are the best part of the book. Each order has its special chapter, in which some important species is described as fully as the size of the book will allow. Any boy or girl who has studied these chapters thoroughly will not only have some knowledge of them, but, what is far more important, will certainly have a new interest in them and a stronger desire to study the different species and find out their habits. The style is clear, and the subjects made interesting. The student's mind is not confused by a mass of details, or by unsatisfactory descriptions of a large number of specimens which he can never expect to see, much less examine ; but the brief sketches of a few of the most important forms will awaken in him a desire for wider knowledge. The figures are numerous, averaging almost one to each page ; yet they are so well selected, that, while one grudges so much space, he finds few which he would omit. They are clear and well executed.

First lessons in zoölogy. By A. S. Packard. New York, *Holt*, 1886. 12°.

SCIENCE.

FRIDAY, OCTOBER 22, 1886.

COMMENT AND CRITICISM.

THE LARGE NUMBER of persons who are interested in the subjects of prison labor and prison management generally look forward to the second annual report of the national bureau of labor with great interest: for it has been announced that in this report Col. Carroll D. Wright, the able and experienced chief of the bureau, will give the results of his investigations, made personally and by special agents, into the question of labor in prisons in all its forms and its relations to labor outside. In his circular of instructions to agents, Colonel Wright enumerates four systems of prison labor in the United States, and defines them, — the contract system, the piece-price system, the public account system, and the lease system. The inquiries made cover the kind, grade, and value of the goods produced, the number of hours of daily labor required, the number of convicts employed in productive labor, the number of free laborers necessary to perform the work, and the average wages of free laborers. Colonel Wright also wants to know the number of convicts idle or employed in prison duties, the aggregate number, their average age, the average length of sentences, the amount received by convicts for working over-time, and the receipts and expenses of the institution. The inquiry is meant to throw light upon the following points: 1°, the influence of the labor of convicts upon free labor; 2°, the influence of the various systems in use upon the criminal; 3°, the general conditions under which the work is carried on. This question of convict labor is a wide and complicated one, concerning which we need, above all else, to know the exact facts, inasmuch as it has of late taken on a political aspect as a result of the representatives of certain classes of the community. We can trust Colonel Wright's ability and integrity to procure and lay before us these facts.

THE POPULAR GENIALITY of Mr. Grant Allen's scientific writings has perhaps seldom found so appropriate a theme as the one discussed by him in the October issue of the *Fortnightly review*, — a theme, by the way, not at all suggestive of a scientific article; namely, 'Falling in love.' The article was called out by the following sentence in the address of the president of the anthropological section, Sir George Campbell, at the recent meeting of the British association: "Probably we have enough physiological knowledge to effect a vast improvement in the pairing of individuals of the same or allied races, if we could only apply that knowledge to make fitting marriages, instead of giving way to foolish ideas about love and the tastes of young people, whom we can hardly trust to choose their own bonnets, much less to choose in a graver matter in which they are most likely to be influenced by frivolous prejudices." The question is a serious one; for it raises the issue whether the time-honored instinct of falling in love is a useful one or not; whether an artificial system of pairing would accomplish the object, the amelioration of the race, better and more directly.

Mr. Grant Allen decides that this most involved exemplification of the universal selective process is thoroughly efficient: for we cannot fall in love with everybody alike; and the person with whom we do fall in love, as is shown by the fact that in nine cases out of ten it is a reciprocal affection, is to some extent our physical, moral, and mental complement. In this way too close likeness is avoided, and the great means of betterment — variation — is insured. Moreover, it is the biologically excellent traits that are sexually attractive, — youth, beauty, strength, health. So strong ought our faith to be in the efficiency of this curious, vague, and unfathomable instinct, that it should be our aim to discountenance all but marriages on the principle of spontaneous affection. It is the marriage on the basis of money, of rank, or other practical reasons, that results in deterioration. In short, the old theme of the novelists and poets is justified against the rather crass precept of the modern scientist. But a word for the latter should be added. It is, that, without any artificial interference, the public sentiments, so influential in the guidance of the sexual selections, can be unconsciously guided into the channels which science points out as the best. Science should and can not prevent people from falling in love; but can it not so influence public opinion as to make falling in love even a more efficient and beneficial process of selection than it now is?

THAT THE LAWS which now exist for the protection of the ignorant, both poor and rich, against quacks and charlatans, are totally inadequate to that end, must be painfully evident to every one who keeps himself at all informed on the general news of the day. It is not long ago that one death was caused by the application of kerosene, and another by the fluid extract of the St. Ignatius bean. Within the present year a strong, robust farmer in middle life, and apparently having a long life before him of usefulness and enjoyment, was, within ten hours after the application to the lip of strong potash and chloride of zinc by one of these harpies, dead from the absorption of this corrosive poison. The first two cases mentioned were brought to a successful issue in the courts; the judge holding, that if a person publicly practising as a physician, on being called to a sick person, prescribes with foolhardy presumption a course of treatment which causes death, proper medical assistance being at the time procurable, he may be found guilty of manslaughter, although he acted with the patient's consent, and with no ill intent. There is no more important legislation than the regulation of the practice of medicine; and it is to be hoped that the medico-legal societies or some other organizations will prepare laws which will drive from the country the thousands of impostors who are to-day living and growing rich upon the credulity and ignorance of the people.

AMERICAN ARCHEOLOGISTS might conveniently be divided into two classes, — those who dig, and those who do not dig. The diggers seldom get beyond the range of articles which they or some one else has dug up: the non-diggers rely chiefly on the chroniclers or contemporaneous historians for their facts. It is seldom that we meet with a man, who, like Mr. Maudslay, combines the best features of the two schools. At a recent meeting of the Royal geographical society, he gave an interesting account of his exploration of the ruins and site of the old Indian pueblo of Copan. This place was apparently unknown to Cortes, who passed near it in his celebrated march to Honduras. Our author argues from this that it was uninhabited at the time, — a deduction that does not seem to us altogether safe. At all events, the place is not mentioned by any early writer, and the first account we have of it is in a letter from the licentiate Diego de Palacio, an officer of the Audiencia of Guatemala in the year 1576. Copan, in the usual sense of the word as applied to the village which has been built amidst the ancient ruins, is situated just within the western boundary of the republic of Honduras, on the right bank of the Copan River. Mr. Maudslay went to work in a truly methodical and scientific way, and the results of his research are in some respects remarkable.

ALTHOUGH PROFESSOR FROTHINGHAM has left Baltimore to accept a chair at Princeton, the Johns Hopkins university is not to be without an instructor in archeology this winter. Prof. Rodolfo Lanciani is announced to give a course of six or more lectures during the current academic year, probably in January next, on Roman archeology. Professor Lanciani, though still a young man, has made a wide reputation for himself, and is one of the very first authorities on Roman archeology. He has been for some years inspector of excavations at Rome, and professor of archeology at the university there. He is a leading member of the Roman archeological commission and of the Pontifical archeological society. He has followed with great care the very important excavations that have, since 1871, laid bare so large a portion of the ancient Latin capital. In 1880 he published "I comentarii di Frontino intorno le acque e gli aquedotti, sylloge epigrafica aquaria," — a work which was crowned by the Academy of the Lincei. This book forms but a part of Professor Lanciani's great critical and historical work on the topography of ancient Rome, on which he has been at work for a long time.

A CASE OF GREAT INTEREST and importance has just been decided in Brooklyn against the municipal authorities. In 1881 the legislature of the state passed what is known as the 'plumbing law,' by which the plumbing and drainage of all new buildings were required to be done under the direction of the board of health. For the guidance and instruction of the plumbers, rules and regulations were established governing the construction of the works referred to in the law. Some of the plumbers violated these rules in various ways, among others by putting in iron pipe of a less thickness than was permitted. Although such a violation was made a misdemeanor, it was found that houses might be constructed with serious defects; and, before any legal measures could be taken, the houses would be occupied, and the health of the occupants imperilled. In order to assist the health department in the enforcement of the law, the city works commissioner passed a rule that Ridgewood water should not be furnished to any new house until the plumbing-work was completed in accordance with the sanitary rules. For five years this rule has been enforced, and has been of great aid to the health officials in their endeavors to have houses properly sewered. Recently a row of houses has been constructed in which the soil-pipes were of light iron, in violation of the law; and, as the health department would not accept the work, no water could be obtained. On an application for a mandamus to compel the city to furnish water, one of the judges of the supreme court granted it, although the soil-pipes are of such weight as not to comply with the regulations. He holds that the city must grant permission to introduce water entirely irrespective of the regulations of the health department, and that, if any of these are violated, there is a remedy provided by the law. The result of this decision will be to embarrass the health department, temporarily at least, although ultimately it will doubtless find some way of speedily punishing offenders against the law.

It seems that the 'bogus butter issue,' as the politicians call it, is not confined to the United States. A similar agitation to that recently witnessed here is taking place in India; and a bill dealing with the adulteration of *ghee*, or clarified butter, hurriedly drawn and introduced in response to the urgent demands of the native community, has recently been passed by the Bengal council. The scope of the measure is very broad; and it applies, not to Calcutta only, but to all municipalities in the province. The result will be, it is hoped, the subsidence of the panic which has prevailed for several months. The reason for the panic is apparent, for *ghee* enters into the composition of every kind of cooked food used by all classes of the natives, and its adulteration with beef or pork fat meant loss of caste to Hindoos, and defilement to Mohammedans. So great has the panic been, that the wealthier natives have been importing *ghee* from Persia, while those unable to afford that have been abstaining altogether from cooked food. The subject has attracted such general attention, that it will probably be dealt with as part of a general act, applicable to all India, to prevent the adulteration of food.

THE PRESENT CONDITION OF THE COAST SURVEY.

The administration of President Cleveland presents no greater enigma than the contrast between the high standard of public fidelity which its head has infused into most branches of the public service, and the unending succession of personal quarrels, charges, and counter-charges which he has allowed to discredit the administration of the coast survey, and impair its character and efficiency. The present condition of that work is such as almost to make us forget that there was a time, and that within the memory of every reader, when it was the model branch of the civil service, enjoying a world-wide reputation for the perfection of its organization, the standard of its work, and the character of its assistants, and cited by the advocates of reform as an example of what the civil service might become under an improved system of appointment to and tenure of office. One wanting to know on what system a scientific bureau ought to be administered cannot do better than study Bache's administration of the coast survey, and note how he combined the greatest liberality with the most scrupulous regard to the forms of law, the responsibilities of a public officer, and the requirements of a disciplined service.

Fifteen months have now elapsed since this dream of perfection was suddenly interrupted by the alleged discovery of grave irregularities and the forced resignation of a superintendent. Men were not unprepared for the latter result. It had become widely known that physical and mental infirmity, intervening at the end of a long and honorable career in the public service, had incapacitated the superintendent for the proper execution of his office; but wise and thinking men reserved their judgment when they were assured through the public prints that general corruption had eaten into the vitals of the organization, and that the work made famous by Bache had become a nest for peculators of the public funds.

The first act of the administration after learning of the seemingly demoralized condition of the survey was the appointment as superintendent, of the man on whose report of irregularities that office had been made vacant. For such an appointment there could be but one apology. The President and his secretary of the treasury were responsible to the public for the conduct of the survey; and it was their duty to take every measure for discovering any irregularities which might exist in its administration. A searching inquiry into the past disbursements of the officers and employees was eminently proper under the existing circumstances. Mr. Thorn, as head of the investigating commission, was well qualified for the inquiry; and we may charitably suppose it was on this account, and this alone, that he was made superintendent. Such being the case, the course prescribed by every principle of public justice and governmental policy was quite clear. An old and reputable branch of the public service was on trial before the President, for grave shortcomings in the conduct and character of its employees. Sound policy required that it and they should be conceded that same right to a speedy trial and a public verdict which an individual enjoys when accused of crime. For more than a year a body of men of high professional attainments and unstained reputation have felt themselves wounded by imputations on the service to which they belong, of which they once were proud, and of which they sometimes hope to be proud in the future. After waiting so long, they cannot but feel it a public wrong that the head of the government takes no measures and announces no conclusions which will indicate his verdict upon their official characters.

In this connection let us think kindly of Mr. Thorn. No one questions the honesty of his intentions or the purity of his motives. Circumstances not of his own making imposed upon him a disagreeable duty, in the performance of which he has spent more than a year. He has done as well as possibly could be expected of a man without administrative experience, placed in charge of a great public work in the capacity of prosecuting attorney. Gradually compelled by the force of circumstances to conduct the office in accordance with long-established custom, and to trust the men whom his predecessors have trusted, he now sees the very accusers of former administrations, who put him into power, turning against him, and even going so far as to file charges of malfeasance in office with the public prosecutor of the District of Columbia.

In the Washington *Post* of Monday last we find a statement by him so conclusive of the whole question, that we should doubt its authenticity did it not bear every mark of being given in his own words. At the conclusion of a long reply to the charges we have mentioned, he alludes as follows to the testimony of last year, on which the survey was condemned, and Mr. Hilgard compelled to resign: —

"The testimony, which the present proceeding is said to be intended to revive, has been out of my custody and in that of the department much more than a year. It is mainly *ex parte* affidavits, some true, some false, some mistaken, some since retracted, and more or less wild gossip since disproved. The publication of such material against people who were not confronted with the witnesses, and did not cross-examine them nor appear by counsel, and the spreading of it before the public, who can know nothing of the credibility or motives of any of the witnesses, or of the probable value of their testimony, would be simply an indiscriminate assassination of character."

Such an admission is most creditable to him, and must gratify every lover of purity in the public service. It must require a rare endowment of moral courage and respect for truth and justice to move one to speak thus of testimony which was collected by himself, and which formed the only basis for his appointment to one of the most important offices in the gift of the President. If we accept Mr. Thorn's statement, we shall see why the present condition of the survey tends to demoralization. It is a public establishment, in the prosecution of which the *esprit de corps* of its members is as important a factor as it is in the army or the navy. But the revival of the old pride in the service is impossible under the conditions which now prevail. The survey is in danger of losing the services of its best men, whose incentive to work is not salary, but professional pride in the honorable character and public utility of the work they are doing. That vacancies can be filled by men of equal promise under the conditions which now prevail, no one acquainted with the case can for a moment suppose. There will, of course, be a crowd of applicants for every vacancy, but the number really fitted for the places will be small, and will be sure to be passed over by any one but an expert in the selection of men for such a service. A year or two more such as the last will leave nothing worth preserving of an organization which was once the pride of American applied science, and a connection with which was a letter of introduction to similar organizations the world over.

SORGHUM SUGAR.

Experiments are being carried on at Fort Scott, Kan., this fall, under the direction of the U. S. department of agriculture, in the application of the diffusion process for the extraction of the sugar from sorghum cane. This is a continuation of the work at Ottawa, Kan., last year, the results of which are embodied in Bulletin No. 7, chemical division, department of agriculture. At Ottawa experiments were made in connection with a sugar-factory, which employed a mill to work up most of their crop. This year the Parkinson sugar company of Fort Scott, relying upon the results obtained there, erected no crushing machinery whatever, depending entirely upon the diffusion battery to extract the sugar from their cane-crop of over eight hundred acres.

The crop this year showed the remarkable power of resistance to drought of the sorghum-plant, the patches of which constituted about the only oases of green in an otherwise dry and withered-up vegetation.

The factory has been in operation since about the 1st of September; and while the results do not, perhaps, fulfil the anticipations of the more ardent advocates of diffusion, still they are in many respects most satisfactory, and full of promise for the future success of the sugar industry.

It is turning out a very fine article of sugar, in large quantities, fully as good as to crystallization, color, and taste, as any made by mill extraction; while the analysis of the exhausted chips shows an almost complete extraction of all the sugar content of the cane, — something which is impossible to obtain by pressure extraction, however thoroughly applied.

The principal difficulties which were encountered have been, first, the proper chipping of the cane, or preparing it for diffusion; and, second, the treatment of the juice obtained. These are both points in which the previous applications of diffusion, viz., on beets, offered but little guidance, the nature of the substance used being so very dissimilar. The sorghum cane is fed directly to the cutters, with the leaves and sheaths still on (it is too expensive to strip it); and while these are partially taken out afterwards by means of blowers and fans, still a large percentage find their way into the cells with the chips of cane, and from these a great many colloid matters are extracted by the juice which interfere materially with its proper clarification and the crystallization of the sugar. The solution of this difficulty will undoubtedly be found in a more perfect mechanical cleaning of the chips, or by the invention of machinery by which the stripping of the cane can be accomplished more cheaply than by hand-labor.

The problem of the proper treatment of the juice calls for the greatest amount of chemical ingenuity and invention. The juice obtained by diffusion is much more impure and difficult to treat than that obtained by a mill, partly on account of the presence of the leaves, etc., as already mentioned, and partly because the tissue of the cane does not seem to be as good a medium for osmosis as that of the beet.

The process sought to be applied to this juice at Fort Scott is that of carbonatation as used upon beet-juice. The details of this process are well known to those versed in sugar methods: milk of lime is added in large excess to the juice, and is then precipitated as carbonate by treating with carbonic-acid gas. The glucose, however, which is a constant constituent of sorghum juice, and of which the beet contains no trace, unites with the lime to form a dark-colored, bitter-tasting compound, which no amount of carbonating can break up. This difficulty has been to a large extent surmounted by performing the carbonatation at a low temperature, and heating only after the excess of lime has been entirely neutralized by the carbonic-acid gas. A novel modification of this process has also been attempted by adding freshly precipitated carbonate of lime directly to the juice, heating, and sending directly to the filter-presses, thus avoiding the direct contact of the juice with caustic lime. The indications from the present results are most hopeful, — that, with the expenditure of a small fraction of the money and brains that have been required to develop the sugar of the beet, the sorghum-sugar industry will take a leading place among American industries, and enable Uncle Sam to accomplish a long-cherished hope, viz., of making his own sweets.

It is the intention of the department of agriculture, at the conclusion of the sorghum season, to make some trials of the Kansas machinery upon Louisiana cane, getting it in by rail, pending the trial of next year, when it is expected to erect a diffusion plant in that state. With the proper co-operation of the railroads and of the southern planters, this can undoubtedly be carried out; and the results will be most valuable. The sugar-planters of Louisiana have been watching with the keenest interest the experiments in Kansas, several of their representative men being on the ground. They reason that its success upon sorghum cane will augur its success upon their own plant, many of the difficulties attendant upon its application to the former not holding good with respect to the latter.

LONDON LETTER.

THE series of congresses, more or less scientific in character, which in England claim a share of attention from men of science, who devote some of their hardly earned vacation to them, may be considered to have closed with the Sanitary congress at York. Sir Spencer Wells presided over it, and in his opening address observed that the main question now to be considered is, how sanitary improvements may be carried still further by the co-operation of investigators, legislators, and administrators. For this purpose he suggested the formation of a college of health, to organize a well-directed attack against existing obstacles. Much, however, had been done: in the last fifty years, for example, the average duration of life in Great Britain had been raised from thirty to forty-nine years. Of the various subjects discussed at the congress, probably the disposal of the dead was the one which excited the greatest interest. There appeared to be decided evidence that the feeling in favor of cremation was on the increase; and the opinion of the representative clergy present was to the effect that they were waiting for a decisive word from the scientific men upon the matter, by whom they were willing to be guided.

The return to England of the Solar eclipse expedition on Sept. 20 was speedily followed by a letter from the *Times* correspondent who accompanied it, in which the chief results obtained were discussed in preliminary fashion. Most of this letter is reproduced in *Nature* for Sept. 23. The new facts obtained were chiefly due to the work of Professor Tacchini, who satisfied himself that there was a great distinction between the eclipse prominences and those seen by the ordinary method. Both he and Mr. Lockyer consider that the former are due to down-rushes of comparatively cool material upon the sun's surface, and that they form a whitish fringe round the more incandescent centre. This, if well established, has a very important bearing on the theory of solar physics. Captain Darwin's work appeared to demolish entirely the idea entertained by Dr. Huggins and others, that the solar corona could be and had been photographed at times other than those of eclipses.

The opening of the medical schools in connection with the metropolitan hospitals, at the beginning of October, is always signalized by the delivery of some thoughtful introductory addresses by prominent members of the staff. One of the most remarkable of these was delivered at St. Mary's hospital by Dr. Malcolm Morris, and dealt with mysticism, scepticism, and materialism in medicine. He thought that the element of mysticism in medicine had been forced on it by the public. It was the result of two opposing conditions, — the absolute knowledge demanded by the laity, on the one hand; and the more or less extensive ignorance of the professor of the healing art, on the other. This ignorance, where it existed, he must not acknowledge: he was expected to be able to recognize disease, and to know how to treat it. Despite recent strides, medicine was still extremely defective. The absolute knowledge insisted on by the public could not be obtained, and therefore had to be invented. Scepticism in medicine was neither more nor less than modern fatalism. The tendency of the present day was to devote attention to the part rather than the whole, and it was too commonly supposed that truth lay at the bottom of the microscope. At King's college, Dr. G. Johnson, F.R.S., urged at some length the value of the study of chemistry as a mental training and discipline, and then proceeded to point out that the only safe foundation for specialism was a thorough knowledge of disease in general; and this he illustrated by reference to diseases of the eye and of the larynx. The principal of the Royal veterinary college pointed out that in both human and veterinary medicine the elaboration of the germ theory of Pasteur, in its earlier triumphs in the department of surgery, was likely to be surpassed by what might reasonably be expected would yet be achieved in the domain of medicine.

True to the exceptional character of the year in matters of temperature, October has set in unusually hot, 78° being recorded in the shade in London on Oct. 1. Such an October temperature has only once been exceeded during the maintenance of existing records. W.

London, Oct. 3.

NOTES AND NEWS.

CAPTAIN BAKER, British steamship Red Sea, Liverpool to New Orleans, reports to the U. S. hydrographic office that on Sept. 19, when some miles north of the Azores (exact position not given), he experienced what he considers an earthquake shock, on account of its suddenness, force, and after-effects. The first warning of a meteorological change was noticed in the dropping of the barometer for a tenth or more, and the freshening of the breeze, though veering. This was suddenly followed by a shock, sudden and powerful, causing the vessel to be thrown on her beam ends. She quickly righted, and was headed on just in time to meet the immense sea which suddenly rushed towards the port bow. She rode it gallantly, throwing her propellor far out of the water, shaking the coal on deck (for the donkey-engine) all over, and causing the boats to strain their davits severely. No damage was sustained, but the captain doubts if any heavily laden vessel could have ridden the sea as his vessel did, she being in ballast only.

— *Nature* states that advices from the waters of Spitzbergen now confirm the former news from Iceland and from the mouth of the Pechora, on the Siberian coast, to the effect that the ice in the Arctic Sea has this year extended unusually far southwards. Spitzbergen, the sealers report, was found to be surrounded with an ice-belt from five to eight miles broad, and there was firm pack-ice from Hope Island to Forland, about fifty-six miles. The great bays on the Storfjord, Hornsund, Bellsund, and Isfjord, were quite inaccessible; and the sealers, after waiting all the spring and most of the summer, returned at the end of August, as there was no prospect of the polar ice dividing.

— Mr. H. B. Gibson of Harvard college presents in the *American meteorological journal* the results of a study of the water-spouts on or near the Gulf Stream, recorded on the monthly pilot-charts of the hydrographic office. He shows that they are here by no means so rare in winter as observations from other parts of the ocean have led writers to suppose; and, on comparing the dates of their occurrence with the corresponding signal-service weather-maps, it appears that they coincide with the extension of cold north-west winds, or 'cold waves,' from the land out over the relatively warm sea. A similarly exceptional winter frequency of spouts might be looked for on the warm Kuro Siwo, east of Asia.

— The need of a neat and comprehensive record-book for meteorological observations has been supplied by Sergeant O. N. Oswell, of the signal service (now at Cambridge, Mass.), who has prepared a blank volume giving appropriate pages, columns, and daily lines for temperature, pressure, precipitation, humidity, wind, weather, and remarks, followed by a page for the monthly summary. Its use would save much time to the many volunteer observers who have to rule their columns to suit their needs.

— A statement to the effect that glass railway rails were being manufactured in Germany, which has been going the 'rounds of the press,' was based, it is discovered, upon the mistake of a translator, who should have written 'sleeper' instead of 'rail.' Samples of these glass sleepers for railway rails, recently tested in Glasgow, resisted a weight of four hundred pounds falling nine feet and a half, not breaking until the sixth blow. Cast-iron sleepers are expected to stand a similar test up to seven feet only.

— A report on the Charleston earthquake, by Prof. T. C. Mendenhall, at that time an assistant in the U. S. signal service, states that the origin of the disturbances appears to have been somewhere below a point fifteen or twenty miles north-west of Charleston; that is, in the neighborhood of the town of Summerville. A chart of provisional coseismal lines, drawn by Mr. Hayden of the geological survey, and published in *Science* for Sept. 10, seems to locate this centre somewhat farther north than the point indicated above. At the time of its construction, however, information from many points was lacking, and that which was at hand was admittedly doubtful in some degree.

— The *British medical journal* reports the case of a workman who fell a distance of 110 feet from the steeple of a church. In his fall he broke a scaffold, and, after passing through the roof of an engine-house, broke several planks and two strong joists, finally falling upon some sacks of cement. As a consequence of this fall, one leg was broken, several small bones about the wrist were dislocated, and the back and hips were bruised, notwithstanding all of which the man left the hospital where he was taken for treatment in twelve days, with his broken leg in a splint of plaster-of-Paris.

— *El thifaa* ('the cure') is the name of the only medical journal published in Egypt. It is printed in Arabic, and published monthly. Its price is thirty-five cents a number. The principal contributors are Egyptians and Syrians. It has proved in every way a success.

— The St. Petersburg *Novoe vremya* of Oct. 1 contains an article on the Afghan frontier question, exhibiting surprise at the recall of the British commission, expressing the opinion of the possibility of further misunderstandings as to the north-eastern frontier at the foot of the Pamir range, which section is insufficiently explained by the agreement of 1873, and dwelling on the necessity of defining the frontier on the middle and upper Oxus, where Afghanistan borders on Bokhara. The Afghan frontier commission reached Haibak, 190 miles from Khamiab, on the 26th of September, and halted for a few days to explore the Hindoo Koosh passes. It probably reached Cabul on Oct. 14.

— That cholera has obtained a strong hold in Europe is becoming daily more apparent. The disease still exists in Pesth, and it is reported that at Szegedin, Hungary, seven persons died within twenty-four hours. The Austrian state director of railways returned to Vienna from Pesth last week, and died from cholera on the 17th.

— The fever which existed some months ago at Biloxi, Miss., a seacoast town eighty miles east of New Orleans, on the Louisiana and Nashville road, and which was pronounced to be yellow-fever by the Louisiana state board of health, has again broken out in epidemic form, there having been three hundred cases with eighteen deaths. Great excitement exists in New Orleans and its vicinity, and the most rigid quarantine has been instituted against the entire county in which Biloxi is situated.

— The first person upon whom the title of doctor in medicine was ever conferred was William Gordenia. The college at Asti gave the degree in the year 1329.

— During the past year two new methods of treating hay-fever and other forms of nasal catarrh have come into use. The one is the use of the galvano-cautery for destroying the mucous membrane of the nose; and the other, the employment of hydrochlorate of cocaine, either in the form of spray or as a suppository or tablet. The testimony of the physicians and the sufferers from hay-fever who took part in the thirteenth annual meeting of the Hay-fever association in Bethlehem, N.H., was to the effect that cocaine gives but temporary relief. Some reported that they were completely cured after treatment with the galvano-cautery; others, that they were much relieved; but the larger number of those who had been thus treated had found no relief whatever.

— Dr. William H. Dudley, president of the collegiate department of the Long Island college hospital, Brooklyn, died in his seventy-sixth year, on the 8th of October, from hemorrhage of the lungs. He was one of the founders of the hospital, and lived to see it take a place in the front rank of American medical colleges.

— The Brookville society of natural history has recently been provided with very commodious rooms in a new business block. These rooms are now being fitted up for its use, and will be occupied by Nov. 1. Dr. D. G. Brinton of Media, Penn., delivered the first of the lectures in the course given by the society, on the evening of Oct. 15, upon 'The study of man.' This will be the fifth course of free lectures which this society has given.

— Mr. G. A. Smith, the private secretary of Mr. Edmund Gurney, the indefatigable secretary of the Society for psychical research, is shortly to visit this country, and while here will hunt up a good many of the persons who have furnished accounts to the society. Mr. Gurney's book, 'Phantasms of the living,' will appear shortly. It will be recalled that it was announced in the spring; but a large fire destroyed almost the entire edition, and from correcting the proof on, the whole process of book-making had to be gone through with a second time.

— The Afghan frontier commission is now expected in India. Colonel Lockhart's mission found that Manchester cotton goods had complete command of the market in Ghilgit, Chitral, and even Wakhan, and sold at an average price of one rupee for five yards. Russian cotton seemed unknown, and what was not obtained from English sources was supplied locally or from Chinese Kashgar. They also found that American fire-arms were imported *via* Russian Turkestan, underselling English weapons from India. A good revolver from Cincinnati was purchased in Chitral for fifteen rupees.

— Mr. George Muirhead, says *The athenaeum*, has for some years been studying the birds of Berwickshire, and is about to publish his researches. He has paid special attention to the hawks, the dotterel, the bittern, and other birds, many of which are rapidly lessening in numbers. Provincial bird-names and folk-lore will not be forgotten, and a special chapter will be devoted to falconry. The book will be illustrated by etchings, and Mr. Douglas of Edinburgh will publish it.

— It is gratifying to find that lithology is being rescued from the status of a merely 'practical study,' in the curriculum of the American college, and is becoming established as an exact science. The monograph ('Modern petrography,' by G. H. Williams, Boston, *Heath*, 1886) of Professor Williams on that subject supplies the student with a compact yet full history of the steps taken to elevate it from the domain of conjecture to that of fact, and to change the microscope from a toy to a valued assistant. While not giving to our home institutions as full credit for regular instruction, in the past, as the facts warrant, the monograph is interesting as showing that a desire for the more exact methods of rock-analysis is becoming prevalent among American students, and that it will not be necessary to go to the continent for needful instruction. The appended note on forming rock-sections, and the cost of obtaining them from trustworthy parties, will be of value to the beginner, as will be the bibliography of the science.

— The 'Theory of magnetic measurements,' by F. E. Nipher (New York, *Van Nostrand*, 1886), will be found a very convenient book of reference by those who have already had some acquaintance with the methods of determining the constants of terrestrial magnetism, and who desire to refresh their memories upon any of the more important principles of the theory and practice of the instruments ordinarily used in magnetic surveys. Such persons will find especially convenient the forms given for recording and reducing observations made with the various instruments. Some trouble would be saved, however, if the explanations of the quantities set down in each column were brought into a closer connection with the columns themselves. To those unacquainted with the subject the book will often seem wanting in clearness, — a fault which appears in many cases to be the result of too great an effort at condensation. A few pages are devoted to the method of least squares, and tables are given to assist in determining the meridian from observations on the elongation of Polaris. Opinions will differ as to the advisability of inserting so much of a general discussion on the relations between systems of units in order to derive the ratio of the 'foot-grain' to the C. G. S. value of the horizontal intensity.

— Mr. A. Lawrence Rotch, of the Blue Hill meteorological observatory, has issued reprints of several articles in the *American meteorological journal*, with additional heliotype illustrations, on the 'Mountain meteorological stations of Europe,' which he visited in the summer of 1885. The establishment, outfit, publications, and results of seven stations are described in much detail. Their names, altitudes, and dates of establishment are as follows: the Brocken, Germany, 1,141 metres; Schneekoppe, Germany, 1,599 metres, 1880; Wendelstein, Bavaria, 1,837 metres, 1883; Hoch Obir, Austria, 2,148 metres, 1878; Sentis, Switzerland, 2,504 metres, 1882; Puy de Dôme, France, 1,463 metres, 1876; Pic du Midi, France, 2,877 metres, 1880; Ben Nevis, Scotland, 4,407 feet, 1883. It may be added that Mount Washington was the first, and Pike's Peak is still the highest, mountain meteorological station in the world.

— The Appalachian mountain club has lately published a copy of the contour-line map of Williamstown and Greylock, as executed by Messrs. Johnson and Natter, topographers of the U. S. geological survey, in the joint topographic undertaking with Massachusetts. The reproduction is on the scale of the original plane-table sheets, 1: 30,000, and therefore covers an area fourfold that which will be allowed on the publication of the map. The district is in the northwestern corner of the state, and is well chosen for illustration of the progress and value of the survey, as it includes the highest and probably the roughest piece of ground in the commonwealth. The 'hopper' on the western slope of Greylock, and the rugged ridges on the eastern slope, are very well expressed by the contours, although the photolithographic reproduction is not so delicate as could be desired. The cost of the sheet is, however, very moderate, — thirty cents; for sale by Clarke & Carruth, Boston.

— The August number of the *Alpine journal* contains a statement of the results obtained by Dr. Marcet from many experiments on breathing while climbing at high altitudes. He first shows by experiments at ordinary altitudes and in a state of rest that some persons make much better use than others of the air they inhale, inasmuch as their exhalation is very rich in carbonic acid: this may be expressed by measuring the volume (at sea-level pressure and freezing temperature) of air inhaled to produce one gram weight of carbonic acid. Dr. Marcet himself had to breathe 15.5 litres of air, while two younger men needed only 13.7 and 10.8 litres respectively: the latter had a remarkable power of keeping his breath under water, and was little troubled in mountain ascents. Further experiments, conducted at various altitudes up to 13,600 feet, show, that, as a person ascends, he breathes fifteen to twenty-five per cent less air (reduced, as above, to standard pressure and temperature) to produce a given weight of carbonic acid: the action of air on the blood in the lungs seems, therefore, to be facilitated with decreasing density. It is evident that this will materially diminish the quickness of breathing that would otherwise be required in rarefied air.

— A meeting of the National association for supplying medical aid to the women of India was held at Simla on Sept. 29, Lady Dufferin presiding. The reports received from the various provinces were highly satisfactory. The main object now was to establish the association on a permanent footing, for which purpose further funds were required. The estimate for next year's work showed a surplus; but, before the financial condition of the undertaking could be called thoroughly satisfactory, it required a lakh and a quarter more capital. Sir C. Aitchison gave an account of the work done in the Punjab. He said that the province was not rich. The few wealthy men had given what they could, and the movement was spreading among other classes.

— A new laboratory-burner, devised by a Detroit inventor, appears to be both simple and efficient. The base of the burner is provided with a stationary needle-valve surrounded by a vertically adjustable jet-tube with a conical aperture controlled by the valve. Arms extending upward from the jet-tube support a vertically adjustable mixing-tube, constructed so as to close the upper end of the jet-tube when desired. The proportions of gas and air, as well as the size of flame, may be regulated by a simple rotation of the jet-tube upon the base.

— One result of recent experiments with oil for smoothing the surface of the sea during stormy weather is that inventors are turning their attention toward improving the methods of applying the oil. A device recently patented is a floating distributer, consisting of a case containing two compartments, one of which serves as a buoyant chamber, while the other is perforated, and receives and distributes the oil, which is supplied to the distributer through a supply-tube.

— It is proposed to form an association of the graduates of the Lawrence scientific school connected with Harvard university. There are numbered among these graduates many of the students of Agassiz.

— Messrs. B. Westermann & Co. announce the continuation of Carus and Engelmann's Bibliotheca zoologica. The first part of the continuation is expected immediately, and the whole will be completed in 1888. Carus's *Zoologischer anzeiger* has since 1878 recorded the publications on zoölogy. The new volume of the Bibliotheca zoologica is intended to fill the gap between the *Anzeiger* and Carus and Engelmann's Bibliotheca zoologica, which covered the literature of 1846–60.

— Several cases of hydrophobia have recently occurred among camels in Algeria. As the animals had never been bitten, the origin of the disease was unaccountable, until it was ascertained that a mad horse had gained admittance to the pasture; and the explanation given by those who studied the case is, that his saliva had fallen on the grass, and the camels had become infected through abrasions in the mouth.

— A healthy boy has just been born to an aged couple of St. Joseph, Mo., the father being seventy-one and the mother sixty-five years of age.

— Dr. Williams, in the *St. Louis medical and surgical journal*, relates an interesting case of temporary blindness from the excessive use of tobacco. The patient was a blacksmith, thirty-two years of age, who complained of failure of vision to such an extent that he could no longer see to drive nails in shoeing, and was compelled to depend on his sense of feeling. His health was good, he having no other complaint. Vision was found to be only one-sixth of what it should be. Things appeared to him to be covered with a dense mist. For many years he had been an excessive smoker, using the strongest tobacco to be had. Tobacco amaurosis is quite common, but usually in men beyond middle life. The probability of recovery is great if the habit is given up, and this should be done gradually. In this case, a very few days' abstinence from tobacco caused an improvement in vision, and the man has now made material progress toward recovery. Dr. Williams does not regard chewing tobacco as so likely to produce this defective vision as the habit of smoking.

— Pasteur, in a letter to Dr. Davis of Philadelphia, gives the following *résumé* of his experience in inoculation for the prevention of hydrophobia from the beginning up to Sept. 1 of the present year: —

Countries sending patients.	Treated.	Died.	Remarks.
France and Algeria	1,324	4	Too late for treatment.
England	68	1	
Austro-Hungary	43	0	
Germany	9	0	
United States	18	0	
Brazil	2	0	Average failure is 1 for 150 foreign persons treated, and 1 for 330 French and Algerians.
Belgium	50	0	
Spain	75	2	
Greece	10	0	
Portugal	24	0	
Holland	14	1	
Italy	138	0	
Russia	186	12	8 by wolves, and 4 by dogs.
Roumania	20	2	
Switzerland	2	0	
Turkey	2	0	
Bombay	1	0	
Total	1,986	22	6 too late for treatment.

— After a long discussion, according to the *Chemical news*, the Belgian academy of medicine rejected the two following propositions, which had been submitted by Dr. DuMoulin: viz., "Copper combined with articles of food in the proportions usually met with is not dangerous;" "Especially the greening of preserved vegetables with copper salts is absolutely inoffensive." The academy, on the contrary, adopted the following proposition, which will be transmitted to the government: "The compounds of copper are not merely useless in foods; they are injurious."

— Kite-flying, from a scientific point of view, has received considerable attention in France. As the result of a series of experiments with a gigantic kite, it has been determined that the best results in ascensional power and height of flight are obtained when the string is attached to the kite at a point above the centre of pressure, in a line drawn from the centre of pressure to the centre of gravity, in such a manner that the distance from the centre of gravity to the point of attachment of the string shall be three times the distance between that point and the centre of pressure.

— A recently completed iron water-tower, 250 feet high, at Sheepshead Bay, near Coney Island, while being tested a few days ago, gave way at the base, and fell, shattered, to the ground when the water reached a height of 227 feet.

— The meeting of the Public health association was closed at Toronto recently. Dr. George M. Sternberg was elected president, Prof. Charles N. Hewitt first vice-president, Prof. C. A. Lindsley second vice-president, and Dr. Irving A. Watson secretary, for the coming year.

— Pretty much the whole of the September number of the *Journal of the Society for psychical research* is devoted to an interesting tale of a 'haunted house.'

— Arrangements are being made at Newcastle-upon-Tyne for holding there a mining, engineering, and industrial exhibition (international and colonial) in 1887, to mark the jubilee year of the reign of the queen.

— Dr. Schweinfurth has, says *Nature*, addressed to all Europeans, especially physicians, residing in Egypt, an inquiry as to whether, so far as they are aware, families of northern origin settling in Egypt do, or do not, die out within three generations, or whether the race is capable of being perpetuated beyond that limit.

— It is stated by the London *Engineering* that a dirigible balloon of colossal dimensions has been for some time in course of construction in Berlin. It is 500 feet in length, 50 feet in diameter, and weighs 43,000 pounds. The propelling power consists of two steam-engines of 50 horse-power each.

— In a recently patented soda-motor, intended for use on street-railways, the process of generating steam is as follows: the caustic soda, which is contained in a reservoir surrounding the steam-boiler, is raised to a high initial temperature by means of jets of burning gas or petroleum, thus evaporating all moisture from the soda. The heat from the soda produces steam in the boiler, which is applied to an ordinary engine; the exhaust steam from the engine is then absorbed by the soda, producing heat sufficient to generate steam, until the soda is supercharged with moisture, when the jets of flame, which in the mean time have been dispensed with, are again ignited to regenerate and reheat the soda. The operation may be repeated continuously. This is a modification of the soda-motors which have been in use several years past in this country and in Europe.

LETTERS TO THE EDITOR.

****Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

How astronomers may work.

In your issue of Oct. 15, I notice the reply of Professor Holden to your comment on his scheme of inviting the leading astronomers of the world to visit Mount Hamilton, one at a time, to use the Lick telescope when not in use by the regular observers. I think Professor Holden is unfortunate in his selection of examples of good work done at high elevations. Each one of his examples might be quoted as an instance where excellent results were gained as the reward of *continuous* work by a skilled observer, using the instrument with which he was most familiar, and in a field of research where his powers of observation were at their best. Probably we should know less than we now know about radiant energy, if Mr. Burnham had gone to Mount Whitney to use the bolometer, in place of Professor Langley and Mr. Keeler. And we may be quite certain Professor Langley would not have added to his reputation, had he gone to Mount Hamilton to use Mr. Burnham's telescope, searching for double stars. Doubtless, many men will be glad to have an opportunity to look through the Lick telescope, to note how familiar objects appear when seen with an instrument of its anticipated perfection and power. But it does not seem possible that any results of scientific value can be obtained from such scrappy, disjointed work as is proposed by Professor Holden. T.

New York, Oct. 19.

Larval amblystomas for laboratory work.

During the past summer I have sent to the Smithsonian institution several hundred living specimens of larval and adult amblystomas. These were to meet the demand for these important forms on the part of special workers, and the biological laboratories both in this country and Europe, a number of them having been sent to M. Chauvin in Germany.

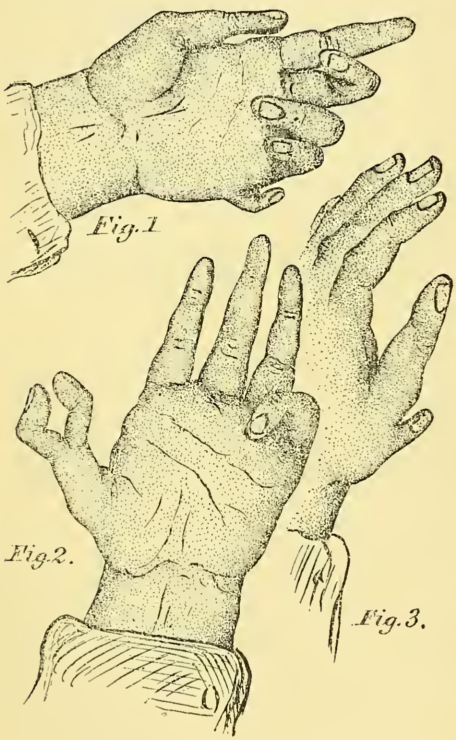
Quite recently, however, I have received a number of other applications from colleges and other points, requesting a few specimens of these animals for their investigations, and for the use of biological students. To meet these latter demands, I send by express to-day an unusually fine lot of some two hundred and fifty living larval amblystomas, and two adults, to Professor Baird, at the Smithsonian institution, Washington, D.C., where, if proper application be made for them, I am assured they will be sent to any point in accordance with the regulations governing the distribution of such material from that institution. R. W. Shufeldt.

Fort Wingate, N. Mex., Oct. 8.

Polydactylism.

An instructive example of this abnormity was under my observation at about the time Dr. Le Conte published his interesting letter upon the subject (*Science*, Aug. 20), and Mr. John B. Smith of the U.S. national museum, in a subsequent number, added his own observations (*Science*, Sept. 3) in regard to it.

The case I refer to is that of a man (F. G.) living near Fort Wingate, N. Mex. He is about thirty-five years of age, and comes from a Mormon family, and is polydactylous upon both hands. His father's hands were normal; but his father's twin-brother had bud-like, nailless, supernumerary little fingers, without any bones in them. There are fourteen children in his father's family, seven of whom have normal hands, while the remaining seven have either a surplus number of fingers or toes. A sister older than himself had both extra little fingers and toes, but they had no bones in them: indeed, he is the only one of the children that possessed them in that degree of perfection. Two sisters younger than himself had supernumerary little fingers and toes, and two of his younger brothers had simply the boneless little fingers, while their feet were normal. There is no history of polydactylism on his mother's side, and he has no recollection of the condition prior to his father's twin-brother.



I carefully examined these additional little fingers in the man in question, and present with this letter, in fig. 1, the palmar aspect of his left hand, the member upon which it was best developed. It has two joints. the distal one being somewhat flexed upon the proximal one when the hand is at rest; but, as the finger is supplied by both a good flexor and extensor tendon, it can be readily moved independent of the normal digits. These tendons, as well as I could ascertain, were branch offshoots of the tendons of the flexor sublimis digitorum and the extensor minimi digiti respectively.

The proximal head of the first phalanx articulates with an extra metacarpal head, which branches from the metacarpal bone of the little finger proper, to the outer side of its own distal head, and rather on the external aspect of the side of the shaft. No doubt the arterial supply of this extra little finger corresponds to the similar branches of the deep and superficial palmar arches, and an offshoot from the little-finger branch of the posterior carpal at the back of the hand, which go to the little finger proper.

A perfectly formed nail is found upon both of these supernumerary digits; though in some particulars the extra digit of the right hand is not as near like a normal finger as the one I have figured on the left, more especially in points of mobility and size.

Several years ago I saw a very remarkable case of polydactylism in a man of about forty-five years of age, an ignorant Irish farm-hand; and I could get nothing of the history of the inheritance of it from him. This man (P. M.) had, articulating with the distal head of the proximal phalanx of pollex, two small and supernumerary thumbs, which faced each other, as I have drawn them in fig. 2. Each of these had two joints and perfect nails, and was evidently supplied with special branch slips of tendons; as I have frequently seen the man use them as a kind of pair of forceps, and pick up, if he chose, his pipe with them. If I recollect rightly, both hands were similarly deformed. The only other record I have ever made of this case was in 1872, when I drew a rough sketch of it for Prof. Burt G. Wilder at Ithaca, who was at that time interested in such matters, and making a special collection of such data, and deformities of these members.

Supernumerary thumbs occur elsewhere on the hand, as in the case I have drawn in fig. 3. This was a boy schoolmate of mine (J. O D.), now a prominent artist in New York, and it was early removed during childhood by amputation. If I remember correctly, his father's and mother's hands were perfect, and the deformity only occurred upon one of his own hands.

Among the vertebrates below man, we occasionally meet with cases of polydactylism. and in all vertebrates, as we know, numbers of cases where we find duplicature of entire limbs. R. W. SHUFELDT.

Fort Wingate, N. Mex., Oct. 7.

Psychology of the bear.

In *Science* for Aug. 27 is an interesting letter from James P. Marsh upon the psychology of the polar bear. The following item, bearing upon the same subject, is going the rounds of the press, and may be of interest to those familiar with the ways of animals in general, and bears in particular: A bear had been having a merry time among the sheep of the farmers of Clarendon, New Brunswick, during the summer. All attempts to catch the beast failed. Last week a trap was set, and a fence erected so that he would have to step into the trap in order to get at the bait. Bruin surveyed the situation, and concluded, after some study, that he could get over better. He went to the rear of the enclosure, dug a deep hole under the trap, and then overturned it, thus securing the bait without any injury to himself. Not to be outwitted by a bear, the farmers tried again. The old trap was left where it was, and another placed where the bear got through before. The ruse worked like a charm. Bruin came along, snuffed at the bait, and, recollecting his previous success, determined to try the back entrance. He did not see the second trap, and coolly put his foot into it. He was there next day, full of wrath, and a bullet put an end to his existence. H. J. T.

Millerite.

I wish to place on record the occurrence of the mineral millerite in the Keokuk beds of the subcarboniferous rock of Iowa. I have just received a few specimens of rock blasted out when the government was deepening the channel at the 'rapids' in the Mississippi, above Keokuk, some years ago. The specimens show cavities in the limestone, partially filled with calcite crystals, mostly of the scalenohedral form. In some instances these crystals carry very beautiful thread-like crystals of millerite. They are usually aggregated in the form of cones, the apices of which are almost solid on account of the threads being so close together, while at the bases of the cones they are much farther apart.

The occurrence seems to be in every way similar to the occurrence of the same mineral at St. Louis, Mo. A few small crystals of tetrahedral chalcopyrite are also present. Erasmus Haworth.

Penn college, Oskaloosa, Io., Oct. 9.

Alligators in the Bahamas.

Catesby, in his 'Natural history of Carolina, Florida, and the Bahama Islands,' published about a century ago, speaks of having seen alligators on the Island of Andros in this group. At present there are none, and, with the object of finding out if there was any tradition current bearing upon the subject, I made inquiries through the medium of the *Nassau guardian*. In answer to my questions, I lately received from the rector of Inagua, at the extreme south-east of the group, a letter, in which he mentions that stories of alligators having been drifted on logs of mahogany, and thrown up on the shores of the island, are common, but that he had not been able to verify any of them. However, a few days previous to the date of the letter, while on a visit to one of the settlements, Mr. de Glanville (the rector) was shown the skin of an alligator eight feet long from tip to tip, which had been shot on shore a day or two before by a man whose name is given. Many logs of mahogany had been cast up on the shores of Inagua about that time; but the alligator had not been observed to land, and had been seen on shore several times before it was shot.

There seems, however, to be no reasonable doubt that the alligator was drifted by the current from the south-east to Inagua, on a log of mahogany from San Domingo, the nearest place in which alligators are found. This means that it travelled a distance of from one hundred to one hundred and fifty miles. With regard to the occurrence of alligators on Andros, Catesby was a very accurate observer, and there seems to be no reason for doubting his statement. These alligators would appear to have been carried on drift-wood from the north-west coast of Cuba, a distance of three hundred miles, by the Gulf Stream, and cast on the edge of the Great Bahama Bank, whence local currents, aided by the wind, might have carried them to the west coast of Andros. The absence of traditions on the subject may be owing to the fact that the present inhabitants of Andros are principally descendants of persons who settled there at a period subsequent to Catesby's visit.

These instances of the dispersion of large animals by means of oceanic currents may be of interest to those of your readers who study the question of the geographical distribution of animals.

While on the subject of Andros, may I be allowed to mention two rather curious superstitions current among the inhabitants of that interesting island? The interior of the northern part of the island consists of swamps and lakes, interspersed with patches of rocky ground on which the Bahama pine (P. bahamensis) grows thickly. The negroes have a great dislike to entering these pine-woods alone, or even in small companies; for they say that a peculiar race of malevolent beings, called 'little people,' inhabit the trees. These creatures are said to be like tiny men covered with hair. They sit on the pine-boughs, and if a man notices them, and points them out to his companions, the whole party is rendered immovable for a day and a night; but, if fire is thrown at the 'little people,' they disappear without doing any harm.

The other superstition also relates to the pine-woods. Creatures like enormous hairy men, called by the negroes 'Yayhoos,' are said to march about the woods in 'schools,' the largest coming first; and 'when dey cotch you, dey tear you.' These beings are naturally much more dreaded than the 'little people.' It looks as if their name had been given by some traveller familiar with 'Gulliver's travels,' and struck with the resemblance between them and the terrible creatures of Swift's imagination.

Both of these superstitions would appear to be traditions of the land from which the negroes originally came. The 'little people' are probably a recollection of the small, arboreal monkeys, while the 'Yayhoos' represent the gorillas, of West Africa.

John Gardiner.

Nassau, Bahamas, Sept. 17.

Earthquake sounds.

In answer to your correspondent who asks, in the last number of *Science*, for some explanation of the sounds which often precede and accompany an earthquake shock, I would offer the following brief statement, condensed from Mallet's discussion of accompanying tremors and sounds (Report on Neapolitan earthquake of 1857, vol. ii.): Considering a rent or fissure to form in rock and rapidly enlarge, its formation is commenced and ended by tremors of very small amplitude, while the waves of amplitude great enough to produce the ordinary effects of an earthquake shock cannot be generated till after the focal cavity is enlarged to a certain amount. Waves of sound probably accompany the rending of the entire fissure: if the velocity of inceptive rending be sufficient, the sound waves set out the earliest of all, and, travelling through solid rock with a far greater velocity than in air, often reach the ear before the tremors of the earthquake-wave itself are noticed. Thus an observer often first hears a low and distant rumbling, then feels the tremors before the shock, then the great *shove* of the shock itself, and, lastly, the tremors with which it departs along with the sound. The order of the phenomena must also depend largely upon the distance and form of the focal cavity; the inclination of its plane towards or away from the observer; and many other circumstances, such as the physical, geological, and topographical character of the intervening country.

It is extremely desirable that your correspondent, and, indeed, any others who have any interest in the solution of the extremely intricate problems connected with the study of such phenomena, should send their observations to the U. S. geological survey. Very many observers who could easily give information which might be of great value when compared with other reports, often hesitate to do so because in itself it seems too vague or meagre to be worth the trouble. EVERETT HAYDEN.

U. S. geological survey, Oct. 18.

Barometer exposure.

In connection with the recent discussion of barometer exposure, the following results of observations made during the high wind of Oct. 14 may be of interest. The barometers are kept in the transit-room, east wing, of the observatory, and windows at north and south were open at the top a foot or more, allowing free access of outside air.

At 7 o'clock A.M. the reduced barometer reading was 29.181 inches, the lowest for many months. At 10 o'clock, when the wind (directly from the west), as indicated by a Robinson's anemometer and Gibbon's recorder, suddenly increased from five to thirty miles per hour, the reduced height was 29.199; and a constant increase was observed for the remainder of the day, although the wind velocity was nearly constant for four hours.

I carefully examined the barometer (Green, No. 2006) for sudden changes in height, and was able repeatedly to detect and measure with the vernier oscillations of .02 of an inch, and at one time a movement of .029 of an inch. The majority of these oscillations did not last over 1.5 seconds; a few as long as 2 seconds.

It was noticed in nearly every instance that the oscillation did not follow immediately upon each gust of wind, but about five or six seconds later. It is possible that the situation of the east wing, sheltered by the main building and dome, may have influenced the result. CHAS. A. BACON.

Beloit, Wis., Oct. 15.

A large squid.

The U. S. fish commission schooner Grampus, which recently arrived at Wood's Holl from a cruise to the eastern fishing-banks, brought in, among other things, a fine specimen of the large broad-finned squid, Stenoteuthis megaptera, Verrill. Although much smaller, this is next in size to the giant squids, and much larger than the common varieties. The one brought in by the Grampus is the first perfect specimen obtained in this country, and the second of its kind in the world. It is also slightly the largest, and, because it was taken alive, is probably the best preserved specimen extant.

The first known specimen was cast ashore near Cape Sable a number of years ago, and is now in the Provincial museum at Halifax. Since then four fragments of this species have been obtained by the Gloucester fishermen, and presented to the national museum, these consisting only of jaws and single arms. It therefore follows that the fine specimen of this animal which has now been secured by the fish commission will be a valuable acquisition to the collections in the national museum.

It was caught on a squid jig of the ordinary pattern, by John F. McDonald, one of the crew of the schooner Mabel Leighton, of Gloucester, on the night of Sept. 25, while he was fishing for the common squid, Ommastrephes illecebrosus. At that time the vessel was off the southern part of Lee Have Bank, in north latitude 42° 45′, and near the 64th meridian of west longitude. When fresh, the total length of the specimen was fifty-two inches from tip of tail to extremity of longest pair of tentacles, while its largest circumference was fifteen inches. The Halifax specimen was forty-three inches long from tip to tip, after having been in alcohol several days.

On the next day after the squid was caught, the Mabel Leighton met with the Grampus, and Captain Greenwood, of the former vessel, presented the animal to the officers of the fish commission schooner.

In this connection it is only just to remark that the Gloucester fishermen have exhibited a very intelligent interest in making collections for the commission. They are frequently able to detect peculiarities in unfamiliar species, and to save rarities. In consequence, their 'aids to science' have been of great value to many specialists in their study of the marine fauna off our coasts. J. W. COLLINS.

Wood's Holl, Oct. 15.

Visual illusion.

In *Science*, No. 176, doubt is expressed concerning the visual illusion noticed by M. Charpentier before the French academy: "After a small, feebly illuminated object has been attentively viewed for some time in complete darkness, it will often appear to move in some determined direction in the field of vision, at a speed varying from two to three degrees per second, and sometimes through a distance subtended by an angle of thirty degrees or more." This illusion has been frequently noticed by me during the last fifteen or twenty years. The motion is usually vertically upward; occasionally the object seems to retrace its path, moving downward, but only after very attentive observation. Recently I have made repeated trials of this illusion, with exactly the same results as were obtained years ago, before I had made the eye a subject of special study.

A. H. COLE.

Hightstown, N.J., Oct. 16.

The significance of coincident weather-conditions.

On Oct. 14 there was an outbreak of violent storms in Europe and America. As was suggested in my letter published in *Science* for Aug. 13, such an event affords an opportunity to test the theory that there is a relation of some sort between disturbances on the sun and storms on the earth. If this relation does exist, the sun should be disturbed in proportion to the magnitude of these exceptional atmospheric movements. That this was the case on Oct. 14 is shown by the fact that on that day there was an extremely rapid formation of spot-groups in the sun's eastern quadrant. On Oct. 15 the number increased to such an extent that on the 16th the entire group was fairly comparable to that which was visible during the great storms in May. During the great gulf storm just previous to Oct. 14, there had been various solar disturbances which upon that date had disappeared, for the most part, by solar rotation.

M. A. VEEDER.

Lyons, N.Y., Oct. 16.

SCIENCE.—SUPPLEMENT.

FRIDAY, OCTOBER 22, 1886.

THE PROGRESS OF NEW ZEALAND.

THE very interesting paper by Sir Robert Stout, premier of the colony of New Zealand, lately read before the Statistical society of London, and now published in the journal of that society, deserves a wide notice, not only because of the interest of the facts and figures adduced, but because of the scientific way in which they are exhibited and discussed.

New Zealand has passed through several distinct economic eras, said the speaker. In the earliest days it was looked upon as the seat of the whale-fishery in the Pacific, and whalers from all parts of the world were found in its harbors. Following the whale-fishers came traders who bartered with the Maoris. After this came the settlements founded by the New Zealand company; and the result was the active pursuit of agriculture, the products being sold to the gold-diggers of Victoria. Pastoral pursuits also became of importance, and an export trade of considerable amount sprang up. But in 1861 the gold-fields in Otago were discovered; and the rush of adventurers to New Zealand soon swelled the population to such an extent that there was a home consumption for every thing that could be raised, and not only did exports cease, but food-supplies had to be obtained from abroad; and while Chili and South Australia provided wheat and flour, England was drawn on for dairy-products, hams, etc. After 1864 agriculture in New Zealand developed much more rapidly, and more lately a number of manufacturing industries have been built up.

At the end of 1884 the colony's population was 564,304, of whom 306,667 were males, and 257,637 females. In addition, there are perhaps 45,000 Maoris. In 1881, when an accurate census was taken, 45.60 per cent of the population were born in New Zealand, and the percentage of native-born New-Zealanders goes on increasing. According to the same census, 41.5 per cent of the inhabitants belonged to the Church of England, 23.09 were Presbyterians, and 14.08 Roman Catholics. In 1884 the colony's birth-rate — proportioned to each 1,000 of the population — was 35.91; the death-rate, 10.39; the marriage-rate, 6.87. This marriage-rate is lower than that of any of the other Australasian colonies. Of those whose occupation was determined by the census enumerators, we find that 70,926 were engaged in trade, commerce, and manufactures; 54,447 in agricultural and pastoral pursuits; 14,273 in mining; 10,233 in the educated professions; 41,635 in ordinary labor, domestic service, and miscellaneous.

Education is well cared for under the general education act of 1877. Of persons between fifteen and twenty years of age, 97.48 per cent are able both to read and write: after twenty years there is a decrease in this percentage, but it is slight. There are 24 secondary schools in operation in the colony, the number of pupils enrolled being 2,577, and the annual expenditure on secondary education 71,517 pounds sterling. New Zealand university is solely an examining body: it confers degrees, but employs no teachers. The teaching-work of the university is done by five affiliated institutions at Dunedin, Christchurch, Auckland, and Nelson. The number of university students in 1884 was 499, and the expenditure for university education £26,815. The expenditure in primary education was £363,316 (including £49,769 on buildings), the number of pupils enrolled amounting to 96,840. The colony supports one civil policeman to every 1,293 of population. The number of offences against the person was, in 1884, 871, or 1.57 per 1,000 of population; and the proportion of offences against property, 2.14 per 1,000. This is a better showing than that made by any of the neighboring colonies. The amount of juvenile crime is very small; and Sir Robert Stout attributes that to the elaboration of the industrial school system, now a permanent institution in the colony.

The government has three industrial schools under its control, and also occasionally supports children at private institutions. Children committed under the industrial school system are of three classes: 1°, those who have themselves done wrong; 2°, those who were in destitute circumstances; 3°, those whose parents have either done wrong or neglected them. The total number committed in 1884 was 313.

As to illegitimacy, — a test often applied to determine the morality of a community, — New Zealand compares favorably with other colonies, though there is an increase in illegitimate births as the colony grows older, and as the population grows more dense in the cities. In 1884 the illegitimate births averaged 2.95 for every 100.

The larger settlements are well supplied with libraries and museums, and the desire for reading-matter is increasing. In 1884 books to the value of £115,246 were imported. This does not include magazines, newspapers, and books sent by post. There are 172 newspapers published in the colony, — 49 daily and 91 weekly, bi-weekly, and tri-weekly, — or 1 to every 3,281 inhabitants. In England and Wales the ratio of newspapers to population is 1 to 13,828 ; in Ireland, 1 to 32,585 ; in Scotland, 1 to 21,013 ; and in the United States, 1 to 4,656.

New Zealand now enjoys direct steam-communication with England by two lines, and there is a fine mail-service running monthly to San Francisco. In 1884 the number of ships entered inwards was 852 vessels of 529,188 tons : of these, the United States was represented by 23 vessels of 10,935 tons. The shipping outwards was 872 vessels of 534,242 tons ; of these, 9 vessels of 4,086 tons belonged to the United States. The value of the exports was 7,091,667 pounds sterling, and that of the imports 7,663,888 pounds sterling.

The mining interests will probably increase as new capital flows in to enable the fields — other than the shallow alluvial deposits — to be worked. The value of the gold product since the opening of the mines has been £42,368,192 ; the amount exported in 1884 was £988,953. The fall in copper has had an injurious effect upon the copper-mines, and their production has been very large. The main development of the past twenty years in mining has been the production of coal. In almost every province of the colony are to be found extensive brown coal deposits. In 1884 the number of tons produced was 480,831. There is a strong probability that early attention will be paid to silver, shale, tin, and the other mineral developments of the colony.

In 1864 New Zealand exported 16,691,666 pounds of wool : in 1884 this had increased to 81,139,018 pounds. In the same time the number of sheep had increased from 4,937,273 to 14,056,266 ; the number of cattle, from 249,760 to 700,000 : of horses, from 49,409 to 170,000 ; of pigs, from 61,276 to over 200,000. In connection both with pastoral and agricultural pursuits, there has grown up the exporting of frozen meats, and this has encouraged the rearing of sheep on lands formerly used for grain-raising.

The area of land alienated from the crown was, in 1864, only 7,759,954 acres : in 1884 it amounted to 17,692,511 acres. In 1884 no fewer than 6,391,075 acres were under crop and sown grasses. In 1864, as was stated above, New Zealand not only exported almost no agricultural products, but drew its food-supplies largely from abroad. But in 1884 the exports included, wheat, 2,706,775 bushels, valued at £436,728 ; barley, 128,450 bushels, worth £25,138 ; malt, 51,311 bushels, worth £14,665 ; and oats, 2,474,613 bushels, worth £267,286. The exports also included £33,324 worth of flour, £53,536 worth of potatoes, and 254,069 hundredweight of frozen meat, valued at £345,090.

Agriculture is now seeking other outlets : orchards are being planted, tobacco is raised, and linseed is now produced. The area of forest-lands is 20,000,000 acres, and of this area 9,000,000 acres contain useful timber-trees.

The manufacturing establishments are of so recent a date that statistics have not been obtained concerning them ; but during this year it is proposed to determine accurately their number, the amount and value of the goods produced, and the number of workmen employed. For manufacturing purposes, New Zealand has the unusual advantages of a moderate climate, a large coal-deposit, and ample water-supply in almost any part of the colony.

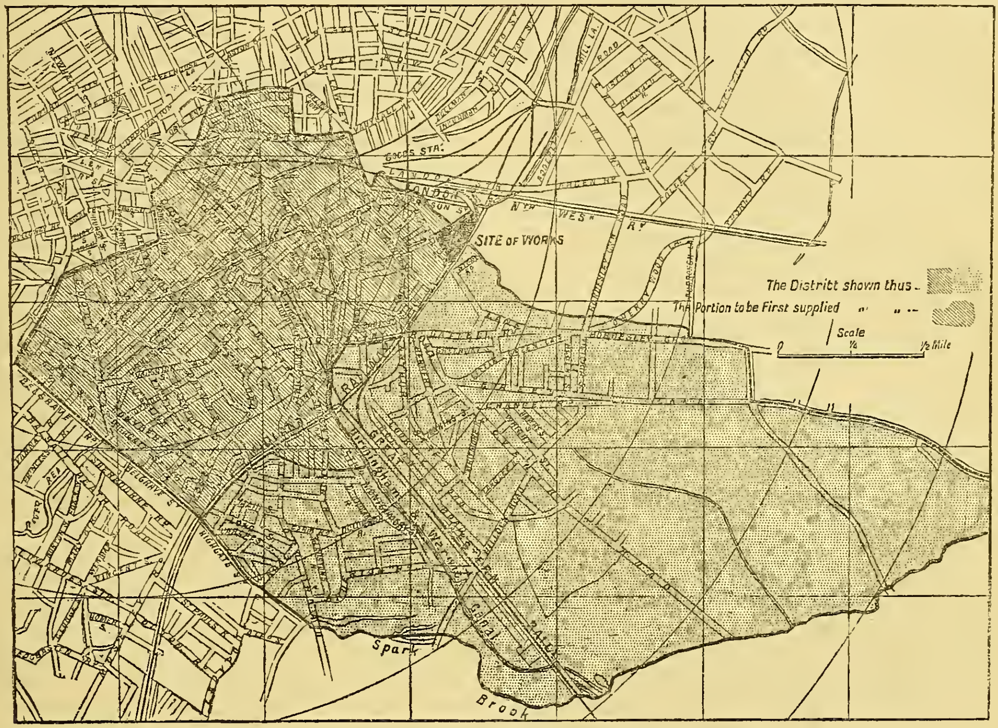
The wealth and material prosperity of the colony are rapidly increasing. In 1881 there were, in all, 103,335 houses, of which 87,646 were wooden. In 1884 the savings banks had on deposit £1,926,005, and the ordinary banks £9,372,004. One person in every seven holds a life-assurance policy, — a larger percentage, probably, than obtains in any other country. The value of the personal property that is taxed is 40,000,000 pounds sterling, and the value of the real property held by the colonists is 75,000,000 pounds sterling. 1,527 miles of railway are in operation, and 10,474 miles of telegraph-wires ; and 1,961 telephones are in use. The number of letters carried in 1884 was 16,611,959, and the number of telegrams sent 1,654,305. Gas is used in 27 incorporated towns. The colony's revenue in 1884 was £3,955,188, and its expenditure £4,101,318. The large expenditure was due to the fact that large sums were borrowed for the prosecution of public works. The total public debt is £30,649,099, but of this a large proportion has been spent on public works which are now returning a good interest.

Sir Robert Stout predicts that this splendid progress will be maintained, and that population will rapidly increase. Agriculture will become more varied and be diligently prosecuted, dairy farming will come into prominence, and mining will increase. He thinks, too, that the record of the next twenty years will show an advance rather greater than less than that which his valuable paper describes.

DISTRIBUTION OF POWER BY COMPRESSED AIR.

Air at a pressure of forty-five pounds to the square inch will, in the near future, displace steam as a motive power in many of the smaller manufacturing establishments of Birmingham, England. The air will be compressed at a central station, and supplied through street mains, much as gas and water are now distributed, taking the place of steam for driving engines. Steam has long been distributed from a central station in this city with economy and safety, and there is no reason why compressed air should not be distributed in a similar manner. The Birmingham company, which has charged itself with this enterprise, will begin operations with a plant capable of supplying fifteen thousand horse-power, six thousand of single-acting air-compressors, capable together of delivering two thousand cubic feet of air per minute at forty-five pounds pressure, will be driven by each engine, making a total capacity of thirty thousand cubic feet per minute. Six million gallons of water per day will be required for the boilers and condensers.

The street mains will be of wrought iron, laid in concrete troughs with removable covers, not far below the surface of the street. Valves will be fixed at intervals in the mains, to automatically shut off the air in case a section of pipe



POWER DISTRIBUTION BY COMPRESSED AIR, IN BIRMINGHAM, ENGLAND.

which have already been contracted for. The accompanying illustration shows the district covered by the first plant, the darker portion being that which will be first supplied with power. This area will require about twenty-three miles of mains, ranging in diameter from seven inches up to twenty-four. The central station is located between a railroad and a canal, so that coal and water are readily obtainable. The coal will be converted into gas, which will be then used as fuel under the boilers, of which there will be forty-five, supplying steam to fifteen triple expansion engines of one thousand horse-power each. Six should burst; the same valves serving as stop-valves, which can be closed by hand, if desired, through man-holes in the street. The compressed air delivered to customers will be measured by meters, and charged for by the thousand cubic feet, a special device in the meter compensating for any variations in pressure. The total amount used will be registered on a dial at the central station by electric apparatus.

A paper upon the Birmingham compressed air scheme was read before the British association on Sept. 8 by Mr. J. Sturgeon, in which he showed that the large number of engines of moderate size used in Birmingham, often intermittently, renders the system peculiarly applicable to that city. Although each thousand horse-power at the central station may produce only five hundred horse-power at the users' engines, it will displace fully a thousand horse-power of small boiler plant, etc., while the centralization of the power-producing plant admits of the conversion of fuel into power under conditions most favorable to economy and efficiency.

THE MENTAL FACULTIES AND SOCIAL INSTINCTS OF APES.

A WRITER in the *Revue scientifique* (Aug. 28, 1886) has made an admirable *résumé* of the suggestive analogies between the mental habits of the higher quadrumana and those of low savage tribes, and to some extent of civilized children. The importance of this stage in mental evolution has not been overlooked; but much of the material is unreliable, and direct observations by good observers are few. Mme. Clémence Royer gives copious references to the best of these observers, and thus succeeds in making a useful presentation of the subject in a very few pages. Even the mere summary which is here to follow, of the points in common to the ape and the savage man, will be sufficient to impress one with the far-reaching extent and real significance of this comparison.

Sociability and the family. — The degree of sociability varies greatly in different species. The gorillas of West Africa live in small patriarchal families, while the cynocephalus and many American species live in troupes, without any definite sexual relations. Savage tribes showing each of these forms of family life have been described. Houzeau remarks that the patriarchal system is maintained among many of the anthropoid apes by subordination to the authority of a chief. Each group has but one chief, — an adult male. The females and young ones are subject to his control until they tire of this dependence, and abandon or kill the ruler. Among the chimpanzees and gorillas, even smaller families, with a single pair at the head, are found; and here the feelings of maternal and conjugal love are developed to a high degree. Paternal affection is rare, but many savages do not recognize the right of the father. It is common to find them tracing descent through the female line only, without any regard to paternal instincts. Three authenticated examples of conjugal love among apes are recorded.

Language. — By this term must be understood, not a finished systematized speech, but simply some rudimentary mode of expressing emotional and mental states by sounds and gestures. Apes, of course, have cries for all their common emotions, — their desires, their fears, pains and pleasures. These cries differ considerably in different species. Houzeau records an instance in which the animal used a special cry when it was displeased by having an object given to it which was not the one it wanted.

The faculty for imitation is certainly characteristic of the quadrumana, and has given us the phrase 'to ape.' It is a trait common to savages, to children, and to idiots; in short, to low-type, undeveloped minds. The attitudes and general conduct of apes are so human, that some savages believe that it is only out of spitefulness that they do not speak. But even this poverty of sounds is not without parallel in savages: many have a very meagre alphabet of sounds, and help themselves out with clicks and natural noises. All apes (except, perhaps, the orang-outang) have voice: they often repeat sounds, which are usually complex articulations involving gutturals and harsh sounds, with little variation. But the New-Zealanders lack twelve of our consonants, and other tribes show similar imperfections. And, curiously, it is just the labials so often found absent in the languages of the lowest species of men that are never used by apes. But the labial *m* is almost the first sound learned by the civilized chief, as is shown in the word 'mamma.'

Apes readily understand our language sufficiently to be tamed, and trained to astonishing performances; and they are guided by sound as well as by gesture. Perhaps they understand our language somewhat as a child of fifteen or eighteen months understands its mother. But of course they lack every trace of a method of recording mental conditions. If the most primitive savage had not had some sort of record-making, even so simple as the Peruvian *quipus*, we could hardly know of his existence.

The phrase of Rabelais, that 'laughing is a peculiarity of the genus Homo,' is shown false by the evidence of this power in apes. It may be noted that many half-civilized people laugh very seldom, such as the Turks. One can readily read the expression on an ape's countenance. They weep too, and have been observed to frown.

Fêtes and funeral rites. — Houzeau likens the assemblages observed among the quadrumana to those of the Hottentots and other people. The apes of South America, when they have drained the resources of a certain area, have a re-union before they decide to emigrate. They jump and run and shout; the males running along the trees, while the females carry the young ones in their arms. Stories are told of the regularity with which such re-unions are held. In Africa the apes, on such occasions, collect sticks, and make a noise by hammering on the trees: the analogy with primitive music-making is sufficiently evident.

The Chinese tell of a species of ape that accompanies the body of a deceased member to its final resting-place, but this may be doubted. The Caffres of Africa, however, do not take the trouble of burying their dead, except in the case of chiefs or children.

Weapons and contests. — Apes, like men, fight and kill one another. The leader is the one who has shown his strength. When the male gorillas grow up, and have gained the full degree of their power, they attack the old ones, and do not leave the field until the issue has been decided. The abandoning of the aged is a custom in many tribes. Herodotus records it of certain people of Scythia. The gap between the lowest human morality and that of animals is small indeed.

Their fights are mostly hand to hand, with an active use of their canines, though some species very seldom bite. The Spartans are said to have fought with tooth and nail when deprived of their arms. The gorilla's method of attack is most nearly human. He raises a cry like the war-whoop of savages, and, beating his breast with his hands, rushes with savage ferocity upon his antagonist. With the exception of the gorilla, the quadrumana fear man, but do not hesitate to attack him in self-defence.

The hurling of projectiles, whether lances, tomahawks, or clubs, and so on, is common to all savages, and is likewise found among apes. They tear off branches of trees and use them as arms, or take refuge in the trees and hurl fruit at their enemy. This means of attack is found even in high degrees of civilization, as in the middle ages, and is made use of by animals (e.g., elephants) lower in the animal scale.

Friendship, enmities, etc. — Individual preferences can be observed among apes at any zoölogical garden. Their affection for their keepers is well known. They have aversions too, sharing with man the dread of snakes. Tribal enmities are also observed: the orang-outang has an instinctive animosity against almost all other apes. Similar feuds abound in savage tribes. Apes readily show temper, and have often been compared to spoiled children. Their anger is expressed by cries and wild gesticulations.

Apes readily drink wine when it is given them, and quite as readily drink to excess. Their conduct, when inebriated, is closely similar to that of man in the same condition.

Though antipathies are common between apes of different species, friendly assistance is often shown among apes of the same species. They join to ward off a common danger. The hand is the great means of giving aid: we have the expression 'to lend a hand.' It is true in a general way that species provided with organs of apprehension are sociable. Apes often plan attacks on orchards, etc., reach inaccessible places by forming a living chain and bridging themselves over, and seem to delight in the act of theft. They have been observed to take care of the wounded, to wash and cover their wounds with leaves, and to nurse them.

Intelligence. — The possession of acute sensibility for foreseeing danger, and the like, is a common animal trait, not wanting in apes. The similar sagacity of savages, e.g., our own Indians, is well known. Apes soon learn the danger of fire-arms; and the story is told of one who dropped from a tree when he saw that his assailants were armed, apparently giving himself up as dead.

An ape's curiosity and power of fixed attention are well known: these qualities are necessary to make a good imitation. In several cases they have observed the use of a lock and key, and made use of their knowledge in secret. Chimpanzees have been taught to eat with a knife and fork, and learn similar human customs. Their tendency to pilfer is another point in common with savages and children.

Industry. — Man has been called the tool-using animal; but apes have been observed to use a stone for opening nuts too hard for their teeth. Erasmus Darwin tells of an old ape who had lost his teeth, and always used a stone to open nuts.

Apes can be taught to mount and guide horses and dogs; and one traveller tells a story of an ape who learned this of his own accord, thus reminding one of the savage's method of procuring horses. Humboldt records similar observations. The stories of apes kindling fires are unreliable, though they often keep up fires deserted by natives or travellers.

Domestic services. — Apes have been used for carrying water and as bearers of messages. A French officer tells of the services of a chimpanzee aboard ship. It helped turn the capstan, climbed the masts, tied the ropes, and performed other functions. But only a few species are adapted for such an education.

Richard Owen, comparing the psychic condition of a chimpanzee with that of a Bushman or an idiot, finds no clear dividing-mark. It is only a difference of degree. Agassiz finds a complete resemblance between the mental faculties of an infant and of a young chimpanzee. It is only by the greater development of the former that it becomes human with all the great distinctions of that term.

ANTHROPOMETRICAL TESTS.

SINCE Mr. Francis Galton conducted his anthropometrical measurements at the International health exhibition, increased attention has been given to the measurement of physical characteristics and of the senses. Mr. Galton has received letters from Tokio, from Rome, from Paris, and elsewhere, asking for the necessary apparatus for establishing a laboratory where the important measurements of the body and testing of the senses can be made.

The importance of such observations is well understood. It will enable us to determine accurately racial characteristics, to mark the stages of individual growth, to detect abnormalities of development in time to check them, to lay the foundation for a rational education of the senses and the muscles.

Mr. Galton has been devoting much time to the preparation of instruments for measuring the head and the delicacy of the senses; and Mr. Horace Darwin, of the Cambridge scientific instrument co., has aided him in the work. The last Journal of the Anthropological institute of Great Britain contains a preliminary account of some of their devices.

As regards the size of the head, it is well known that the caps of university students are larger than those of the uneducated population. With a convenient method of determining the size of the head in various directions, one could find at what age generally and individually the growth of the brain comes to a standstill. The method of taking the measurements is still a matter of controversy. The maximum breadth can be gotten by a pair of calipers, with rough teeth, like those of a comb, to penetrate the hair. The maximum length from the glabella (the central point between the eyebrows) is also easy to measure. The great difficulty is in getting the height of the head. Mr. Darwin's instrument for this purpose is inserted into the two ear-holes, and a slight projection is caught by the inner edges of the orbits: this determines the horizontal plane, and measurements are taken to either side from it. He will improve the instrument by having a band attached, to be inserted under the chin, and thus press the frame close against the orbit.

For the color of the eyes and hair, Mr. Galton suggests, instead of printed shades, which are apt to fade, small disks of colored glass for the eyes, and spun threads of this glass for matching the hair.

The usual form of dynamometer for measuring the force of one's grip is objectionable, because the maximum clutch depends on the width and convenience of the instrument at its widest point. Mr. Darwin is making an instrument to avoid this defect.

With regard to sight, Mr. Galton admitted that there was no good recognized way of measuring the acuteness of vision, but thought the simple method of getting the distance at which one can tell in what corner of a white card a black dot is to be found, as good as any. Mr. Brudenell Carter, who has published some interesting views on the relation of eyesight to civilization, objected to this method, and preferred the test of distinguishing two closely adjoining dots. There are many good methods of testing the color-sense; and Dr. Cattell's experiments at Leipzig, on the time it takes to perceive the various colors, are of interest here. He found that it requires 8 ten-thousandths of a second to see orange, 10 to see yellow, 12 to see blue, 13 to see red, 14 to see green, 23 to see violet. The exposure was made by an arrangement similar to the instantaneous shutter of a camera. Great individual differences in the perception of various colors appeared, and a simple form of his apparatus might be useful for testing the color-sense.

With regard to sounds, we have almost no exact methods of measuring. The susceptibility to pitch can be readily measured.

Mr. Darwin also exhibited before the Anthropological society an ingenious contrivance for measuring one's reaction time, which works on the principle of snapping a rod, and arresting it in its fall as soon as possible after the sound is heard.

The subject is really one of the highest practical importance, and physiological as well as mechanical problems are involved. A physiologist with a mechanical bent would certainly find here a fruitful field.

THE STUDY OF THE SENSES.

THE great name of Helmholtz stands for the union of the physical and biological sciences. The late Professor Clifford speaks of him as "the physiologist who learned physics for the sake of his physiology, and mathematics for the sake of his physics, and is now in the first rank of all three." In his 'Physiological optics' and his analysis of the 'Sensations of tone,' he gave to the world two classical works, as invaluable to the physicist as to the psychologist and physiologist. The real greatness of these studies, the new engine that he employed. consisted in recognizing the dual nature of all phenomena, and attacking his problems from both points of view. To the physicist a body is a piece of matter exhibiting certain properties under certain conditions: to the psychologist it is a complex of sensations. For many purposes it is advisable to keep these things separate. But the convenience arising from this separation gave rise to the false notion that the two things had little or nothing in common, and, if useless metaphysical questions were to be avoided, had better have little in common. It was an example of over-specialization. Helmholtz showed, that, apart from any metaphysical notions or discussions, a large common field lay open, where the combined forces of physics and psychology could and ought to unite to shed new light on a most important department of scientific research.

Helmholtz was not long without followers in his rich line of work, and foremost among these is Professor Mach of the University of Prague. He, too, is a physicist, but was constantly driven to a study of the senses by the wide point of view from which he regarded his science. He is best known as a psychologist by his study of the sensations accompanying motion. In these he contrived an ingenious apparatus by which persons were swung around in various directions, and the inference drawn from the nature of the vertigo caused by the revolutions, that the semicircular canals of the internal ear, which experiments on animals had shown to be a mechanism for maintaining equilibrium, served a similar function in man. He has also repeated and added to the analysis of tone sensations which Helmholtz made. His work is characterized throughout by an unusual ingenuity, great accuracy, and a clear and easy exposition.

In a recent publication[1] he has added some highly suggestive studies in the sphere of sight and hearing, and accompanied them by a statement of the point of view from which he regards the study of the senses. It is to the latter that attention is to be briefly called.

"Through the deep conviction that science in general, and physics in particular, is to expect the next great advancements with regard to its fundamental position from biology, and more especially from the analysis of sensation, I have been repeatedly drawn into that field." This the opening sentence of his preface may be regarded as a text. Before proceeding with his argument, he wants to clear the ground by a few 'anti-metaphysical' remarks. In the first place, as to what a thing is. It is what can be perceived by the mind at once: it is this that gets a name. An apple is a complex of visible, tangible, smellable, tastable qualities. One's self is a more constant complex of such and other sensations associated with the body. By a comparison of various such complexes of sensations, we analyze them, and divide off the visible, tangible, etc. The visible, again, we divide into form and color, and these are our elements. The body is only the sum of the sensations to which it can give rise. The illusion that because we can abstract each of these sensations separately, and still retain the body, we can do so with all at once, has given rise to the metaphysical 'thing *per se*.' The chasm between physics and psychology exists only in our stereotyped mode of presentation. A color is a physical object when we consider its dependence on the source of light, its relation to other colors, its heat-giving properties, etc.: it is a psychological object when we consider its dependence on the retina. In the first case we trace a relation between two series of phenomena: in the second case one of the series is replaced by a third, of different nature. It is the point of view that makes the difference. We avoid the conflict between the physical and psychological points of view by considering sensations as the ultimate elements. This, too, is not to be regarded as the permanent, but, as for present purposes, the most economical position.

The sensation, in turn, can be subjected to a psychological analysis, can be regarded as a physical (physiological) phenomenon, or its dependence on physical processes worked out. The latter, whenever possible, is the ideal goal to be reached. Our guiding principle is that of a complete parallelism between the psychic and the physical. At times, it is true, more light will be gotten from a purely biological (evolutionary) point of view; but this, again, can be formulated under the general rule.

The advantages that physics is to gain from such considerations are many. In the first place, a false conception is eradicated. There is no subject and object, no thing and sensation. Only one kind of elements exists, from which subject and object are built up. The 'sensible' world is the common property of physics and psychology. It is physics as long as we disregard our own body: it is psychology when that is the special object of research. Again, the physicist will no longer be misled by such imposing entities as matter, atoms, etc. He will recognize their purely secondary and symbolical origin.

An adaptation of our method of thinking to the facts is the end of science. This goes on unconsciously in the daily life of every one: it is education. When raised into a conscious and deliberate object, it becomes scientific research. If

[1] *Beitrage zur analyse der empfindunger.* Von Dr. E. Mach. Jena, 1886.

the facts of nature really are as here represented, the gaining of this new point of view must be regarded as a distinct advance in this adaptation.

From the above unsatisfactory [1] sketch of Professor Mach's position, it may perhaps be seen that he regards a great psychophysic movement in science as the next revolutionary process. Many signs of such a movement are already evident.

J. J.

[1] The account is perhaps unavoidably so; as it was the task of the reviewer to avoid the technicalities of the psychological part on one side, and of the physical part on the other.

A MANUAL OF NORTH AMERICAN BUTTERFLIES.

ALTHOUGH a really good manual of our butterflies has long been a desideratum, Morris's Synopsis being altogether out of date, it cannot be said to be supplied in the present work.

The whole aim of the author seems to be to enable his reader to find out the name of a specimen in hand; and to this end his 'analytical key' is fairly good, so far as the perfect insect goes, excepting, that as no tables are given for genera, families, etc., it would not help the student if species not included in the book were to turn up. The key is also faulty, because largely made up of very unimportant characters, and because it takes no account of the earlier stages; indeed, no means whatever are anywhere furnished for finding out the affinities of a caterpillar or chrysalis in hand, except by wading through all the descriptions in the book.

We fail to see how the work can be of any possible pedagogical service, although this is claimed as its chief end. For, first, the only clew it gives to the classification, i.e., the natural arrangement of butterflies, is in the brief statement that is presented of the characters of some of the higher groups, and, incidentally, in the actual arrangement of the species treated; there is scarcely a reason suggested why the sequence of the groups should be as it is; it is simply stated in the preface that Edwards's arrangement is followed, yet Edwards has never offered a reason, but only printed a bare list. Second, the arrangement itself is unnatural, holding its ground only through precedent, as a legacy from the less-informed authors of fifty years ago. Third, the whole aim of the author appears to be to enable the user to answer the question, 'What is the *name* of my butterfly?'— for pedagogical purposes not even a worthy, far less the best end.

The genera are nowhere characterized; the descriptions of the butterflies could be much improved by more concise and methodical expression and the italicizing of the most distinctive features; the early stages of a considerable number of species are omitted, when they have been known and published for many years; and, finally, there is not a line or suggestion throughout the book which would lead one to suspect that science had changed within the last eventful quarter-century. It is but the rehabilitation of the dry husks of a past generation.

The butterflies of the eastern United States, for the use of classes in zoölogy and private students. By G. H. FRENCH. Philadelphia, *Lippincott*, 1886. 12°.

SCRANTON is the centre of what is known as the northern anthracite coal-field of Pennsylvania, comprising nearly two hundred square miles. Using this fact as a fulcrum, and taking for a lever the fact that natural gas has to a great extent displaced coal in Pittsburgh, the Scranton board of trade are endeavoring to lift their home into prominence as one of the great manufacturing cities of the future. In a neat pamphlet recently published by the board, it is pointed out that gas is a more economical fuel than coal; that the supply of natural gas will soon be exhausted; that there are forty million tons of culm, or coal-waste, — which may be had for the taking, — lying about the mines of the Scranton region; that this amount is being increased by two million tons annually; that gas may be made from this waste at a cost of two cents per thousand feet; that in the near future coal will probably be converted into gas in the mines, and piped to the surface; that gas-engines are steadily growing in favor; and that Scranton is already a great railway centre, with excellent shipping facilities to all points of the compass. The conclusion is inevitable, at least to the publishers of the pamphlet, that Scranton is a very desirable place for the establishment of industries requiring cheap fuel and power.

— An experiment with a new hydro-carbon fuel burner for locomotives was recently tried on the Third Avenue elevated railroad in this city. The burner is about six inches in length by five in diameter. A spray of petroleum and steam was forced through perforations in the burner, producing a large volume of flame; but, through inability to control the draught of the furnace, combustion was imperfect, and the experiment was a failure. This was only one of a long series of experiments with similar devices, none of which has succeeded. As the consumption of coal on the locomotives of the elevated railroads averages only two and six-tenths pounds per horse-power developed, there would seem to be no field for the economic substitution of petroleum at present prices.

SCIENCE.

FRIDAY, OCTOBER 29, 1886.

COMMENT AND CRITICISM.

A GOSSIPY WRITER in the *Nineteenth century* magazine has given us an interesting article on what girls read. He refers, of course, to English girls, but most of his data and all of his conclusions suit our young women quite as well as their British cousins. He shows that authors for girls have been developed, and form quite as distinct a class as Reid, Verne, Hughes, and others who write primarily for boys. Among this class he enumerates Mesdames Alcott, Dodge, Marshall, Banks. Browne, Beale, Symington, Owen, Sewell, Wetherell, Holmes, Meade, and Yonge. To Miss Alcott the writer himself awards first place, and speaks very highly of her books. He finds that an unnatural tone pervades much, if not all, of the current literature for girls, and says its teaching may be summed up thus : "If you are wicked, you must reform ; and when you have reformed, you will die." Good biographies, he continues, form the best reading for girls, for "fiction should lend relief to girl-life, biography should impart high-principle and poetry grace." Some interesting statistics are appended to the article, being made up from answers by one thousand girls between the ages of eleven and nineteen.

The answers to the two questions, 'Who is your favorite author?' and 'Who is your favorite writer of fiction?' are added, together with the following result, those names receiving fewer than five votes being omitted : Dickens receives 330 votes ; Scott, 226 ; Charles Kingsley, 91 ; Charlotte M. Yonge, 91 ; Shakspeare, 73 ; E. Wetherell, 54 ; George Eliot, 41 ; Lord Lytton, 41 ; Longfellow, 31 ; A. L. O. E., 30 ; Canon Farrar, 22 ; Thackeray, 18 ; Verne, 16 ; Macaulay, 13 ; Miss Alcott, 12 ; Mrs. Stowe, 11 ; Tennyson, 9 ; Carlyle, 6 ; Ruskin, 6 ; Charlotte Brontë, 5. The above, being the vote received by the principal authors, is curious in several respects. First, it is odd that authors whose works are classic should so far outstrip those who appeal especially to a girl audience. This may be explained either by saying that the girls put down names of authors whose works they knew they should read rather than those whose works they actually do read ; or it may be that the parents and teachers generally recommend such authors as Dickens and Scott, and that their advice is more generally followed than is usually believed. Again, it is curious to see Longfellow so far ahead of Tennyson, Carlyle, and Macaulay, in a list made up by English girls.

THE QUESTION HAS OFTEN been asked, For what purpose were mosquitoes created? Dr. Finlay of Havana seems to have answered the question, in part at least, by announcing that the mosquito is one of the active agents in the spread of yellow-fever. The doctor's theory is, that the sting of the insect, after penetrating the skin of a yellow-fever patient, retains on its exterior the germs of the disease, which may thus be conveyed to the next person it attacks. As a result of his study, he finds that every mosquito that stings may be considered a fecundated female, and will probably deposit its eggs within a few days after its bite, provided it can find water in which to deposit them. The young mosquito will be developed in about three weeks. As the eggs are deposited in the locality where the female stung its victim, the young would also be produced there, and, finding the yellow-fever patient near by, would sting him, become infected, and carry the germs to other human beings. Dr. Finlay believes that yellow-fever is not transmitted through the air nor by contact, but by inoculation, largely by means of the mosquito. He regards the disease as incapable of propagation wherever tropical mosquitoes do not or are not likely to exist ; ceasing to be epidemic at the same limits of temperature and altitude which are incompatible with the functional activity of the insect, and spreading wherever the mosquito abounds Dr. Finlay reports, as confirming his views, that in the summer of 1885 mosquitoes were scarce in Havana, but were very numerous in the autumn, and that, although the summer was unusually hot, yellow-fever cases were few in number, but in October and November increased considerably. The subject which has been thus brought to the attention of medical men and sanitarians is one which, it would seem, admits of proof or disproof ; and the experience of others practising in regions where yellow-fever prevails will doubtless elucidate the question.

IF, AS MANY THINKERS CLAIM, the chief philosophic interest in England now centres about psychology, the current issue of *Mind* cannot be cited as evidence to the contrary. It is distinctly psychological. Professor Bain writes approvingly of Mr. James Ward's Encyclopaedia Britannica article on 'Psychology,' though, of course, mentioning his points of difference from the Cambridge professor. Professor Bain's argument, that a series of states can be aware of itself, seems to us very weak and inconclusive. The president of the Aristotelian society, Mr. Shadworth H. Hodgson, takes up the articles by John Dewey of Michigan university, which appeared lately in *Mind,* and attacks them vigorously as based on 'unwarrantable assumptions.' Mr. Hodgson has no difficulty in making out a case. The following article on Hegel's conception of nature, by S. Alexander, is far more clear and interesting than expositions of Hegel usually are. Dr. Cattell continues the record of his psycho-physical experiments, treating now of will-time and of the influence of attention, fatigue, and practice on the duration of cerebral operations. Joseph Jastrow records his investigations into the perception of space by disparate senses. The book reviews are as full and valuable as usual.

THE DEGREE TO WHICH the medical charities are abused in this country is beyond computation. Hospitals and dispensaries which were organized for the relief of the poor are daily thronged with the well-to-do ; and even the rich do not scorn to take advantage of the services of the physicians which can there be obtained gratuitously. It was recently estimated that about one-fourth of the inhabitants of Boston were receiving medical treatment free ; in London and New York the proportion is about the same ; in Philadelphia it is one-fifth ; and in Liverpool, 298,320 persons in a population of 579,724, or more than one-half, are, according to the *British medical journal*, receiving free treatment in their illness. The writer knew of a case in one of our large cities where a lady came to a dispensary for treatment in her carriage, leaving it a block away, and walking that additional distance. Physicians on duty at these places not infrequently learn that their patients have been spending a portion of the summer at Long Branch or in the Catskills. Dr. F. F. Doggett of Boston read a very interesting paper on this subject before the Massachusetts medical society, calling attention to the abuse of the present methods, and suggesting a plan for their improvement based upon practical experiments of his own in this direction, which have been carried out with success since 1883. Briefly, his plan consists in ascertaining the financial condition of the applicant, and, if he finds him able to pay for treatment, to refuse to prescribe for him at the dispensary. Dr. Doggett has found that this plan has reduced to a minimum applications from those whose means will permit them to employ a physician at their own homes, while at the same time it has not prevented the relief of the poor, and indeed has been greatly to their advantage by permitting the physicians in attendance at the dispensaries to give them more time and attention. Dr. Hall, of the northern dispensary of New York, has followed a somewhat similar plan, with like results. Dr. Derby of Boston, in speaking of the methods to correct these abuses, says, "The solution of the whole matter seems to me so simple that I mention it with diffidence. It is but to accept the principle that the out-patient department is for the benefit of those whose lack of means would prevent their obtaining relief elsewhere, and to leave the application of this principle to the physician in attendance. When any thing in the dress, manner, or statement of the individual causes hesitancy to be felt, a few questions, put with tact and kindness, will readily resolve the matter ; or, if any doubt should still be felt, the applicant for aid should certainly receive its benefit." The evils of this gratuitous treatment to those who are able to pay are many, not the least of which is the effect upon those who receive it, lessening their self-respect, and causing them to look about for gratuitous assistance in other directions. If a central bureau could be established to investigate the claims of all applicants for free dispensary treatment, much good would be accomplished. Unless this was done, or some plan generally adopted, the rejected ones would apply at other dispensaries and be treated there.

THE *Meteorologische zeitschrift* (Berlin) for June contains a note by Lieutenant Sobieczky of the Austrian navy on the meteorological stations in the West Indies, which he had opportunity of visiting. Mention is made of the former establishment of stations during the hurricane months of the autumn in connection with our signal service, now mostly abandoned by reason of an unfortunate and unwise economy. The more important existing stations, fitted with good instruments and in the care of good observers, are as follows: Havana, Cuba, at the Jesuit college, in charge of Padre Benito Viñez; Kingston, Jamaica, in charge of Prof. Maxwell Hall; Port au Prince, Hayti, directed by Jesuit priests; two in San Juan, Porto Rico, one controlled by the government, the other in a Jesuit monastery. Besides these, there are records of less detail kept at Santiago, Cuba, and on the several English islands; but they are not published in good or easily accessible form, if published at all. Considering the direct importance of uniform series of observations on the Antilles, especially during the hurricane season, and the probability that observers could be found there if instruments could be supplied to them, the field commends itself to international cultivation; and in time we trust to see our hydrographic and signal offices taking the lead together in this work, to which other nations will undoubtedly contribute a valuable assistance.

THE LEGISLATORS of European countries seem to be ever on the alert to devise means by which the general health and vigor of the youth may be increased. While it may be true that the real motive which actuates these efforts is not a philanthropic one, but is rather with the idea of raising up material for an army with which to defend the fatherland or to carry conquest into other countries, still the end which is reached is a most beneficial one. By a law recently enacted in Germany and Switzerland, the principals of all schools are required to dismiss their pupils at noon of every day on which the thermometer registers, at 10 A.M., 20° Reaumur (77° F.). We commend this action as worthy of reproduction in this country to those who, during the coming year, will serve in our state legislatures.

THE PRELIMINARY ACCOUNT of an analysis of the Mexican codices which appears in this number of *Science* aroused an unusual interest in the section of anthropology at the recent meeting of the American association. All previous attempts at deciphering these queerly artificial systems of picture-writings were confessedly inadequate; and the principle of ascribing a phonetic value to the characters, and not a merely symbolic one, is as rich in its consequences as it was unexpected. It is highly improbable that a method of interpretation yielding such definite and rational results even in a small number of instances should not be the key to a large portion of the writings; just as improbable, for example, as that a thousand letters of a printer's 'pie' should happen to form rational sentences. Moreover, the discovery of the determinative signs does much to complete whatever gap may have been left in the evidence. Linguists and anthropologists alike will await with anxiety the results of the application of this promising innovation to the mysterious remains of Mexican thought and customs.

TECHNICAL EDUCATION.

IT is pleasant to notice that the subject of technical education and manual instruction in connection with the public-school system is being actively and favorably discussed in New York City. The board of education some time ago appointed Messrs. Dewitt J. Seligman, Henry L. Sprague, and E. J. H. Tamsen a special committee to make a report on the subject of technical education, and on Oct. 13 their report was received and discussed by the board. The report emphatically favors the introduction of manual training into the public-school system, and points out that it may be accomplished in one of two ways: first, separate schools for manual training may be established; or, secondly, it may be made part of the regular course of study, as now pursued in the various schools. Inasmuch as the superintendent of school buildings reported that there were vacant rooms in various schools, the committee was of opinion that mechanical or constructive drawing, modelling in clay, wood-working by means of hand-tools, etc., could be taught immediately, such vacant rooms being used for the purpose. To carry out the proposed experiment in male grammar schools, the committee asked the board of education to apply to the board of estimate and apportionment for an appropriation of fifty thousand dollars.

The manual training of girls was not overlooked by the committee, and an additional ten thousand dollars was asked for in order to introduce experimentally into the female grammar schools instruction in elementary cooking (twelve lessons, of two hours each, would suffice, in the committee's opinion), instruction in sewing (sewing is now compulsory one hour a week in the primary schools for girls), and to provide for courses of lectures to the older girls on the elementary rules of housekeeping. Some discussion arose concerning the adoption of the report, some of the older members of the board of education seemingly regarding the proposed innovation as a reflection on the character of the education now given, and therefore opposing it.

Unfortunately the special committee was defeated in its request for immediate action ; and, as the report was referred to the standing committee on the course of study, it is hardly possible that, even if it is finally adopted, any thing can be accomplished under it for another year. But the report itself, the favorable reception it has met with in the press and among all intelligent citizens, and much of the discussion concerning it in the board of education itself, clearly indicate that this proposed advance in the common-school system of the metropolis will soon become an accomplished fact. It is only a question of time now, and we trust of a short time.

ANNUAL MEETING OF THE NEW ENGLAND METEOROLOGICAL SOCIETY.

The third annual meeting of the New England meteorological society was held at the Institute of technology, Boston, Oct. 19. Prof. J. D. Whitney read a paper on 'Rainfall statistics in the United States,' considering especially the statements that have been made concerning the increase of rainfall on the western plains as a result of cultivation of the ground. These statements are considered altogether untrustworthy. In dry regions the amount of precipitation is generally variable. The records kept in the west are seldom of long enough period, of sufficient accuracy, or of sufficient uniformity, to decide so large a question. Moreover, in the eastern part of the country, where long records have been kept, no definite variation in the precipitation is found.

Mr. S. A. Eliot read an essay on the 'Relations of forests to rainfall and water-supply.' The common opinion that forests increase and clearings decrease the rainfall was traced to the authority of eminent writers, based, not on well-kept observations of rainfall under these contrasted conditions, but chiefly on the well-known diminution of stream-flow in cleared districts. This, however, may be due to increased evaporation rather than to decreased rainfall. Forests undoubtedly retard evaporation of fallen water, but it is very problematic if they increase the amount that falls. Mr. Fitzgerald commented on this by referring to a statement, apparently on the authority of DeLesseps, that the rainfall along the Suez canal had increased since trees were planted there. On writing directly to DeLesseps, answer was received that he had made no such statement, and that there were no facts to support it. Mr. Davis added, that, if the causes controlling rainfall be separated into those dependent on and independent of forests, we find that the latter are now powerless to produce forests in forestless countries, such as those around the eastern Mediterranean, and therefore could not have originated the forests once there, unless formerly of different value from now ; but, if it be admitted that these non-forest causes vary, the deforesting may be due to natural changes, not to the hand of man.

Several seismoscopes and a series of photographs illustrating the effects of the Charleston earthquake, lent by the U. S. geological survey, were exhibited and explained at the meeting.

In the absence of the director, Professor Upton, an informal report on the work of the year was presented by the secretary. Members now number 110, against 95 last year, and include well-known meteorologists outside of New England. The monthly bulletin has been regularly issued, and recent numbers include reports from 140 to 151 observers, against 123 last year. More attention has been devoted to improving the character of the observations than to increasing the number of stations. Free tests of instruments belonging to observers reporting to the society have been begun by Prof. S. W. Holman. Three valued observers have been lost by death, — Hon. Hosea Doton, Woodstock, Vt. ; Dr. B. F. Harrison, Wallingford, Conn. ; and Mr. R. H. Gardiner, Gardiner, Me. The records of the last two will be continued. Special investigations, supported by grants from scientific funds, have been undertaken : a report on thunderstorms in New England in 1885, by the secretary, is thus already distributed to members ; and a report on the distribution of rain in cyclonic storms, by the director, is now in press. While such special studies are generously supported, the society still needs to increase its membership for the support of its regular work.

PARIS LETTER.

M. Ch. Zenger recently made known, at a meeting of the Academy of sciences, some interesting facts concerning the singular property that different substances have of giving luminous rays in darkness after having been exposed to solar or even diffused light. M. Zenger remarked that Mont Blanc emits, till about half-past ten in the evening, a peculiar blue-green light, very similar to that given by Lake Leman ; and he believed that this light originates in the ice of the glaciers as well as in the lime of the rocks. Thinking it might be possible to take a photograph of the mountain by night, he spread on a plate of glass a thin layer of phosphor of Balmain, and put it in the camera, exactly as if it were a sensitive plate. After a few seconds, the plate was taken out of the camera, and left in the dark, in contact with an ordinary sensitive plate. An hour after, this last plate presented a good photograph of the view which had been focused upon the phosphorized plate. Believing that carbonate of lime can, by exposure to the rays of the sun, absorb some light and give it off in darkness, although these rays may not be perceptible to the eye, M. Zenger allowed a phosphorized plate to remain at the focus of a camera for a quarter of an hour, at midnight, on the terrace of the astronomical observatory of Prague. This plate was then left for some hours in contact with an ordinary photographic plate; and the result was very satisfactory, since the monuments and towers whose invisible image had been concentrated on the first plate in the camera, came out very well on the second. Another experiment was the following: a piece of white paper, with a picture or some words written or printed on it, was left in the sunlight for an hour and then put in the dark, in contact with ordinary sensitive paper. The experiment succeeded well, and M. Zenger has since used this system to copy bills and notes. Of course, black parts come out white, and white ones, black. The general result of M. Zenger's researches is, that many substances absorb luminous rays during the day, and at night emit these rays in such a manner as to be able to impress sensitive plates, although they do not impress the retina.

The smallest country in Europe is not the state of Monaco, nor the republics of San Marino or of Andorre, as many think: it is a yet smaller territory, whose name is hardly known outside of its narrow limits, and compared to which the above-mentioned states assume a gigantic appearance. The territory of Moresnet is about halfway between Verviers and Aachen, between Belgium and Germany. It comprises six square kilometres and two thousand inhabitants, and is situated in a very pretty valley. It is completely independent. Its wealth consists mainly in tin ore. In 1815, after the Napoleonic wars, a committee was appointed to establish the frontier between Germany and Belgium. All went right till Moresnet was approached. Here the delegates disagreed. Each wanted Moresnet for his country on account of the riches under ground. As no understanding could be arrived at, it was agreed that this strip of land should remain independent, and belong to neither country. At that time Moresnet was a beggarly collection of some fifty huts: at present, although still a very young state, it is in a prosperous condition, and comprises more than eight hundred houses. Agricultural and industrial pursuits are carried on to a considerable extent. It is governed by a mayor, or burgomaster, chosen by two delegates, — one German, and one Belgian. This imposing official — a prosperous and hearty farmer — has a second, an old doctor, and presides over an assembly of ten, chosen by himself. This assembly does all the business under his supervision. Nobody votes in Moresnet. There is no military service, and only six francs taxes. The revenue amounts to about twelve thousand francs, and is quite enough to pay for the roads, schools, and the military force, which comprises one man of undefined grade. It would seem that the mayor ought to be satisfied with the state of things. Not so, however: this ambitious man wants to find mineral waters in his territory. But none are to be found yet, so he consoles himself by manufacturing soda-water. Another of his ambitions is that Moresnet should stamp its own stamps, and have his effigy on them. But the delegates from Germany and Belgium do not see the use of the thing.

Unfortunately, fish-culture amounts to nothing in France. Nobody seems to take any interest in it, nor to realize how very useful and profitable it might be to all if the rivers and streams were cared for, and fishes reared, and protected while young. The French fisheries are very poor indeed, and it would require an intelligent and energetic man to call the attention of competent authorities to the fact, and try to secure their good-will. River and pond fisheries amount almost to nothing, but as yet the marine fisheries have been very prosperous. This year, however, sardines are very scarce. This fact is a very serious one, since some sixty thousand persons are occupied in the sardine-fisheries. It seems that this fish is prevented from following its natural course alongside the French coast, from Biarritz up to Brittany, by the Portuguese fishermen, who, it is said, as soon as the fish arrive from the south, spread large nets, many kilometres long, in their course, and so prevent them from going any farther. So they all turn back for a while, but some time after, they try to pass. This gives the Portuguese a second fishing-season. The fact is, that in Portugal the fisheries are very prosperous, and that sardines are sold this year at the rate of a franc and a half or two francs per thousand. In France they are so scarce that they range between six and eight francs (the small ones): fine sardines are sold at from thirty-five to forty-five francs per thousand.

A new balloon has been recently tested in Paris. It was built by an engineer whose name is not yet made known. M. H. considers that it causes great loss of force to put the motor power in the basket, and that, if it were applied on the sides of the balloon, a great deal less would be required to give much more satisfactory results, as the power would act at the point where the resistance is greatest. So he has given his balloon a cigar-like shape, and, instead of a propeller underneath it, he has used a pair of wings on the sides of the balloon: they are put in motion by electricity, which is generated in the basket, and conducted by two wires to the wings. With this contrivance, M. H. believes he can obtain the same results as MM. Renard and Krebs, with less power. A public experiment, some days ago, gave, it seems, very satisfactory results, and the balloon was worked very well. Another balloon is being prepared, and M. H. is confident that it will be quite a success.

M. d'Arsouval, an able physiologist, and assistant to Dr. Brown-Sequard, published some time ago some interesting facts concerning the production of heat in muscular tissue. The fact that heat is developed when a muscle contracts, is well known. Many physiologists have made the experiment, which consists in a repeated and violent stimulation of the motor nerve, inducing tetanic spasms and a rise of temperature in the muscles. M. d'Arsouval has shown that it is not necessary to stimulate the nerve in such a manner as to induce tetanic spasms: weak stimulations, that do not bring on any contraction whatever, being too weak to do so, are accompanied by a thermic rise. Of course, the rise is not a high one, but it is measurable. M. d'Arsouval does not believe that the development of heat in organic bodies is a primary fact: on the contrary, he thinks that electricity is the first agency, and that heat results from the transformation. However, new experiments are necessary to ascertain this point.

M. L. Grandeau, the director of the agricultural station of Nancy, has recently published two interesting papers concerning a trip he made in Switzerland, during which he gave much attention to the agricultural productions of that country. There are in Switzerland some 30,000 square kilometres devoted to agricultural pursuits, 21,600 to pasture-land, 7,700 to forests, and 300 to vineyards. The greater part of the 21,600 is merely pasture-land (70 per cent): the remainder (30 per cent) is used to grow wheat. The pasture-land is used only for cattle-raising. Horses would not do well in Switzerland, on account of the climate. In Europe the increase of population has been much greater than that of meat-production. There is less meat to be had to-day per individual than there was fifty or sixty years ago. Cattle-raising is a profitable business, but it cannot yet become important enough in Switzerland to allow of exportation. If some cattle are exported, many more are imported: the excess of importation over exportation is fifty per cent, and more. As most Swiss peasants have only one or two cows (38,000 have only one, and 52,000 have three or four), an association system has been organized in many parts of Switzerland, after an old custom of Franche-Comte. It works as follows: some twenty or thirty peasants put their cows together in a herd, sending only as many as the lands they dispose of in the mountains can feed. A man is in charge of the herd, who every day milks the cows and cares for them, and makes the cheese during the summer season. When the cold sets in, the herd is brought down to the valley, and the cheeses are sold. The profits are distributed among the proprietors of the cows, according to the quantity of milk given by each of them. This quantity is carefully noted every day by the milkman. The result is, that, as cheese sells much better than milk, the benefits for each proprietor are nearly double what they would have been had the milk been sold as such. The whey is generally used to feed pigs, but of late it has been proposed to make milk-sugar from it. One litre of the whey contains some four or five grams of this sugar, which sells at one hundred or one hundred and ten francs per hundred kilograms. In Switzerland as well as elsewhere, the association system among small proprietors or producers proves very profitable and useful. M. Grandeau gave an interesting account of his visit to the Swiss works of the Anglo-Swiss condensed-milk company, built in the village of Cham, by your countrymen MM. Page. The idea of condensing Swiss milk originated in 1866, and was put forth by M. G. Page, at that time American consul in Zurich. He imported the instruments in use in the states, and began immediately. In 1867 the milk was furnished by 263 cows, and the works prepared 137,000 cans of milk. In 1886, twenty years after the first start, the works of Cham condense the milk of 8,000 cows (60,000 litres per diem), and sell some 15,000,000 or 17,000,000 cans.

We hear from Bologna that a committee has just been appointed to celebrate the centennial of the discovery of animal electricity by Galvani. It is a pity that frogs cannot speak, for the speech their delegate would deliver on that occasion would be worth while hearing. From the day Galvani noticed the movements which put him on the scent of his discovery, to the present minute, how many of these unfortunate creatures have died cruel and lingering deaths! The balcony is yet shown in Bologna on which Galvani suspended his frogs, and where he noticed for the first time the facts that led him to his fertile discovery.

M. Brown-Sequard delivered a communication on *rigor mortis* at the last meeting of the Academy of sciences. It is known that this phenomenon is generally ascribed to an hypothetical ccagulation of myosin after death. Dr. Brown-Sequard shows, that, if blood is injected in rigid limbs, rigor disappears immediately, and appears again if the blood introduction ceases. This fact has been noticed by him, even twenty-eight days after death. If, during the first eight hours after death, a limb is maintained in a state of constant agitation by means of some mechanical contrivance, no rigidity appears. It is to be noted, also, that cadaverous rigidity does not affect nervous excitability. Dr. Brown-Sequard does not believe in the theory of myosin-coagulation, and thinks that muscular tissue retains, after death, a particular sort of vitality.

M. Succi, concerning whose fasting experiment I gave you some particulars in my last letter, has victoriously achieved his feat, and is getting on quite well. He intends to renew the experiment in Paris. However, he is not considered as much more than a humbug; and to persons of a scientific turn of mind his experiment does not seem to have been conducted in a serious manner. As E. de Cyon remarks in a short but 'telling' paper on the subject, there is no proof whatever that M. Succi has not been able to feed himself secretly.

Among new books I must say a word of the memoirs published during the competition for fellowships in the medical school. Some subjects are interesting; for instance, 'On progress of teratology since Geoffroy Saint Hilaire' (by Princeteau), 'Muscular work and heat' (by Tapie), 'The origin of heat and power in living organisms' (by Lambling), 'Alkaloids of animal origin' (by Hugounenq), 'Pigments and coloring-matters of animal economy' (by Villejean), 'Air' (by Morelle), 'Calorimetry and thermometry' (by Malosse). Generally speaking, these memoirs are good and substantial, and they give a good idea of the present state of science concerning the questions to which they refer.

The professors of the different schools are coming back to Paris, and preparing their winter work. In the medical school some considerable material changes are being made. The new laboratories are ready, in the new building in front of the medical school, and the professors entitled to occupy them are going to move their instruments and books. Professor Vulpian visited his laboratory the other day, and was happy to see that he was to benefit by the change. The fact is, that the old rooms he has occupied in some old houses close to the school these many years are quite inappropriate for laboratory work, space and light being very scarce. In the new building, although he will have nothing very extraordinary, he will be much better off. But our best French laboratories are small and inconvenient when compared to German ones. Nevertheless, France can boast of many great physiologists, such as Magendie, A. Bernard, Vulpian. Fine laboratories do not create genius, but they help a good deal in making work easier and more accurate. V.

Paris, Oct. 15.

NOTES AND NEWS.

The *Quarterly journal of economics*, announced by President Eliot of Harvard at the last commencement as having its origin in a fund of fifteen thousand dollars given to Harvard for the purpose by John E. Thayer, Esq., has appeared. While primarily an economic periodical, its prospectus does not exclude from treatment current topics in other branches of political and social science. In outward appearance the new *Quarterly* is very attractive, and the contents of this first issue are of excellent character and quality. Professor Dunbar, the editor, writes the opening article on 'The reaction in political economy.' To him "this movement appears to be no revolution, but a natural reaction, probably salutary, and destined to promote ultimately a rapid but still orderly development of the science, upon the lines laid down by the great masters of what is called the deductive school." In view of its historical and ethical aspect and its directing the attention of the economic world to new problems, Professor Dunbar thinks that the importance of this movement can hardly be overrated; but nevertheless it is not an absolute break, as is sometimes supposed, in the continuity of economic thought. The second article, by Mr. Arthur T. Hadley of Yale college, treats of 'Private monopolies and public rights.' It deals principally with the railroad problem. Mr. S. Dana Horton, whose reputation is international, writes learnedly and clearly on 'Silver before congress in 1886.' It is a strong argument for immediate action by congress in order to put an end to the 'present amorphous and anomalous state of affairs.' Following the leading articles come valuable notes and memoranda, and an interesting letter on economics in France by Arthur Mangin. The bibliography for the quarter is appended, carefully classified, and in an appendix is included a partial translation of Wagner's review of Cohn's 'System der nationalökonomie,' from a late number of the *Jahrbücher für national-ökonomie u. statistik*. The first number is in every way commendable, and we can heartily congratulate all students and readers in the great fields of political and social science that it has been found possible to found in a single year two American quarterlies to deal with those subjects, and both of the highest order of merit.

— A hand-book of school superintendents, for 1886 and 1887, has been issued by The writers' publishing company, No. 21 University place, New York.

— In the last number of the *Philosophische monatschrifte*, Professor Schaarschmidt announces that Professor Natorp of Marburg will hereafter be associated with him in the conduct of that journal.

— 'A manual of lithology,' by E. H. Williams, jun. (New York, *Wiley*, 1886), may be of value to engineers and others who wish to know something of the names and composition of the commonest rocks in a superficial way ; but its title, 'A manual of lithology,' is certainly not warranted by any thing which it contains. The author regards only the macroscopical characters of minerals and rocks, which modern students know are, by themselves, most unsatisfactory and often misleading. After a few preliminary definitions, the commonest rock-forming minerals are mentioned, and a few of their characters given with more or less accuracy in tabular form. Then follows an enumeration of the principal rock-types, with the briefest possible description of each. The nomenclature here is quite antiquated, and employed apparently with no knowledge of the recent advances in petrographical science. The author's difficulty in distinguishing between crystalline and amorphous bodies leads him throughout the work into curious blunders. Why the peridotite rocks should have been placed in the group of 'special rocks,' it is difficult to see. Altogether this little book is very unsatisfactory, even for the extremely limited field which it attempts to cover.

— A fatal case of poisoning by bisulphide of carbon has recently occurred in England. The patient was a shoemaker, who was under the influence of liquor at the time that he drank the poisonous liquid. Although a physician was in attendance within fifteen minutes after the bisulphide was taken, and applied the proper treatment, the man died in two hours.

— A correspondent of the *British medical journal*, who has had large experience in the treatment of hydrophobia, says that the usual duration of the disease, from the time of attack to death, is from three to five days. He had but little difficulty in administering liquids, if they were of a dark color, and given from a vessel which was not transparent, so that the contents would not be seen until the vessel was placed to the lips.

— Dr. Joseph Jones of New Orleans recommends most highly the drinking of large quantities of fresh milk in cases of arsenical poisoning. His explanation of its action is, that it dilutes the poison, encloses it in its coagula, sheathes the inflamed surface of the mucous membrane, and, when the stomach is capable of absorption and digestion, it forms an aliment of the greatest value. His experience includes more than thirteen cases, all of which recovered.

— Dr. Morse of Amissville, Va., claims to have treated one hundred and twenty-five cases of diphtheria without a fatal result in a single case. Although he employs other remedies as adjuvants, he attributes his success to bicarbonate of potassium, which he gives to an adult in doses of from ten to twenty grains every two hours, with the view of saturating the system as soon as possible.

— A student at an Arkansas college, while making hydrogen gas, applied a match to the tube from which the gas was escaping, and, the air not having been expelled, an explosion followed which burst the retort, the pieces of glass flying in all directions. One of the student's eyes was injured at the time ; and as the trouble was lately increasing, the eye having in the mean while become blind, and as it was feared the sound eye might be sympathetically affected, the diseased eye was removed, and embedded in the tissues was found a piece of glass 15 millimetres long, 12 wide, and $1\frac{1}{2}$ thick.

— The Marchant steam-engine, now being introduced in England, shows a remarkable advance in efficiency, unless there be some undiscovered source of error in recent tests made. According to reports published in the London *Electrical review*, in a run of six hours and a half the engine developed ninety-eight horse-power upon a consumption of fuel of 77.54 pounds of coal per hour, or 0.791 of a pound of coal per horse-power hour. The accuracy of the methods employed in making the tests has been questioned by experts, and the resulting controversy will only be ended by further and more extended tests under conditions satisfactory to all. The action of the engine is as follows : the steam, at its initial pressure, passes from the boiler to the high-pressure cylinder, whence one third of the steam is taken to the low-pressure cylinder, expands, does its work, and is exhausted into the vacuum maintained in the condenser, converted into water, and finally conducted to the pumps as feed-water ; the other two thirds of steam, on leaving the high-pressure cylinder, passes into another, is expanded at two-thirds the stroke, and, having exerted its power, proceeds to a pump, where it is again expanded. After this the two-thirds steam is compressed in the last pump into the one-third feed-water; this latter process is carried on at the expense of engine-power, which is exerted not only in forcing the steam into the feed-water, but in compressing a cushion of air maintained at a proper pressure by means of air-pumps. This cushion or air-spring, on the return stroke, renders up its stored energy by pushing or returning the combined feed of steam and water back to the boiler.

—The next meeting of the Indiana academy of sciences will be held at Indianapolis, Dec. 29. It is proposed that the papers presented to the academy be grouped according to the topic; that is, that all papers upon geology be brought together, and all upon biology, etc. Those who desire to present papers should, at their earliest convenience, send the titles of their communications to the secretary, Mr. Amos W. Butler, Brookville, Franklin county, Ind.

—The new U. S. cruiser Boston, Mr. Gould's yacht Atalanta, and Mr. Vanderbilt's yacht Alva, are to be furnished with dense-air ice-machines, which are now being built at the Delamater ironworks in this city. In these machines, which require no chemicals, the air is compressed and expanded between the limits of twelve and four atmospheres' pressure, being used over and over again in what is called a 'closed cycle.' In the ordinary cold-air ice-machines the air is compressed and expanded between the limits of the normal atmospheric density and three or four atmospheres. The lower limit of density in the new machines—four atmospheres—is produced and maintained by a small auxiliary air-pump, which is automatically thrown out of action when the proper pressure is reached, resuming again when, through leakage, the pressure is reduced. It is said that with these machines ice may be produced at a cost of two dollars per ton.

—The electric motor is destined to play an important part in the history of railroads in this as well as other countries. Although not yet out of the experimental stage, electric street railways are rapidly gaining ground in public favor. Chicago, Baltimore, Philadelphia, Minneapolis, Toronto, and other cities already have electric street-railways in successful and profitable operation. About a dozen new roads are in course of construction, and a score or two more are projected. Montgomery, Ala., will be the first city in the world to have a complete electric street-railway system. In this city it is expected that a new and powerful Daft electric motor will soon be making trial trips on the Ninth Avenue elevated road, hauling a train of four or five cars; and on a branch of the Third Avenue road a passenger-car equipped with Sprague motors has been making experimental trips during a great part of the summer.

—The contributions to the mineral wealth of the world from the mines of Victoria, Australia, up to the beginning of the present year, show the very respectable total value of $1,052,635,824. This is divided as follows: gold, $1,047,129,274; tin, $3,239,524; copper, $920,000; antimony, $824,466; silver, $350,840; coal, $84,738; iron, $61,045; lead, $25,937. During the past year there was a total of 26,192 persons engaged in mining in Victoria, of which number 4,950 were Chinese. It is noticeable that of the latter there were only 202 engaged in quartz-mining, the rest working at the alluvial or placer diggings.

—The tincture of the chloride of iron, diluted with water, is very generally used as a tonic. Recent experiments have shown that when thus diluted it acts very injuriously upon the teeth. This is explained by the fact that the peroxide formed in the alcoholic solution is precipitated when water is present in such a flocculent form as not to adhere to the surface of the teeth, and consequently the free hydrochloric acid can act upon the lime salts of the teeth without let or hinderance. When the tincture is given without water, no action takes place; the peroxide which is then formed is of the anhydrous form, and so compact as to adhere to the teeth, and protect them from the action of the acid. These experiments have resulted in determining that there are three menstrua which can be used as diluents of this tincture, which will produce no injurious effects upon the teeth: they are alcohol in some form, vichy water, and a simple sirup.

—Professor Legge states that he has found two embryos in a single blastoderm in a fowl's egg at the third day of incubation.

—A remarkable death has recently occurred in Paris, in which the cause would never have been discovered had not an autopsy been held. A young girl was found dead in the street, and was at first supposed to have been the victim of foul play. When the post-mortem examination was held, the larynx was found to be closed by lumbricoid worms, which had been vomited, but had not been ejected from the mouth.

—The report of the director of the Leander McCormick observatory of the University of Virginia, for the year ending June 1, 1886, states that the great equatorial has been chiefly employed in the examination and sketching of southern nebulae. The nebula in Orion, and the Trifid and Omego nebulae have received special attention. 351 observations of miscellaneous nebulae have been made, resulting in 226 drawings, and the discovery of 233 nebulae which are supposed not to have been hitherto detected. Only a few nights have been suited to the micrometrical measurement of double stars; 76 observations have, however, been made. Observations of three comets have been made. Tuttle's comet was observed at only one other observatory. Nice, in France; and Barnard's comet of 1886 was observed at this place three weeks later than elsewhere. The small equatorial has been employed in revising the catalogue of stars south of 23°. The observations for the revision of the 23° zone are now practically completed. The director, Ormond Stone, expresses the opinion that the past year has been, without exception, the poorest for astronomical observations which he has ever known. Not only have there been an unusual number of cloudy nights, but even on clear nights the definition has been almost always extremely poor.

— An interesting combination of the Coulier-Aitken theory of the control of dust on cloud-formation with Thomson's investigation of the effect of surface form on evaporation has lately been made by Dr. Robert v. Helmholz. He finds that a definite and perceptible cooling of a mass of moist air below its dew-point is needed before any condensation begins, and ascribes this to the facility with which the first-formed water-droplets would evaporate on account of their sharply curved surfaces; so that super-saturation is needed to begin their formation. At the same time, the degree of super-saturation ordinarily needed is less than that required in dust-free air, because the dust particles diminish the surface-curvature of a given minute volume of water; and also, at the beginning of condensation, the particles may prevent evaporation from the surface of water that is attached to them. Filtered air has been carried to tenfold super-saturation without a trace of mistiness.

LETTERS TO THE EDITOR.

****Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Ely's Labor movement in America.

ALTHOUGH I have never before written any thing in reply to the censures of a reviewer, I feel moved to say a few words about the critique of my 'Labor movement in America' which appeared in *Science* for Oct. 15.

There are several reasons for this departure from my ordinary course. First, other authors have established the precedent, and *Science* has already published statements in reply to severe criticism of a book. While an author should doubtless decline to discuss his own capacity or general qualifications for his task, it may be very proper for him to call attention to positive misstatements of his reviewers. I am inclined to think it desirable that this should become general, as it would perhaps lead people to read a book carefully before reviewing it, — a thing which may be regarded as exceptional at present. Second, while it is doubtless not worth while to notice those who fail to distinguish between a torrent of personal abuse and serious criticism, it cannot be incompatible with one's self-respect to point out the errors of fact in a critique written by a person like N. M. B., who evidently desires simply to give expression to truth, and not to vilify an author. Third, a review is read by many who never see the book reviewed; and it may even be my duty to correct serious misapprehensions to which the article by N. M. B. must give rise, especially as they relate to such grave and pressing problems of the hour.

N. M. B. says that I seem to uphold "the extremists in their contention that all the evils of the present state of society are due to private property and the lack of proper co-operation in production and distribution." This is simply inconceivable to me; for the exact opposite is stated, I think I may safely say, fifty times in the book reviewed. I can find no more rational explanation for this astounding assertion of N. M. B. than that during a nap between chapters it came to him in a dream. If I held the opinion attributed to me, the remedy for social evils would be the abolition of private property; in other words, the socialistic programme. Is it not a little strange, that, with one exception, the sharpest attack on the book should have appeared in the organ of the socialistic labor party, while other reviewers complain because I leave nearly every thing to sympathy and benevolence, and furnish no adequate room for the activity of the state? The truth is, I point out many causes for the evils of present society, as intemperance, imperfect ethical development of man (which N. M. B. acknowledges, thereby falling into self-contradiction), unchastity, ignorance of the simplest laws of political economy, extravagance, and, in fact, 'the wickedness of human nature.' When, in his reproof of me because I failed to see so deeply as an ancient sage, N. M. B. goes on to ask labor agitators and 'their allies among professed political economists' whether the social, political, economic, and ethical elevation of men at large, and the human nature that is in them, is not what is wanted, he repeats my own words. I have dwelt at length on this point because I regard the accusation brought against me as a serious one. While I would not reproach N. M. B. with malevolence, I do bring against him the charge of culpable negligence. This is not the only case where the reviewer dwells on objections to the programmes of labor organizations, which I have pointed out, in such manner as to convey the impression that I have failed to see them. He does this in the discussion of the financial platform of the knights of labor. N. M. B. still labors under the delusion that men in masses in this country strike, and do all sorts of dreadful things, because some one 'snaps his fingers.' No doubt, he has read it in his daily paper; but for a man of scientific pretensions to repeat it, shows a strange ignorance of human nature and of the operations of the mind of man. A knowledge of natural phenomena is now regarded as a necessary qualification in a man who would instruct others in natural sciences. At some future time a knowledge of social and industrial phenomena will be considered a desirable qualification in a writer on economic topics: when that happy time comes, we will hear less about 'some one snapping his fingers' and turning the world upside down.

Only one other point. N. M. B. says I gather facts to suit a preconceived theory. If he had read the book more carefully, he would have learned the true state of the case; namely, that I began my investigation with a theory opposed to labor organizations, but was converted from my former opinion by an overwhelming and irresistible array of facts disclosed by serious investigation.

N. M. B. is not the only one who exhibits gross carelessness in reviews. The fault is common; and my own conscience pricks me when I remember one critique which I wrote several years ago. But it is time to emphasize the duty which a reviewer owes not merely to the author, but to the general public, to master the contents of a book before presenting an estimate of it to the world. Richard T. Ely.

Johns Hopkins university,
Baltimore, Oct. 22.

In a criticism of Professor Ely's 'Labor movement in America,' by N. M. B., in your issue of Oct. 15, it is stated that the evils which socialists ascribe to 'the institution of private property' are not the true cause of the evils or labor troubles, but that they are caused, as Aristotle held, by the 'wickedness of human nature.' No standard for good and bad is given by N. M. B., and the reader is left at a loss what 'wickedness' may be according to Aristotle or N. M. B. It is fair to presume that selfishness — utter, brutal, unmodified selfishness, the mere following out of the brutal, selfish instincts of man, regardless of the welfare or interest of other selves — is what Aristotle and N. M. B. mean.

"Every one for himself, the devil take the hindmost," is, then, the expression of the greatest wickedness or worst trait of human nature: that is individualism, pure and simple. Opposed to that, on the other extreme, as absolute goodness, would be altruism. Between the two, as the golden mean, is equity, or socialism, — live and let live; each for all, and all for each. The history or evolution of human nature — that is, the ego-altruistic or ethical part of human nature — is simply a development from the utter selfishness of the lowest brutes to the social instinct of man. That is the very thing that makes man, or the human character of the animal man. As man develops from a mere individualist, he becomes, therefore, better according to the degree in which he develops his social or equity nature; that is, as he grows to be a socialist That answers Mr. N. M. B.'s question, whether these labor agitators consider it is the wickedness (total depravity?) of man that needs to be reformed, or the economic-social institutions. The answer is, Both. Human nature has developed already from a low, beastly, selfish savage, to a golden-rule man; but our economic institutions are not yet brought into accord with that development of our human nature. To do that is the work and objects of the socialistic agitators. When that is done, it will again have a reflex action on our nature (like all material environment or social institutions), and help to make human nature still better than it now is. One of the agitators.

On the figures illustrating zoölogical literature.

When a zoölogist takes up his pen, brush, or pencil with the intention of executing a drawing of a zoölogical subject, either new or old, with the view of publishing it to the world, he assumes, in my opinion, one of the greatest responsibilities that can fall to the lot of man. This responsibility is none the less, of course, when the zoölogist is obliged to review the work done for him in this way by others, and applies to all manner of figurative illustration for zoölogical literature. On the other hand, I think science is fully as much in debt to him who furnishes her literature with an absolutely accurate, clear, and instructive figure, as she is to the writer who produces in type a full, trustworthy, and comprehensive description of the same subject. And, indeed, in many particulars, a good drawing of any object in nature, in the vast majority of cases, leaves a much more lasting impression upon the mind of the student than does sometimes the most lucid of descriptions. For instance, if we had never seen an elephant, nor a good figure of one, how different would be the ideas of different persons, were they to attempt to draw an elephant simply from a description, however good that description might be! How important it is, then, that original figures in zoölogy, including all its branches, should be as perfect and correct likenesses of the object they depict, as possible!

The writer, who has thus far contributed some thousand original drawings to the various departments of zoölogy, feels that no one more than himself needs the greatness of this responsibility laid before him, and I am fully aware of the shortcomings of some of my early attempts; but, be it said in justice to myself, I believe at the present writing duplicates, either in press or in the hands of publishers, of all of those that evidently required special improvement, are now furnished.

Great encouragement is held out in the future to all naturalists, in the numerous methods that are being perfected, by means of which the originals are accurately transferred to metal without the interference of another hand; and more especially does this encouragement come to those naturalists who take great pains, and are skilful with their work.

Electrotypy, however, and the ease it affords for reproducing all manner of work, threaten such scientists and naturalists who illustrate their own writings, with another danger, for which steps must soon be taken to protect them. This danger comes more especially from that class of writers who are either indifferent artists or will not take the time to make their own figures. Such people are apt to become very lax in the principles which pertain even to the matter of courtesy in the premises, and often, without your leave or by your leave, copy the drawings of others by electrotypy to illustrate their own books, which latter are only too often hastily made in other particulars.

And should an author have his writings and carefully executed drawings come out from the government press, why then these people to whom I allude seem to think that they are under no obligation of any kind whatever, and immediately plunder any thing they see fit to use. This is a great injustice to the original artist and describer: for in time it is sure to rob him of his right, as government publications are rarely seen by the public at large; and the first thing he knows his unacknowledged drawings are in use in class-books in half the schools in the country.

Then, again, it may operate in some such way as this. Take Professor Coues's first edition of his 'Key to North American birds.' This author says in his preface, "Professor Baird kindly offered me the use of all the illustrations of his late review, while Professor Agassiz generously placed at my disposal the plates accompanying Mr. Allen's 'Memoir on the birds of Florida.' Several of the woodcuts have been taken from Professor Tenny's 'Manual of zoölogy,' with the author's permission; and a few others have been contributed by Messrs. Lee & Shepard. With a few exceptions, the rest of the illustrations have been drawn from nature by the author, and engraved by Mr. C. A. Walker."

Now, here is a work illustrated by 238 figures, 40 of which at least are due to the unequalled genius of Audubon and Wilson; and yet their names are not even so much as mentioned in the preface, or anywhere else in the book, in connection with its illustrations! I will say here in justice to Coues, however, that he amply corrected this in the second edition of his 'Key;' but how does it operate? Why, this way: six or seven years afterwards Prof. A. S. Packard publishes a work entitled 'Zoölogy,' wherein the chapter devoted to birds has 22 figures, at least 14 of which are reduced cuts from either Audubon or Wilson, but each one accredited as being "from Coues's 'Key.'" I hold this to be altogether wrong, and a great injustice to an author or artist naturalist, either living or dead. It is quite as easy to write fig. 465, "Summer duck — from Coues's 'Key,' after Audubon," because that perpetuates the genius of a great artist, and relieves Dr. Coues of the responsibility of having drawn the bird in question!

Foreign authors are exceedingly careful about such matters in their educational works upon biology, for they seem to appreciate the fact that to be otherwise is taking, to say the very least of it, an unfair advantage of a special worker in science, who may not care to publish 'Nature series' for the public. The very recent and admirable publications of Mivart, Claus (A. Sedgwick's translation), Wiedersheim (W. N. Parker's translation), and F. Jeffrey Bell, will bear me out in this.

On the other hand, some of our American authors fully deserve the sharpest of criticism for their carelessness in such matters, and in other cases more severe handling where it actually comes within the operation of the law.

As an example of the majority of the suggestions and views that I have just put forth, let us take a little work just gotten out by Professor Packard for the use of American youth in the schools, and a sort of first steps in zoölogy (steps surely that should be, above all others, in the right direction). I refer to the 'First lessons in zoölogy' (New York, *Holt*). In the present connection, I have nothing to do with the long list of misstatements in biology in this apparently very hastily written book, but draw upon it solely to illustrate what I have said about zoölogical figures.

Dr. Packard, in its preface, makes a very shiftless acknowledgment of some of the authorities for the illustrations, but leaves a very much larger number where he has completely ignored the artists, and finally says that eight of them were drawn by himself; trusting, I presume, that the students would choose from among the most trustworthy and best of the unacknowledged ones these eight, and accredit the author with them.

I observe among several others quite a number of the wonderfully instructive drawings of Prof. E. S. Morse, some of C. V. Riley's, two of my own (figs. 196, 197), a drawing by Coues (fig. 203), and others by Hornaday, Rymer Jones, Owen, and many others, none of which receive a single word of acknowledgment as being authority for the originals.

But now a word as to some of the drawings themselves, — illustrations that are to be presented to classes of our children, and from which they are supposed to gain or derive their *first* notions of animal forms. Take fig. 211, for example, said to be a 'head of a dove,' but of rather a raptorial variety, I should mildly suggest. Fig. 212, on the same page, looks, to my mind, far more like the claw of a young lobster than the head of a cockatoo, which it is intended to represent. There is hardly a schoolboy in America, who has ever given sufficient attention to the matter, who would not know at a glance that the 'Lobate foot of the coot' (fig. 208) is absolutely incorrect in important particulars.

As the author says in the preface that it has been 'copied by electrotypy,' I do not know the authority for the skeleton of the wild ass (fig. 251), but it certainly gives the impression that the symphysis of the pelvis is not joined, and it strikes me that a better and far safer illustration of the mammalian skeleton could have been chosen to meet the end in view. But enough; for I believe I have fairly shown that surely these are not the characters of trustworthy illustrations of zoölogical subjects to bring into the class-room. And I must believe that if any of the youthful students of this little work become naturalists by profession in after-life, and look back upon the drawings I have cited, they will agree with Professor Packard, as he expresses himself on its p. 142, and with myself, after I had seen the figures in question, that, "even after the lancelet came into being, the steps by which the genuine backboned family became recognized in animal society were painful, and only in a degree successful." R. W. SHUFELDT.

Fort Wingate, N. Mex., Oct. 9.

The Charleston earthquake.

I suggest an experiment which will, I think, clear up the ideas of many persons who may witness it, as to the source of the phenomena of the Charleston earthquake.

Let a large sheet of glass (thick plate-glass is perhaps best) be held in a position nearly horizontal. Place an alcohol-lamp beneath it, near enough to heat it. Long before it is hot enough to soften, it will visibly bend, and then break with noise and more or less shock. It will be violently agitated.

To apply this, suppose that dense strata of rock exist at a great depth below the earth's surface, underlying the coast region from the Alleghanies far out under the ocean; that in the course of ages portions of these sheets hundreds of feet thick, hundreds of miles wide, and perhaps a thousand miles long, have been slowly increasing in temperature, and expanding or endeavoring to expand. For a long time, and to a considerable amount of expansion over such large areas, the tendency to expand merely makes the rock denser; i.e., sets up internal strains, compressing the substance of the rock as confined — a mile square of it, fifty miles square of it — to the actual space it has occupied for ages. This rock is like hard glass, elastic, which involves compressibility. At last the compressive stress accumulating for ages becomes too great to be borne without relief, which can come only from fracture.

The fracture, once started, extends from its initial point in lines of dislocation, as is in cold countries constantly observed in the thick ice covering lakes, and as is seen in the heated pane of glass.

But the commotion, the shock, the rending, the noises, are infinitely greater than in the case of the pane of glass or the sheet of ice. In the sudden splitting, rending and jarring dislocation of the glass, we have the working model of the heated strata of rock. If the effect bears any proportion to the relative magnitude of the model and the rock, then we have force, stress, movement, noise enough to produce all the audible and visible effects of the Charleston earthquakes.

The sudden dislocation and displacement under Charleston may produce the local shock ; the noise of the sudden splitting of the rock in place, the sound like distant cannon-shot. The long roar and grinding, like ten thousand rusty iron chariots on a rocky road, may be due to the production of a crack, which, if ten miles long, and instantaneous throughout its whole length, would yet be heard only as the sound from each foot of its length arrived at the ear of the hearer. The sound produced under foot might be heard within a few seconds ; and that produced fifty or sixty thousand feet away, say ten miles, would not reach the ear till it was fifty or sixty seconds old; and, as the sound of successive portions breaking at different distances arrived, there would result a continuous and heavy roar. Such a dislocation would relieve in great measure the general, the widely diffused stress and strain. But movements would be local as well as general, and the smaller but still immense sections of our stratum of rock might continue for days and weeks to adjust themselves by smaller cracks, crushings, and dislocations, producing the lesser shocks, sounds, and roars which commonly follow the first and greatest disturbance. Such have followed that of Charleston and Summerville. In fact, the pane of thick glass breaking over the flame of an alcohol lamp in the laboratory or on the lecture-table seems to give a working model, illustrating all the known and reported phenomena of the Charleston earthquake. The heat supposed to be observed by some in the ejection of water and mud may well have come from the sudden compression and stresses set up in the moment of dislocation. Sudden shocks, compressive stresses, and motion arrested, produce heat, as, when a fifteen-inch cast-iron ball at great velocity breaks to pieces against an iron target, its scattered fragments are all hot to the hand that gathers them. Ten miles square of hard limestone, if heated 10°, would expand three feet in length and width if free to move ; heated 100°, it would expand about thirty feet each way. Here are force and movement enough to wreck a dozen Charlestons. All we need on this theory is a change of temperature not very great nor rapid.

Such changes are plainly registered in the famous three columns of Pozzuoli described by Lyell, which, having been erected above the level of the ocean, have, two or three times within the historic period, sunk below its surface, and been bored at various levels by stone-boring shell-fish (Simaceae saxophagi), and then risen again till these marks, undoubtedly made under water, are now above the water, which merely bathes the floor of the temple, and on which they still stand upright, as though never disturbed. Lyell's clear description assigns these evident changes of level to local changes of temperature in the crust of the earth below Pozzuoli. Visible motion and fracture of rocks also accompany the phenomena of 'creeping' in coal-mines. M. C. Meigs.

Washington, D.C., Oct. 20.

Sea-level and ocean-currents.

I have just received a letter from my friend, Capt. John Brown, son of John Brown the martyr, which I have thought would interest your readers in itself, and furnish a better illustration than I have before given of the power of wind-friction to move great bodies of water. I therefore enclose you the following copy : —

Put-in Bay Is., Oct. 16, 1886.

My dear friend, — At 11 o'clock Thursday evening, the 14th inst., I witnessed here a remarkable fact, the effect of the late tremendous wind-storm. This commenced about 7 a.m., and began to let up at 11 o'clock in the evening, or a little later. I then went down to the shore in front of my house, and found the lake lower than the average by fully six feet! This is the greatest depression from such cause I have noticed during a residence here of nearly twenty-four years. We have not, within this period, had such a high wind steadily continued for so long a time.

The captain of the steamer Chief Justice Waite, running between Toledo and the islands, reports the fall of water-level at Toledo as about eight feet.

Ever yours, John Brown, Jr.

The reply of Mr. Ferrel, contained in *Science* of July 30, seems to me to obscure rather than illuminate the subject it discusses. The question before us is, not whether the wind has the power of raising the water-level on a coast, but whether wind-friction can, in the great equatorial belt and in the track of the Gulf Stream, produce the flow of water which is there observed. The striking cases of the power of wind to heap water on coasts, and to move bodily great masses of it in lakes, are only interesting and relevant as demonstrating the sufficiency of wind-friction to produce broad and rapid surface-currents. This conceded, and the case is won, because, in the lakes and open ocean, like causes produce like effects. Wind of given velocity raises in both places waves of equal height in equal times: against these waves the wind presses in the direction of its flow, with no opposing force. As a consequence, the roughened water-surface, from greatly increased friction, is moved bodily forward just as though impelled by the paddles of a revolving wheel. This surface-flow is in time communicated to underlying strata, and, if the wind continue to blow in the same direction, ultimately a large body of water will be set in motion; in other words, an ocean-current will be produced. There is no escape from this conclusion ; and all that part of Mr. Ferrel's paper which relates to wind-velocities, gradients, cross-sections, etc., are irrelevant. The great truth remains, that wind-friction can produce ocean-currents. The difference in specific gravity between cold arctic and warm tropical water is undoubtedly also a *vera causa*, the only difference between Mr. Ferrel and myself being as to the relative value of these two factors. Impressed as I am with the palpable evidence of the tremendous efficiency of wind-friction, and realizing the extreme slowness of readjustment of disturbed equilibrium by a slight difference of specific gravity, the other factor, I am compelled to give in my adhesion to the party, very respectable in numbers and intelligence, who ascribe the greater efficiency to the friction of wind.

So far as the surface-gradients of the ocean are concerned, I must say that I regard them of no significance in this discussion. One has only to turn to Dr. Penk's 'Die schwankungen des meeresspiegels,' and read the record which he and the authorities he quotes have made, to see that along the coast sea-level is altogether a local phenomenon, and is dependent upon the altitude and position of the neighboring land-masses. Where the shores are lofty mountains, there the water attracted by them rises above the normal; it also rises on both sides of the Atlantic, and is probably ten or twelve feet lower in the middle than on either side.

J. S. NEWBERRY.

The genesis of the diamond.

Prof. Carvill Lewis, in his remarks on 'The genesis of the diamond' (*Science*, viii. p. 345), briefly alludes to the peridotite of Elliott county, Ky., as 'suggesting interesting possibilities.' My notes (*American journal of science*, August, 1886, p. 121) on this remarkable eruptive rock are but a brief digest of a report (Bulletin No. 38, U. S. geological survey, not yet published) in which its peculiar features are more completely described. If the hypothesis advanced by Professor Lewis really accords with nature's method of manufacturing this precious gem, it gives to prospectors a most valuable guide; and it is well worth while to carefully examine all localities the geological composition and history of which are analogous to that of the South African diamond-fields.

In Elliott county, Ky., near Isom's mill, six miles south-west of Willard, there are two short dikes of peridotite breaking through the horizontal sandstones and shales of carboniferous age in such a manner as to locally envelop many of their fragments. The slopes in the vicinity are well covered with soil, so that there are but few exposures of either the intrusive mass or the adjacent strata near the line of contact between them; and no considerable excavations have been made. Nevertheless it is evident that the shales have been distinctly metamorphosed by the peridotite. This is most plainly visible in the enveloped fragments of shale, which are quite numerous in the dike at one exposure near Isom's mill, but elsewhere they are almost or entirely absent. Thus both varieties of peridotite described by Professor Lewis occur in Kentucky, but the brecciated form has not yet been found to contain diamonds.

The dark shale, fragments of which are included in the peridotite, may be regarded as composed of sand and clay in varying proportions. The amount of metamorphism experienced by the small fragments of shale is very unequal, and by no means proportional to the sizes of the inclusions. One of the earliest and predominant metamorphic effects is the development of a micaceous mineral in the argillaceous cement. This development may extend so far as to render the inclusion chiefly micaceous. Each enveloped fragment is surrounded by a narrow zone of colorless mica, the scales of which are frequently arranged perpendicular to its surface. An advanced stage of metamorphism is marked by the appearance of very interesting spheroidal bodies with remarkably suggestive properties. They have a high index of refraction, and are pale yellowish to colorless, translucent to almost transparent, and completely isotropic. The diameter of these little globules is generally about .02 of a millimetre, and they are remarkably uniform in size. Rarely this substance appears in irregular grains; but generally it occurs in a form very suggestive of the diamond, for it resembles a hexoctahedron with curved faces. In general appearance it simulates the small translucent crystals of octahedrite in the adjacent peridotite, but their optical properties and action in acids readily distinguish it from that species. They are soluble in concentrated hydrochloric acid, and, when heated to bright redness, they become less translucent and somewhat earthy in appearance; but the change is not prominent. In the small fragments the globules are usually numerous, and scattered throughout the scales of clouded mica, but most abundant and least regular in form near the periphery of the inclusion, where they sometimes form quite a distinct border just inside the one of colorless mica. In the fragments where this peculiar isotropic substance is most abundant, there is but little well-developed mica. Notwithstanding the fact that some of their properties suggest that they are diamonds more or less perfectly crystallized, their solubility in acid renders such a view untenable. Were they diamonds, they would be of comparatively little value, because of their exceedingly small size.

The dark shale which is frequently enveloped by the peridotite is somewhat carbonaceous, but contains a small proportion of carbon as compared with that of the South African diamond-field: for this reason, it appears to me rather improbable that diamonds will be discovered at the locality in question.

Some very pretty pyropes, locally supposed to be rubies, have been picked up in the soil resulting from the decomposition and disintegration of the peridotite, but nothing of greater value has yet been discovered at that place. That the dikes have been prospected, and supposed to contain valuable metals, is evidenced not only by slight excavations, but also by the ruins of what appears to have been a structure for reducing ore. Nothing is known in that country of the history of these ruins, and they may be of considerable antiquity.

It appears to be a significant fact in favor of Professor Lewis's hypothesis, that the diamonds found in the United States have been discovered where peridotites abound. The chief localities are either in North Carolina and Georgia or in California. Of all the mountain-ranges of this country, the northern portion of the Sierras in California is perhaps the richest in serpentine. In cases I have examined, the serpentine is derived by alteration from peridotites. In the same region, among older stratified rocks of the auriferous series, is a black shale or slate which occasionally contains a considerable amount of carbonaceous matter; and it is quite possible that the diamonds which have been discovered in the Sierras had their origin along a contact between peridotite and carbonaceous shale. At any rate, the suggestion opens another field for prospectors, and it should be remembered that corundum, with its gems, is also found under similar geologic conditions.

J. S. DILLER.

Petrographic laboratory, U. S. geol. surv.,
Washington, D.C., Oct. 21.

SCIENCE.—SUPPLEMENT.

FRIDAY, OCTOBER 29, 1886.

PRELIMINARY NOTE OF AN ANALYSIS OF THE MEXICAN CODICES AND GRAVEN INSCRIPTIONS.[1]

I WISH to make a statement of a few of the results I have recently obtained by a translation into the Nahuatl language of the phonetic symbols contained in the Vienna codex and the Bodleian and Selden manuscripts. I find that these entire codices are composed of signs representing parts of speech, forming, in combination, words and sentences. Moreover, I have discovered certain determinative signs that render a misinterpretation of these picture-writings impossible.

The Vienna codex, the Bodleian and Selden manuscripts, are records of lands, tributes, tithes, and taxes. A partial decipherment of portions of the Borgian, Vatican, and Fejérvary codices convinces me that these do not relate, as has been supposed and is maintained, to astrological and exclusively religious matters, but deal with the details of a communal form of government, the existence of which has been suggested by some recent writers, but not sufficiently proved to be generally accepted.

The as yet imperfect insight I have obtained through these native works confirms and completes much of the testimony of the early Spanish writers, but also renders evident the false and distorted impressions they received and handed down.

Familiarity with certain phonetic symbols of frequent recurrence in the picture-writings caused me to perceive, somewhat to my astonishment, that identical symbols are reproduced on the so-called 'calendar stone,' the 'sacrificial stone,' and other equally well known monoliths. Through the decipherment of these and an application of the same method to other symbols engraved thereon, I unhesitatingly affirm, even at this early stage of investigation, that these graven monoliths are not what they have hitherto been considered. On them are Nahuatl words that are found in the codices in Sahagun's invaluable 'Historia,' and in other early chronicles where imperfect explanations of them are given ; and these words reveal, beyond doubt, the true uses and purposes of the stones.

[1] Read before the American association for the advancement of science at Buffalo, August, 1886.

Let us cursorily examine the testimony of the best authorities on a certain point. Duran tells us distinctly that there was in each market-place of ancient Mexico a circular, elaborately carved tablet, held in great veneration. It was frequently consulted, and by it the market-days were regulated. All writers concur in stating that the market was held on each fifth day. According to them, a period of five days answered to our week, and four such divisions formed the period of twenty days termed the Mexican month. They tell us that all adults were obliged by law to resort to the appointed market-place on each fifth day, and that all produce and manufactures had to be brought there, even from great distances, severe penalties being incurred by those who bartered the produce of land or labor on the highway or elsewhere. On the broad, straight, cemented roads leading to the locality of each market, 'resting-places' for the wayfarers and carriers were provided at regular intervals ; and, by the number of such stopping-places between one point and another, distances were estimated.

The enormous concourse of people, the variety of produce exhibited, and the order that prevailed in the markets of Mexico and Tlatelolco, filled the conqueror with wonder and admiration. From Cortes, Bernal Diaz, Sahagun, and others, we learn that the market was a special charge of the supreme chief of Mexico ; that appointed officers presided in state over it, while others moved among the throng superintending the traffic. Standard measures were kept, and rigorous punishment awaited those who sold by false measure or bartered stolen goods.

It is my opinion, and one that I can support by a mass of further corroborative evidence, that the periodical market-day was the most important regulator of the Mexican social organization, and that the monolith generally known as the calendar-stone was the market-stone of the City of Mexico. It bears the record of fixed market-days ; and I venture to suggest that from these the formation of the Mexican calendar system originated. The stone shows the existence of communal property and of an equal division of general contributions into certain portions. I find, moreover, that the face enclosed in the inner circle of the tablet is a rebus. When its several parts are interpreted by the phonetic elements they represent, a sentence is obtained which clearly shows the use of the tablet. Of this sentence I shall submit but two words, deeming these sufficient, for the present, to prove my method and its results.

Thus from the phonetic elements *tetl* ('stone'), *ixtli* ('face or surface'), *pan* ('upon'), is obtained, by combination, according to rules of the Nahuatl grammar, the word *teixpan*, meaning 'publicly.' In Molina's dictionary the noun *teixpanca* is translated as 'something evident and manifest to all.' The protruding tongue yields the two elements of the word *nenepilquiça* ('to mark, note, keep account of'), formed by *nenepilli* ('tongue') and *quiça* ('to go out'). These statements are, of course, almost meaningless to any but Nahuatl students acquainted with the pictographic system.

Now, turning to the monolith generally known as the sacrificial stone, I find it to be a law-stone of similar nature, recording the periodical collection of certain tributes paid by subjugated tribes and others whose obligation it was to contribute to the common wealth of Mexico. A symbolic frieze around the stone consists of groups, placed at intervals, of flints (*tecpatl*), with conventionally carved teeth (*tlantli*), giving, in combination, the word *tecpatlantli*. This word occurs in Sahagun's 'Historia' as the name given to the 'lands of the palace,' and in one of the native works I find designated the four channels into which the produce of these lands was diverted.

THE MEXICAN CALENDAR-STONE.

The periods indicated on it differ from those on the great market-stone, and seem to furnish a solution to the perplexing complementary calendar system mentioned by Spanish writers as 'the lords of the night accompanying the days.'

In conclusion, I would state, that, in my opinion, many of the large stone receptacles that are generally called 'vessels for containing the hearts and blood of human victims' are no other than the standard measures, preserved for reference in the market-place.

Before publishing my final results, I shall submit them to a searching and prolonged investigation. An examination of the originals of many of the codices reproduced in Lord Kingsborough's 'Mexican antiquities' will be necessary to determine important points, and during the forthcoming year my line of researches will be in this direction. Zelia Nuttall.

HOW TO MAKE THE MOST OF A SMALL LIBRARY. [1]

The question is not what to do with a library of five hundred thousand, or a hundred thousand, or fifty thousand volumes. It has nothing to do with libraries which can afford to buy manuscripts or incunabula, black-letter tracts, or early American sermons. It is not for libraries whose collections of original authorities took away, many years ago, the cause of John Adams's reproach that in his time the books from which Gibbon's statements might be proved true or false could not be found in the United States. A student may go to the libraries in the great cities and read at his will, order from abroad books relating to his specialty, or, if he can show just cause for his request, may even have books sent to his distant home. The libraries which concern us are those of thirty, or ten, or five, or even of one thousand volumes, in towns and villages, open, perhaps, all day six days in the week, or two or three hours on one day. I mean this for you, whose library spends a thousand dollars a year; and you, who have but five hundred for books, periodicals, and binding; and you, who struggle along with fifty dollars' worth of new books twice a year. It is for you, too, whose library has existed in a half-alive state with poor American reprints of English books, novels in wretched condition, antiquated volumes of science, biographies of the dreariest, incomplete volumes of magazines. How can such libraries be made centres of sweetness and light in country towns?

'Your house is not large enough to swing a cat in,' said a man to his friend. 'But I don't wish to swing a cat,' answered the friend. This bit of homely wisdom, and another, 'When you can't have what you like, you must like what you have,' are as useful in libraries as anywhere else.

But they do not mean that you are to be satisfied with the present use of many of the books which are now gathering dust upon your shelves. Some of them may easily be made to answer the questions of your readers. Spend the next money that you have in a few books of reference, a new edition of an encyclopaedia, a good atlas, 'Lippincott's biographical dictionary,' 'Poole's index,' and its co-operative supplement the Brooklyn catalogue, and the Providence reference-lists. If you can get also, or if you have already, all the volumes of *Harper's magazine*, *Scribner's monthly*, and the *Century*, the *Popular science monthly*, and *Littell's living age*, with the separate indexes, including articles and poems too short to be indexed in Poole, you are ready to meet the wants of most of your readers. If you have time, index *St. Nicholas*, *Wide awake*, and *Harper's young people*. A librarian of a small library can often satisfy a reader by showing him an article written ostensibly for children, but told in the clear, simple style which appeals to many older persons. The thinking powers of many boys and girls never develop after they leave school at fifteen; and knowledge, in order to be attractive to them in their later years, must be set forth as attractively as in their school-days. If you can overcome the repugnance of many persons to books which they think childish and beneath them, you can often give them just what they are able to enjoy. I sometimes say, "The best article that I know is in the *Wide awake* [or *St. Nicholas*, or *Harper's young people*], and, if you have no objection to reading a boys' and girls' magazine, I think that you will find in it just what you need."

A magazine which has a department of 'Answers to correspondents' asked, in a late number, for no questions which might be answered by referring to an encyclopaedia or biographical dictionary. In the next number a correspondent begged the editor to remember that many persons had no access to such books, and their only way of learning what they wished to know was through the magazine. The library in every town or village should supply this want, and should also contain Brewer's 'Reader's hand-book' and 'Dictionary of phrase and fable' (which, though often inaccurate, are much better than nothing), and Wheeler's 'Dictionary of noted names of fiction,' and 'Familiar allusions.' As soon as you can afford it, buy all the volumes of 'Notes and queries;' but until then you can answer many questions from the books of reference already named.

[1] Read before the Milwaukee meeting of the Library association by Miss C. M. Hewins, July 7, 1886.

The stock questions with which every librarian is familiar, such as who wrote 'I am dying, Egypt, dying,' whether Shakspeare was of noble birth, or Eleazar Williams was Louis XVII., are easily disposed of. If you can make your readers understand that they must formulate their requests in intelligible shape, you have gone a long way towards making your library useful. They expect a librarian to find 'a book about cheerfulness;' or 'a book about whether education is better than wealth;' or 'a book in marbled covers that wasn't exactly a history, but had something about history in it, that mother read about nine years ago.'

This is no place for discussing the merits of rival encyclopaedias. I find the Britannica, Chambers's, Appletons', and Johnson's all useful. If I could have only one, and no atlas, I should take Appletons', on account of its maps, its full lives of living persons, and its yearly supplement. A person often goes to a library with a question which he fancies can be answered only by reference to many learned books, but really is a very simple one. A stranger from out of town once said to me with a pompous air, "I am pursuing an extensive course of historical reading, and wish to know what works the library contains on the history of Constantinople." I meekly replied that we had only a very few of the original authorities, and that they were in English translations. "What have you, then?" I named the more familiar histories, and a few recent books of travel, like De Amicis' and Gautier's. "I wish to see a minute map of the city." — "We have nothing minute. The best that I can give you is in the 'Encyclopaedia Britannica.'" — "Ah, indeed! That is a work I have never heard of. May I see it?" This confession betrayed at once the depth of the stranger's learning. He read the encyclopaedia for about ten minutes, then returned it with thanks, and went away saying that he had now finished his course of reading on Constantinople. An encyclopaedia often satisfies the vague desire for knowledge, of a person who has not learned how to use books, and asks in an indefinite way for something on a certain subject.

The Brooklyn catalogue is especially useful in its biographical references to lives in books which, without it, might stand unopened on the shelves. For example: a librarian, when asked for a life of Queen Christina of Sweden, might not remember, without consulting it, that, although there was no life of her in the library, chapters upon her might be found in Wilkie Collins's 'Miscellanies,' Hays's 'Female biography,' Mrs. Jameson's 'Lives of female sovereigns,' and Russell's 'Extraordinary women.' 'Poole's index' unlocks *Littell's living age,* which is full of biographical and historical articles. Every volume of essays in a library should be indexed, and every title placed in the catalogue.

The question of what kind of catalogue you should have is one that depends largely on the number of your readers and the kind of books which they take. A printed one soon grows obsolete. A card-catalogue, well arranged under authors and subjects, with zinc indicators to show the places of subjects, and brass rods so that the cards cannot be displaced, is as good as any thing that has yet been used. "I made my catalogue," said a librarian to me a year or two ago, "so that the greatest fool in town could not possibly make a mistake in finding an author or title." This catalogue is certainly a model of clearness and simplicity. Long experience with fixed shelf-numbers has convinced me that they should not be used, but should give place to the Dewey plan or one of its modifications.

The books which you buy should depend, like your catalogue, on your class of readers. A library in a village where there are farms and gardens should have the latest and best books upon farming, gardening, the care of cattle and poultry, and several agricultural and horticultural papers and magazines, that may be allowed to circulate after they are bound. I saw not long ago, in a newly endowed library in such a town, several books with finely colored illustrations of beautiful-leaved plants and flowering shrubs, that must certainly have an influence in time in making the gardens of the neighborhood very different from the traditional farmhouse door-yard. A town with telephones, electric lights, machine-shops, and manufactories, where many young men of intelligence are electrical engineers, machinists, and draughtsmen, needs all the newest books that it can afford to buy, on electricity, applied mechanics, and mechanical drawing. We find in Hartford a steadily increasing demand for books of these classes. Scientific works, unless of recent date, are worse than useless, except to a student of the history of science. A person who asks for a book on physics or chemistry from a printed catalogue does not always notice the imprint, and chooses a work quite out of date. A librarian can and should tell him where to find a newer and better one.

The use of books on special subjects grows every year. The Society for study at home, the Chautauqua society, many smaller clubs, *Queries* and other periodicals, with their lists of prize questions, have all done their part in encouraging readers to use libraries. The prize questions are often such as anybody might write by opening any volume of history or biography at random and framing a question about the first name or subject on the page. Such questions are a severe tax on a librarian's time and patience ; but, if a reader comes in search of answers, he must be kindly received, and all the resources of the library placed at his disposal. A librarian needs a certain tact and skill in guessing at the wants of readers. This comes by practice, after one has learned to estimate the mind-power of the frequenters of a library. 'Can you give me something on the French revolution?' asks a young girl. Instead of offering Thiers, or Carlyle, or even the 'Epoch of history' volume, the librarian asks, 'How long an account do you wish, — one in several volumes?' — 'Oh, not very long, and not very deep, please.' — 'An historical novel, perhaps?' — 'Yes,' with a visible brightening of the face ; and the reader goes home happy with 'Citoyenne Jacqueline,' perhaps to come back and ask for another novel of the same period, or even a history. It is, however, too much to expect that every reader who desires a little historical knowledge will go through a course of many-volumed books. The various lists of historical novels published by the Boston public library and other libraries, Professor Allen's 'Catalogue of novels and poems on English history,' and Adams's 'Manual of historical literature,' are every-day helps in even the smallest library. It is not hard for a librarian to make a list of the novels in his or her own library which illustrate different periods. A small library has this advantage over a large one, that it cannot afford to buy poor novels. Miss Hewins closed with a list of about seven hundred dollars' worth of books made for the beginning of a free library in a manufacturing and farming town, whose inhabitants are of average intelligence.

THE AGE OF ELECTRICITY.

In the closing sentence of this book the author remarks that we are to-day entering upon the age of electricity ; so that, in spite of its title, the volume must be regarded as a discussion of incidents in the world's history which were necessary and preliminary to its complete preparation for the phase of its existence which it is now about to take on. Now and then, throughout its nearly four hundred pages, prophetic glimpses are afforded of what this age may have in store for us, but in the main the author has confined himself to the safer ground of already accomplished fact.

The reader is carried from the 'myth of the amber-soul,' which is discoursed upon in the first chapter, to nearly the latest application filed in the patent office up to date ; and, in a general way, the task of summarizing the vast amount of information which scattered itself with great irregularity along the centuries from the earliest of these dates to the latest has been well and satisfactorily performed.

The age of electricity. By Park Benjamin. New York, *Scribner*, 1886. 12°.

The book is written in the interests of the general public, and is nearly free from technicalities, which are so often a bugbear to the general reader. While not especially intended for the student of electricity, it will prove to be a useful book of reference to many whose collections are limited, as it contains a good deal of historical information not otherwise accessible in a single volume. Considered in relation to the supposed demands of the general reader, the author has perhaps erred somewhat in often going into details which may serve to complicate rather than to simplify, and, in a few instances, in avoiding the discussion of an interesting subject because of its seeming difficulty.

Several inaccurate and misleading statements are found scattered through the book, which are all the more noticeable on account of its general excellence. Early in his discussion the author defines the units now commonly used in electrical measurement ; but he has not been able to avoid confusion in their use subsequently, as when he states that the quantity of current necessary to decompose a grain of water is 3.13 ampères, and in other instances. Many readers will be astonished at the statement that the resistance of a battery-cell is in no way altered by increasing or diminishing the size of the plates. The assumption of the resistance of what the author continually calls a 'strange atmosphere' around the poles of a magnet, and in the neighborhood of a conductor conveying a current, in order to account for the phenomena of the magnetic field, would hardly seem to be warranted, even in a popular treatment of the subject.

In his historical references, the author is disposed to give due credit to American science and invention, although in his discussion of the induction coil he nowhere mentions the important contributions of Mr. E. L. Ritchie ; and his treatment of contemporaneous discovery and invention does not seem to be quite free from prejudice and bias.

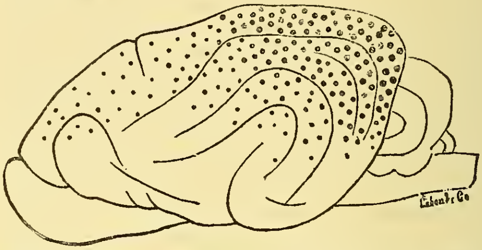
Notwithstanding these and some other faults, the book contains a vast amount of interesting information, presented in an interesting way, and it will doubtless find an appreciative audience. It presents a handsome appearance, and the numerous illustrations are generally appropriate adjuncts to the text. In the fine full-page cut, however, showing a man of war destroyed by a fish-torpedo, it is a little curious to see, that, while the great ship is certainly going to the bottom, the small torpedo-boat itself floats apparently uninjured.

LOCALIZATION OF FUNCTION IN THE CORTEX OF THE BRAIN.

A convenient summary of the main points that have been established by experiments on animals, by pathological records and anatomical research, regarding the relation of certain parts of the brain to the various senses and systems of muscles, is a very welcome contribution to this vexed question. If, in addition, the work brings new light on some of the problems, and a worthy appreciation of its predecessors, it is doubly welcome. The recent work of Dr. Luciani and Dr. Seppilli has these claims to our highest praise.

The view of Flourens, that all the parts of the brain were functionally equivalent, was followed, after the discovery of the excitability of the cortex in 1870, by the very opposite view that the brain consisted of a collection of areas definitely circumscribed, each of which had exclusive charge of a certain function. The view held by our authors, agreeing with that of Exner, Goltz, and others, is a mean between the two. The different parts of the cortex have very different relations to the several functions. But a centre is not a definitely limited area: it has a focus and a 'periphery,' but no hard and fast boundary-lines. The peripheries of the various centres overlap. Take the usual centre, for example. If you regard the sight-centre as all that part of the cortex the removal of which will cause disturbances of vision, then this centre is almost too extended to be localized at all; but, if you distinguish between transitory and permanent (though gradually decreasing) impairment of vision, the occipital lobe, with a small part of the adjoining parietal, is at once marked as the focus of the sight-centre: its 'periphery' extends in the direction of the frontal and temporal lobes. An injury to the peripheral portions will cause less severe and less permanent impairment of vision than injury to the focus.

The extensive destruction of one occipital lobe produces blindness in a small external segment of the retina on the same side, and in a large internal segment of the retina on the opposite side; i.e., each centre is connected with both sides of the body, but more with the opposite side. This furnishes a simple scheme of the decussation of fibres in the optic chiasma. The general results are compactly represented in a diagram of the dog's brain, in which the size and proximity of the dots show the 'intensity' of the different parts of the centre, while the shaded dots show the proportion of the centre connected with the same side of the body.



The accompanying diagram of the dog's brain shows the location and extent of the *visual centres*, as proved by the impairment of vision due to extirpation of this area. The occipital region, as indicated by the size and frequency of the dots, is most immediately connected with this function; but an area of minor intensity extends towards the frontal and parietal lobes. The shaded dots indicate (roughly) the part (a smaller one) of the centre connected with the retina of the same side; the others, the part (a larger one) connected with the opposite retina.

The centre for hearing has likewise a focus and a periphery, and the scheme of decussation would be quite the same. The focus is in the temporal lobe, with the periphery extending in the direction of the parietal and frontal lobes, of the hippocampus and cornu ammonis. The attempts at localizing the centres for smell and taste are less definite and less certain.

On the pathological side, the correlation of certain disorders with lesions of certain parts of the brain tends to the same results in the main, and thus makes the experimental evidence doubly important.

The central convolutions and the immediately adjoining parts of the parietal and frontal convolutions form the sensor-motor zone. It is the terminal station for the reception of skin and muscle impressions, as well as the origin of the voluntary control over certain muscles. The motor zone is directly excitable by electrical stimulation, and is the part the irritation of which produces epileptic spasms. A study of the order in which these spasms affect different groups of muscles, with a post-mortem examination of the brain, tends to a more definite localization of the facial centre, the arm-centre, and the leg-centre. The chapter on epilepsy, from the point of view of Hughlings-Jackson, is a valuable presentation of the subject.

Die functions-localisation auf der grosshirnrinde an thierexperimenten und klinischen fällen nachgewiesen. Von Dr. Luigi Luciani und Dr. Giuseppe Seppilli. Autorisirte deutsche ausgabe von Dr. M. O. Fraenkel. Lepzig, *Denicke*, 1886. 8°.

These cortical centres are not the places where the crude sensations are received, but the places where they are elaborated, interpreted, and associated with other impressions. They are perceptive centres.

The work of Luciani and Seppilli is an onward step in this difficult subject, and can be recommended as the best book to use for those who have only time for one book. While it leaves many problems unsolved, it gives hopes of a solution, and leaves the conviction that we are on the path towards a scientific and rational conception of the functions of the highest product of evolution, — the human cortex. JOSEPH JASTROW.

THE SEPARATE SYSTEM OF SEWERAGE.

THE respective merits of the separate and the combined systems of sewerage are still topics of animated discussion among sanitary engineers. Experts are not at one upon the question whether there should be one set of sewers through which should be removed the discharges from human beings and the water which in the form of rain falls upon the surface of the ground, or whether two separate and distinct sets should be constructed, each of which should be restricted to the removal of one of these varieties of waste material. The writers of this little book of 183 pages are advocates of the separate system, and believe that its moderate cost makes it possible to carry out a system of sewerage in many cases where the expense of the combined system would make the construction impossible. Most of the literature upon this subject is to be found in pamphlets, and papers presented to scientific societies, which are not available for general reference; and the authors have endeavored to supply a deficiency which their own experience has shown to exist by preparing the work now before us. Their aim has been to explain what the separate system is, what it is designed to do, and to give practical directions for designing and constructing sewers in accordance with that system. They recognize the fact that no single design is applicable to every case, but that each town will present some features peculiar to itself, and that the general plan must be modified to suit the conditions of each case. The dangers connected with, and indeed inseparable from, the old-style yard vaults and cesspools, in which filth accumulates oftentimes for years, are graphically portrayed; and the ordinary methods by which wells and streams become polluted are plainly and concisely explained. These are made a text for a homily upon the need of sewerage in all densely populated neighborhoods. The evils of the combined and the advantages of the separate system are contrasted; and the authors then pass on to the consideration of the designing of plans for the construction of a sewerage system, commencing with the preliminary survey, and carrying them up to the condition of completion, with the house-connections made, and the sewage on its way to the sea or other point of discharge. The volume is, considering its small size, a very comprehensive one, and will undoubtedly be of great service to those engaged in practical work of this kind.

The separate system of sewerage: its theory and construction. By CADY STALEY and GEORGE S. PIERSON. New York, *Van Nostrand*, 1886.

CHALLENGER REPORTS.

THIS bulky volume contains the second report of Professor Herdman on the Tunicata, comprising four hundred and thirty-two pages and fifty plates, and Théel's second part of the report on the Holothurioidea, with two hundred and ninety pages and sixteen plates. The high standard of mechanical execution which has characterized previous volumes is fully maintained in both text and plates.

Professor Herdman's first report treated of the simple ascidians. The present one is devoted to the compound forms; and a final part, to discuss the pelagic groups, will probably appear next year. It was at first supposed that the forms remaining after the simple ascidians had been described could be disposed of with comparative brevity; but the compound ascidians proved, on careful examination, to be a much larger and more varied group than had been anticipated. On account of the difficulty in finding good diagnostic characters, and of the similarity which different species sometimes show in their external appearance, it has been necessary to submit nearly all the species in the collection to a detailed histological examination, and portions of most of them have had to be sectionized — a slow and laborious proceeding — before the relations of their different parts could be satisfactorily determined. Then, in the case of a few species, some interesting peculiarities in regard to reproduction by gemmation required a careful and lengthened examination, on account of the important bearing of these features upon the mode of formation of the colony.

The collection of compound ascidians represents one hundred and two species and varieties, arranged in twenty-five genera. Eighty-eight of the species and ten of the genera are here de-

Report of the scientific results of the voyage of the Challenger during 1873–76. Vol. xiv.: Zoölogy. London, *Government*, 1886. f°.

scribed for the first time. A few simple ascidians, overlooked previously, find a place in an appendix.

Compound ascidians were figured by Rondeletius as early as 1555, but nothing of their structure was put on record until two hundred years later. Even then their relation to the simple ascidians was not suspected, though some of the main points in the anatomy of the latter were known to Aristotle.

Gaertner in 1774, and Renier in 1793, recognized the relations of one or two genera, but the majority of naturalists still confused the compound ascidians with Alcyonaria or with sponges. It was reserved for Cuvier and Savigny to demonstrate beyond all question the close affinity between the two groups of the Tunicata. This was in 1816; and, led by these investigations, Lamarck, about the same time, instituted the class Tunicata. Since then important researches on the compound forms have been made by Milne-Edwards. Gegenbauer, Krohn and Metchnikoff, Ganin, Giard, and von Drasche, as well as other students; while Professor Herdman, in the present paper, has summarized the existing knowledge, and added many remarkable anatomical discoveries of importance for the history of the group, to say nothing of the multitude of details useful to the special student, and evincing a thorough and patient method of study which enforces confidence in and gratitude for his prolonged investigations.

Dr. Théel, in the second part of his work on the holothurians, has not limited his labors to a description of the Apoda and Pedata which were brought home by the Challenger, but has added a short exposition of all the shallow-water forms hitherto known. It was rightly considered that such a monograph was highly desirable, though the difficulty of its preparation was very great, and various gaps necessarily occur in it on account of the frequent imperfections of the descriptions given by some authors. Material from many sources was put at the writer's disposal, especially the very rich collection of the Royal zoölogical museum at Stockholm.

The examination of the vast harvest of the Challenger voyage indicates a double derivation for the deep-sea holothurians. The Elasipoda, though species are found occasionally in shallow water in the arctic regions, cannot be derived from the same source as the usual shallow-water types. On the other hand, a certain proportion of the deep-sea species, such as forms of the Cucumariae, show intimate relations with the littoral fauna. The relations of the littoral to the abyssal fauna are discussed in an admirable manner by Dr. Théel, who regards the primitive holothurian to have been shaped like Cucumaria, with an open stone canal, feet, and a well-developed ambulacral system. Some forms have a great range in depth, the same species varying over seven hundred fathoms. Shallow-water genera sometimes reach a depth of some twenty-nine hundred fathoms, while the species are usually different from those of more moderate depths. The characteristic deep-sea forms, however, are the curious Elasipoda, which, as above mentioned, rarely are found except in the abysses.

Not a single species is common to the Arctic and Antarctic seas, though the shallow-water fauna presents much the same characteristics, and many of the species are very closely allied. Many species are circumpolar, but only a few circumequatorial. About 45 forms are known from the Arctic, 32 from the Antarctic, 135 from the Atlantic and Mediterranean, but no less than 305 from the Indo-Pacific region, which, it would certainly seem, must be the metropolis of these forms of animals.

The great value of Dr. Théel's work is self-evident, and only the limits of our space prevent a more thorough analysis. As it is, we have given but a few indications of the wealth it contains, for which the reader must be referred to the original.

ACCORDING to the latest returns published by the minister of agriculture, it appears, says the *Journal of the Society of arts*, that the chestnut-tree is cultivated in every province of Italy, excepting those of Milan, Cremona, Mantua, Rovigo, Ferrara, Ancona, Bari, Lecce, Syracuse, Girgenti, and Trapani, that is to say, it is cultivated in 56 provinces; and that, out of the 8,257 communes in Italy, it is cultivated in 1,313. The chestnut is cultivated on the most extensive scale in Liguria, and on the least in Sardinia. The total production throughout the kingdom, of fresh chestnuts, is 391,393 tons annually, which would average 1.33 kilograms per inhabitant; in Liguria it reaches 101.5 per head, and in Sicily only 3.57. A considerable quantity of chestnuts is exported to France, Austria, Egypt, Switzerland, and South America; while, on the other hand, a very insignificant quantity is imported from France, Austria, and Switzerland.

—A Parisian electrician has devised a mode of utilizing the residual liquids from bichromate and other powerful batteries. He mixes a porous acid-proof substance with the residual liquids, dries the paste thus produced, and uses it as a charge for batteries for telegraphic purposes.

SCIENCE.

FRIDAY, NOVEMBER 5, 1886.

COMMENT AND CRITICISM.

SMALL-POX IS REPORTED to be quite prevalent in Brooklyn. During the past three weeks, twenty-two cases have been reported at the health office of that city. While this should not excite alarm, it should arouse all persons to the necessity of being vaccinated. This applies not only to parents whose children have never been vaccinated, but also to adults who have never been re-vaccinated since their infancy or childhood. We are in little danger in this country of suffering from the attacks upon this method of prevention of a most loathsome disease by the anti-vaccinationists, but we are always in danger of outbreaks of small-pox so long as there is public apathy and neglect in obtaining the necessary protection. So long a time has elapsed since small-pox prevailed in the United States, that there are doubtless tens of thousands who are to-day unvaccinated; and, should this disease once become disseminated, it will find so many victims that a wide-spread and long-continued epidemic may result. The experience of Canada two years ago should be a lasting warning to every nation, state, and city throughout the civilized world. Three thousand deaths in Montreal, and five hundred infected houses, was the tribute paid by one city alone to the anti-vaccinationists.

IN ALL, 3,372 members and associates presented together 522 papers during the recent meeting of the German association of physicians and naturalists. The American association for the advancement of science registered at Buffalo 450 members and associates, including ladies, and had a programme of 247 papers. One thing, however, must not be ignored in this connection. The geological congress of Germany held its annual meeting at Darmstadt, two days after the naturalists and physicians adjourned, and most of the geological papers were undoubtedly reserved on that account. Similar drawbacks may have existed for the other sections of exact sciences, which would naturally interfere with the presentation of a large number of papers, — more so, as the whole organization is merely one for social intercourse primarily. The unstability of such an association is, however, beginning to be understood; and a committee of twelve has been appointed to report on a new constitution next year at Wiesbaden, and a permanent organization similar to those of England and America, will, in all probability, be the result. The city of Berlin appropriated about eighteen thousand dollars for the entertainment of the visitors, and the generosity and courtesy of the individual citizens cannot be lauded too highly. With the exception of hotel accommodations, which were poor at best, every thing was done by the local committee to make their guests comfortable, — in view of the large numbers present, no small undertaking indeed (3,372 members and associates, and 1,475 ladies). There was also an exhibition of scientific instruments and apparatus designed expressly for the visitors. Every thing pertaining to medical and sanitary science, electrical appliances, microscopes, model collections for school purposes, geological maps and models, etc., found here its place in the well-adapted halls of the Academy of fine arts. It seems that the German scientists are strongly in favor of helping in the formation of an international scientific congress, and any movement made in that direction will receive a most hearty support.

ANOTHER INSTANCE tending to establish the contagiousness of tuberculosis is reported in the *Gazette médicale* of Paris. It appears, from the account there given, that a young man living in a small French village contracted bronchitis. He subsequently married a healthy girl. Within a year he died of consumption, and soon after his widow also developed the disease. Their child, not long after, became a victim to the same disease. Not far from the home of this family resided a robust young woman who had at infrequent times visited her sick neighbors, but had never staid with them any time. She had, however, eaten the flesh of fowls which had died at the farm of the invalid, and, believing that these were most nutritious when partially cooked, had eaten them in this condition. About this time another fowl died, and an examination showed it to be affected with tuberculosis, the tubercles in the liver containing the characteristic bacilli of the disease. Upon inquiry, it was found that the expectoration of the consumptive person had been eaten by the fowl. From the history given of the other fowls, it is probable that they died from the same affection. It has for some time been recognized that the milk of tubercular animals could convey this disease to man; and, if the explanation just given is a true one, a new source of danger, hitherto unsuspected, exists. That such a method of communication is probable cannot be denied, and should direct the attention of both physicians and patients to the absolute necessity of the disinfection of the sputa of consumptives.

THE RECENT DEATH of a lady in a Brooklyn dentist's chair has already been reported in *Science*. The coroner's jury, after an investigation, exonerated the dentist and his assistants. The lady, it appears, had called to have a tooth extracted, and the anaesthetic employed was the bromide of ethyl. The patient became conscious after the anaesthetization, but suddenly became unconscious, and in half an hour was dead. The dentist testified that he had employed the bromide at least once a day for nine months without previous injurious result. The jury recommended that in all doubtful cases patients should be thoroughly examined by a competent medical man before the administration of an anaesthetic for dental operation. Even this precaution will not always prevent disastrous results, for numerous cases of death after anaesthesia are recorded where a physical examination revealed no organic disease. It would perhaps be the best advice to give, that, when so trifling a pain is to be borne as is caused by the extraction of a tooth, persons should bear it without an anaesthetic rather than run any risk, no matter how trivial it may seem to be.

ALLEGED EARLY CHINESE VOYAGES TO AMERICA.

MUCH interest was excited in the Société de géographie at Paris by a paper by Dr. Hamy on 'The interpretation of one of the monuments at Copan, Honduras.' This is a stone in the form of a deep convex pie, with a round hollow or cup in the centre of the dome, from each side of which a curved line extends to the margin, which is surrounded by a border much like that put on pies by pastry-cooks. The two curved lines form a sort of S-shaped figure. The whole stone is about a yard and a half in diameter, and its depth about a yard. The two curves are interpreted by Hamy as the sign Taë-Kai of the Chinese, which is venerated by them as symbolic of the essence of all things. Intercourse with China was inferred by Hamy from this sign, corroborated for him by the old story of Fu-sang, first broached by De Guignes in the last century, and by the papers of the late Charles Walcott Brooks on 'Japanese wrecks on the north Pacific coast of America.'

The paper was discussed by Quatrefages, de Charencey, Villemereuil, and others, the general tendency being to accept the idea of intercourse between China, Japan, and America at an early date, especially as Brooks stated that wrecked Japanese were able to communicate with the Aleutian Islanders without an interpreter.

We believe that the very wide hypothesis thus broached, and which in one form or another has had a certain currency for more than a century, rests upon a totally insufficient foundation. That wrecked Japanese, and possibly Chinese, from time to time were cast on the shores of America, is beyond question. The matter has been well discussed by Horace Davis, and to his paper Brooks is indebted for many of his facts. Davidson and others have also drawn attention to the subject. But there is every reason to believe that the wrecked people were, 1°, nearly always males, and incapable of colonizing; 2°, were either killed or enslaved by the Americans in accordance with a general usage; and, 3°, that neither in arts nor language have they left any appreciable trace on American anthropology. The statement of Brooks, that the Japanese and Aleuts could communicate without an interpreter, is true to this extent. I was present when the aforesaid Japanese, three males, were brought to the port of Unalashka, and took pains to inquire into the assertion which was made to me at the time. I found that the communications were wholly by signs, and not by spoken language, as the Aleuts could not understand a word of Japanese without its accompanying signs. Second, Brooks, who was long consul in Japan, informed me that he had particularly searched into the matter of the voyage to Fu-sang, and that he had conclusive evidence that the voyage which actually took place was to the well-known and still existing province of Fu-sang in Korea (see Griffis' work), and had no connection whatever with America. Last, the mere presence of two simple curved lines on a circular stone, taken by itself, proves nothing as to their meaning, and still less that they had any connection with the Chinese symbol.

The temptations of such unbridled hypotheses are the curse of anthropology, and it is extraordinary that such a veteran as Hamy should become entangled in their meshes.

W. H. Dall.

AN ARCHEOLOGICAL FRAUD.

An interesting vase, purporting to be ancient Mexican in origin, was offered for sale some months ago to the American museum of natural history by a collector, and was reserved for possible purchase, and exhibited in the cabinet of that institution. Its grotesque features and the symmetrical and effective combination and arrangement of its ornamentation make it a very noticeable object; but a closer examination destroys the first pleasurable impressions by raising serious doubts as to its virtual antiquity. It may be serviceable to collectors generally to call attention to this striking instance of very probable fraudulent work, as it is a most elaborate effort of the potter, and to indicate its points of divergence from the veritable specimens of Aztecan aboriginal workmanship. The piece purported to be pre-Columbian.

Beginning at the top of the vase, the cover almost instantly excites suspicion. It is too symmetrically convex and too cap-shaped, while the highly modern character of the handle in design is flagrantly recent. The artist was unfortunate, also, in selecting a crocodile for this conspicuous 'coigne of vantage,' as that great reptile does not frequent the *tierra templada* of Mexico, and would be only used in art decoration of the aborigines of the hot and lagoon intersected lowlands. The numerous and equidistant circles seen in the photograph on the surface of the cover are fraudulent. The rim of the vase immediately below the cover, upon which the cover rests, is probably a separate piece from the body of the vase, and is too rectangular in its setting on the neck of the same, though very nearly this is seen in genuine examples. Its circular ornamentation is not Aztecan. The body of the vase is very meretricious, if the author of this unique object meant it to resemble true Mexican art. The neck is unnaturally constricted, and the cavity of the vase too globose, in the style of modern ceramic objects of this description. The Aztec moulded the expanded portion or receptacle, in vases of this character, more gradually upwards into the neck, producing a long slant, not a sudden break. The extraordinary collar of masks, which is almost a *chef d'oeuvre* in its way, is a copy immensely improved upon, of similar conceits in genuine antiques, one of which can be seen by New York students in the Metropolitan art museum, in Dr. Lamborn's collection. But inspection detects glaring contrasts in execution and in detail. The triangular entablatures over the masks are too large and too regular, the masks themselves are not after the trigonometrical style of the Aztec potter, and the mustache-like flaps on the upper lips are strangely inconsistent with any claims for the object as a genuine relic. The expanded flattened chins are anomalous.

The body of the vase, as seen in the cuts, is handsomely ornamented by a face in relief and two semi-disk-shaped annular handles. The face, both as seen in profile and in full view, is not Mexican, and is much too pretty. The fillet surmounting the head should be drawn more closely about the sides of the face, and the V-shaped ends are too large and coarse. The disks attached to the fillet are placed too high, above instead of at or below the ears, and the pendant tassels are abnormally cumbrous. Dr. Plongeon, who agreed with the writer as to the suspicious character of the vase, says that the longitudinal and horizontal bars of these tassels are too few, as they should be respectively five and seven. The handles are very dubious, both from size and ornamentation, while their thin, sheet-like texture is unusual. The legs of the vase are too far under the body of the vase, as in most instances, where present, they sprout from farther up the sides of the object, holding it on inclined supports, and are more usually three in number. The cabalistic ornamentation about and under the vase is significantly coarse and overdone.

The stand, which is seldom found in Mexican pottery, is too elaborate, too highly incised, and false in ornamentation ; the markings on its upper surface suggestive of calendar-stones, etc., are simply trifling ; and the drop-shaped pellets stuck about it at top and bottom are out of place. The serpents used upon it are wrongly placed ; their universal position, I think, being in profile, with usually gaping mouths, while the scroll design between them strikes one as a piece of ingenious but unsuccessful counterfeiting. The whole piece is also too systematically punctured in every part. Since the writer was led to suspect the genuineness of this marvellous production, he has learned from Prof. A. S. Bickmore that Mr. Charnay, in conversation with him, pronounced it a fraud. The aggravated offences so often perpetrated on archeologists by money-making tricksters make it desirable to publish every counterfeit of any importance, both as a warning to the community, of cheats, and as a guide and protection to the less suspicious collectors.

L. P. Gratacap.

A PETROLEUM STEAMER.

The petroleum trade between this country and Europe has assumed such large proportions, that cheaper means of transportation than the ordinary plan of carrying the oil in wooden casks or metal cases are desirable. Attempts in this direction have been made by fitting ships with cylindrical or rectangular iron tanks, but to this method there were many grave objections. With cylindrical tanks, no matter how closely packed, the result is, that, allowing for the weight of the tanks themselves, the vessel can carry but little more than half her dead-weight capacity. Rectangular tanks, fitting more snugly together, are better in this respect. But in both systems there is considerable loss by leakage ; and in the spaces between the tanks, inflammable and explosive gases may be generated, becoming a source of danger.

The attention of ship-builders having been drawn to this important subject, the result is, that a new type of steamer has been devised and constructed for the special purpose of carrying oil in bulk. The Gluckauf, the first vessel of the new type, was built at Newcastle-on-Tyne, to the order of a German firm, and launched last June. She recently completed her first round trip between this port and Germany with a full cargo of oil, and sailed a few days ago for Bremerhaven with her second cargo. The experiment has proved a complete success; and it is stated that other steamers of the same kind, with such modifications of detail as experience suggests, will be built, thus to some extent revolutionizing the oil-carrying trade.

The Gluckauf is an iron steamer three hundred feet in length, and of three thousand tons burden. Externally she has the appearance of an ordinary freight-steamer, except that her smoke-stack is much farther aft, and her half-deck extends forward of the mainmast. Internally she presents some novel features. The coal-bunkers, boilers, and engines are at the extreme stern, in a compartment entirely separated from the rest of the vessel by a water-tight bulkhead. Forward of this bulkhead she is divided into eight oil compartments — four on a side — by transverse and longitudinal bulkheads extending from the ship's bottom to the main deck, two feet above the water-line. From each of these compartments a trunk about eight feet square extends up through the 'tweendecks. These trunks allow of expansion or contraction of the cargo from variation of temperature, and also carry off all volatile gases which may be formed. When loaded, the oil fills the compartments, and extends halfway up the trunks, so that the only surface of oil exposed to the air or to change of position by the rolling of the ship is that in the trunks. As the cargo is in contact with the skin of the vessel, its temperature will never differ materially from that of the sea. As the bulkheads are water-tight, or rather petroleum-tight, the vessel is practically unsinkable; and, as there is scarcely any woodwork about her, the risk of fire is reduced to a minimum. The Gluckauf is provided with powerful pumping appliances, so that her cargo can be loaded or discharged in a single day, which is another very economical feature as compared with the slow process of handling casks or cases. Altogether the new type of steamer admits of a great reduction in the cost of oil transportation; the only drawback to the system being that such a vessel can get no return cargo, being compelled to make one-half of every round trip in water ballast. But this is not a very important point, as most of the vessels at present in the oil-trade between this port and Europe bring back nothing but empty oil-casks.

THE GUADALAJARA POTTERY.

In a recent number of *Science* the editor, in commenting upon the anthropological section of the American association, says, "Its popularity is at once a good and an evil; its good consists in attracting general attention to the variety and importance of the problems connected with man; its evil, in that this variety and interest are apt to give admittance to papers of too vague and pointless a character, which have no place in the sciences, and neither bring nor suggest any thing new." It may be suggested, in connection with these facts, and bearing upon them, that in a meeting of that character, as well as in the ordinary routine of scientific work, two distinct classes of men are working together, — the collector and the systematizer. From each of these an increased degree of accuracy, as well as greater comprehensiveness, is demanded by the steady advance of science. If we are to reconstruct the history of the past from a study of the present, it is especially necessary that the collector understand the demands resulting from previous researches. Nowhere in the world is better systematizing work in anthropology done than in the United States; and, in order to bring about the reform hinted at above, it is only necessary that the men who take the field as collectors understand the wants of those in charge of our great museums. Officers of the army, navy, and civil service, members of the consular and diplomatic corps, missionaries, and private citizens, show the greatest willingness to enlarge the collections in our museums; and the information they desire as to how their work shall be most effective should be furnished them.

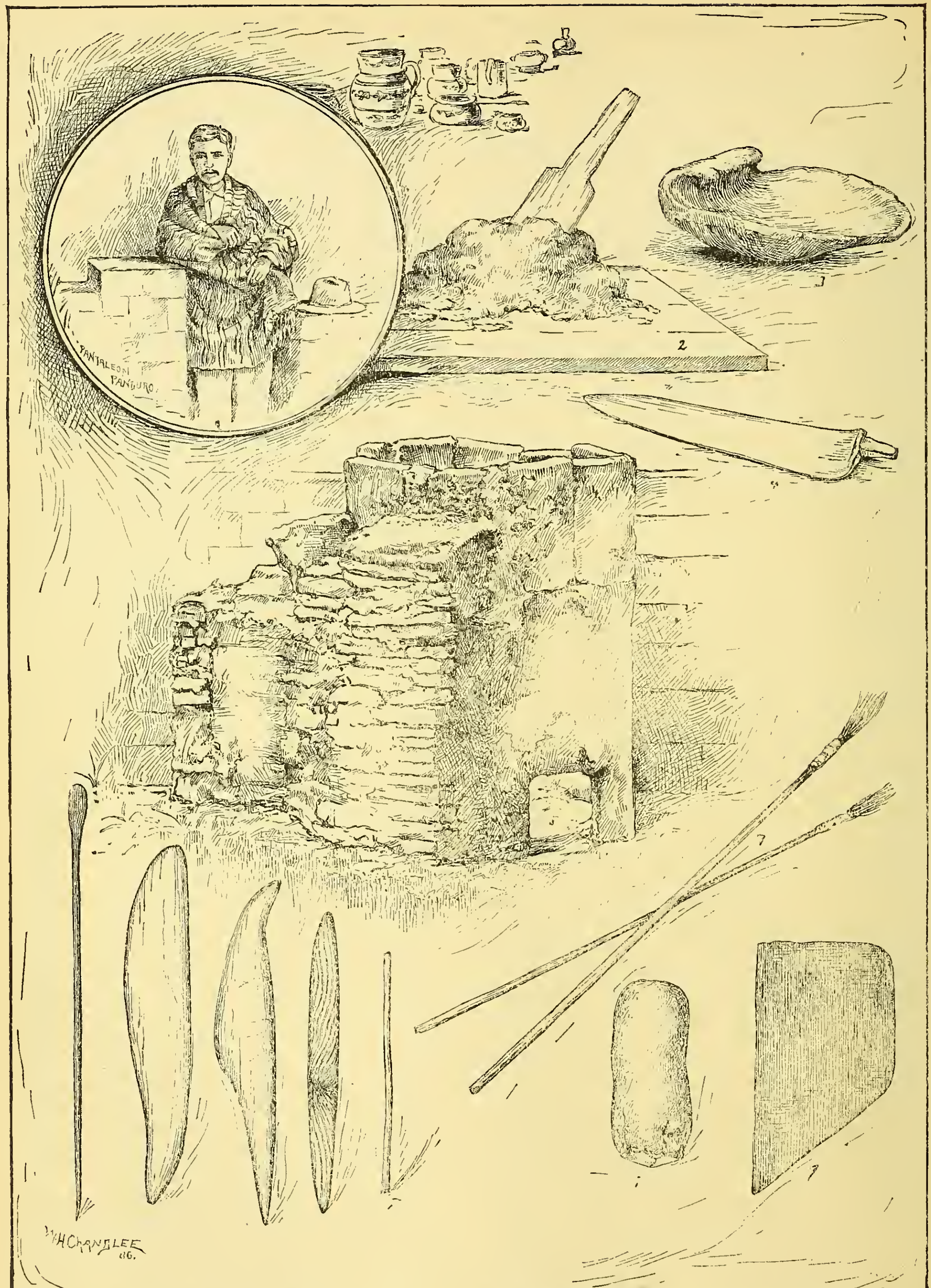
One of the rules prevailing under the new order of things is, make your observations and collections exhaustive. When Professor Putnam, or Dr. Matthews, or Mr. Holmes describes a mound, a Navajo silversmith, or a savage potter, he adopts the method of the anatomist at the dissecting-table, and leaves out not a single item of description. In fact, a good mechanic, with the aid of one of their monographs, can reproduce the thing described. After reading such a description, if one opens a grave or a mound and finds certain pottery or rude jewelry, he is in a position to begin reconstructing the whole social fabric of those who made them.

The accompanying sketches have been prepared for the purpose of showing the results of collecting according to the rule mentioned. Last summer, in the interest of the national museum, Dr. Edward Palmer visited Panteleon Panduro, the noted potter of Guadalajara, Mex., and succeeded in procuring samples of the clay used, in different stages of preparation; the spatulas, brushes, polishers, and scrapers employed; a model of the kiln in which the pottery is fired; and samples of handiwork in various stages of finish. If the tools and the objects collected were placed in the hands of a skilled potter, together with the manuscript description of the process of manufacture, he would have no difficulty in putting himself into technic sympathy with Panduro.

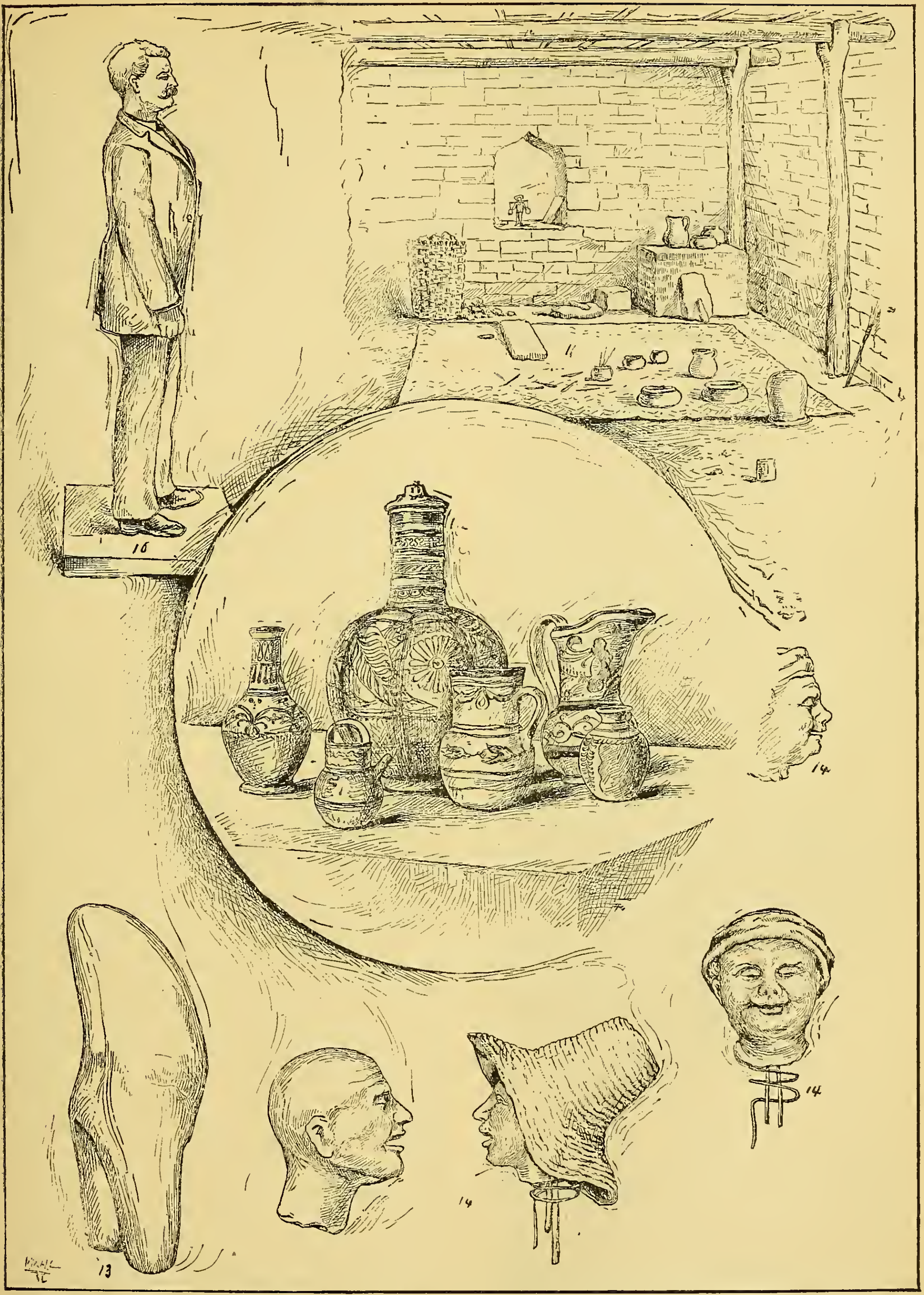
An excellent lesson in the history of civilization is taught by this particular exhibit. You have before you the hand-worked paste, the stone-polisher, the rude wooden shaping and marking tools of the ancient Aztec and Maya workman. The open furnace, in which the ware can be hardened but not glazed, cannot be much further advanced than those of Panduro's ancestors.

One interesting feature shown by the collection is the fading-out of aboriginal forms and patterns, and the substitution of those belonging to civilized life. The modern Guadalajaran delights in statuary, and his portraitures are astonishingly lifelike. His copies of modern vessels are graceful, and delicately ornamented. An amusing feature in the work of the potter is that he does not model *en bloc*, as we do, but makes his bodies, heads, etc., separately, putting the parts together and clothing the figure afterwards.

In zoölogical language, this exhibit is an ontogenetic study. It is the biography or life-history of a single operation. The collection of a hundred such exhibits, from every part of the world, and the comparison of their details, would enable the philosophical ceramist to study pottery philo-



1.—Pantaleon Panduro, the Guadalajara potter.
2.—His clay board, showing the raw material.
3.—Appearance of his paste when worked up.
4.—Spatula for cutting and smoothing.
5.—Furnace of tiles cemented with clay.
6.—Trowels and decorating-tools of iron or rosewood.
7.—Brushes for painting, bristles of yucca fibre.
8.—Burnisher of hematite set in a clay handle.
9.—Scraper of tin.



10.—STATUETTE PORTRAIT IN TERRA-COTTA BY PANTALEON.
11.—PANTALEON'S SHOP, BUILT AGAINST A BRICK HOUSE.
12.—GUADALAJARA WARE, SHOWING FORM AND DECORATION.
13.—MOULD FOR SHAPING PARTS OF THE HUMAN FORM.
14.—HEADS READY FOR THEIR BODIES.

genetically, or to investigate its distribution geographically. The making of such collections, relating to every occupation or amusement in which mankind in any part of the world is engaged, is a kind of work which may be done by any consul, merchant, missionary, traveller, or soldier. The exhibition of any such collection at the next meeting of the American association, accompanied by a descriptive paper, making the whole subject plain enough for the wayfaring man, would call forth the high commendation which it would most assuredly deserve. O. T. Mason.

THE AMERICAN ORIENTAL ASSOCIATION.

The American oriental association held its fall meeting in New Haven, on Wednesday, Oct. 27, in the library of the Yale divinity school. In the absence of Professor Whitney, who, to the deep regret of all, on account of ill health, was unable to be present, Vice-President Dr. W. Hayes Ward, editor of the *Independent*, occupied the chair. As will be seen from the following, the papers that were presented extended over almost the entire range of oriental studies, — a welcome proof of the growth of American scholarship in this direction, as well as an encouraging sign of the steadily increasing utility of this association. Professor Lanman of Harvard university began by reading two interesting letters. The first, from an attaché to the American legation at Pekin, was accompanied by rubbings of a number of Sanscrit inscriptions found in Buddhistic convents. The second was from an Indian gentleman of high rank and scholarship, relating to the publication of some important Sanscrit texts. Prof. Isaac Hall of the Metropolitan museum thereupon spoke of some Syriac manuscripts. He exhibited one which had lately come into his possession, which proved to be an ecclesiastical calendar, rather curiously arranged, containing all the ecclesiastical feasts of the year. Another manuscript which he described gave an account of a journey undertaken to the occident in the middle ages by a Nestorian priest. The discovery of the manuscript created quite a sensation among the Nestorian Christians. It was published in the Journal of the Missionary society. Dr. Ward added a few remarks on the importance of the manuscript.

A letter from Mr. Jewett, a Harvard graduate now pursuing his studies at Beyrut, 'On modern Syriac and Arabic proverbs,' was then read by Professor Toy of Harvard university. To judge from the specimens of the proverbs which Mr. Jewett has already collected, and which were indicated in his letter, the entire collection promises to be exceedingly interesting; and, since there is probably nothing more characteristic of a people than its proverbs, such a collection will also be of much value for the light it will throw on the traits and civilization in general of the modern inhabitants of some parts of the east. Mr. Jewett is enjoying particular advantages for his labors, living as he does in the Moslem quarter of Beyrut, and, indeed, almost like a Moslem. Professor Bloomfield of Johns Hopkins had a paper on some Vedic hymns, an abstract of which was read in his absence by Professor Lanman. Professor Hopkins of Bryn Mawr followed with what was perhaps the most interesting paper of all, on the position of woman in India according to the Mahabharata, which brought out the important fact that her standing, as well as her rights, were greater in the more ancient times than under the later rule of Buddhism. This result is particularly interesting in view of the recent work of the well-known W. Robertson Smith on 'Marriage and kinship in early Arabia,' which shows that exactly the same was the case among the Arabs, where Mohammedanism has tended, while elevating woman's position in some respects, on the whole towards a decrease of the rights and privileges which she enjoyed in the time of 'Ignorance,' as the heathen period is termed by the Mohammedans.

Mr. A. Jackson of Columbia college followed with a paper 'On the similes in the Avesta,' showing the wide range of natural objects and phenomena from which the metaphors were chosen. General Carrington of the U. S. army spoke briefly on the biblical genealogies, and Dr. Morris Jastrow, jun., of the University of Pennsylvania, closed the series with two papers bearing on Assyriology. The first offered an explanation for Assyrian proper names compounded with Budu, and the second embodied the preliminary results of a study of Samaritan in its bearings on Assyrian lexicography and phonology. A number of Assyrian stems which had hitherto been held to be peculiar to Assyrian, or at least so in certain significations, were shown to exist in Samaritan, and the light which the Samaritan throws on some characteristic traits of Assyrian phonology dwelt upon. The meeting thereupon adjourned until the second week in May, 1887. In the evening the members were tendered a reception at President Dwight's residence, at which a number of Yale college professors and their ladies were present.

It is pleasant to note, in connection with this meeting, the greater interest which has during the past decade sprung up in this country for what might be called the more abstract departments of knowledge. Much has been done to dispel that one-sided view of scholarship and learning which attaches a value only to such knowledge as bears more or less directly upon practical life. Until a comparatively short time ago, the higher study of philology (with the exception of Latin and Greek), archeology, and the like, received but little encouragement in this country ; and it is due to this fact alone, that while, in the fields of medicine and the natural sciences, American scholarship has made such rapid strides as to be quite on a par with European nations, in other fields we are still in a state of dependence upon Germany, France, England, etc., and do not hold that rank which is our due. But there are clear indications that a change will soon make itself felt. Such facts as the introduction of Sanscrit in all those higher institutions of learning which aim to stand in the first rank ; the creation of new chairs for Semitic languages, Zend, Persian, and archeology ;[1] the contemplated fitting-out of expeditions to Egypt, Italy, and Assyria, — are important symptoms, which must not be overlooked. They indicate that a broader conception of scholarship is beginning to prevail, which recognizes the equal importance of all higher studies as such. Whether the field be one which is limited to a few specialists, or one which attracts a large number, is of no consequence whatever from this point of view. To return, therefore, to the point whence we set out, it is a matter of congratulation for the American oriental association to find that oriental pursuits are beginning to receive that recognition which they merit ; for there can be no doubt that it is due in some if not in a great measure to the silent influence which that society exerts, that studies bearing on the ancient and modern civilization of the orient, in the widest sense of that word, are rising into greater prominence. And we have no doubt that this influence would be even stronger and more directly felt in the future, if some means were adopted by which the intelligent public could obtain at least a general view, from time to time, of the progress which is being made in these fields of research, so that it may judge for itself of their importance. It might be well for the president of the association to assign to several members the task of presenting at each meeting a summary of what has been done in the various departments of oriental pursuits, the important publications which have appeared, the important discoveries made, and the important projects contemplated. The carrying-out of such a plan would not only make the meetings even more interesting and profitable to the members than they already are, but would bring the society into that greater prominence which it deserves, and, we may add, *needs;* for it must not be forgotten that an association of this nature exists not only for the purpose of forming a union among those whose sympathies and interests naturally bring them into contact, but that it has a distinct mission to perform, — the advancement of those pursuits which come within its scope. Every step, therefore, taken with this end in view, is not only perfectly legitimate, but will, no doubt, redound to the credit of the society.

With its ranks increased by the younger men who have chosen to devote themselves to oriental studies, the American oriental association can look forward to a still more auspicious future.

M. J., Jun.

[1] Yale, Columbia, Princeton, and the Universities of Pennsylvania and Michigan are moving in this direction, and others will no doubt soon follow.

NOTES AND NEWS.

As announced in the Johns Hopkins university circulars for July, 1886, it is proposed to give a special course in Assyriology during the month of January, 1887. The regular Shemitic courses in Hebrew, Chaldee, Arabic, Ethiopic, Syriac, etc., will be interrupted, and all the time exclusively devoted to Assyriology, now universally recognized as being of primary importance for the scientific study of scripture. Paul Haupt, Ph.D., university of Leipzig, professor of the Shemitic languages in Johns Hopkins university and professor of Assyriology in the University of Goettingen, Germany, will teach Assyrian daily from 3 to 4 P.M. In addition to Professor Haupt's classes, individual instruction will be given three or four hours daily by the fellows in Shemitic languages, Messrs. Cyrus Adler and E. P. Allen, assisted by other advanced students in Assyriology. The hall of the Oriental seminary will be open as a reading-room for those who follow the course. There they will find all the books necessary for the study of Assyrian and the cognate languages, and some advanced students will usually be present to facilitate the access to the exceptionally well equipped Shemitic library, and to furnish any other aid that may be desired. The Oriental seminary possesses duplicates of the most important Assyriological works. Additional copies, as well as the rare publications of Botta, Place, Layard, and others, on Assyrian antiquities, are accessible in the reading-room of the Peabody institute, five minutes' walk from the building of the Oriental seminary. No tuition-fee will be charged. Professors and students of other institutions, as well as clergymen, are invited to attend, and arrangements will be made by which they may easily obtain temporary lodgings, provided an early intimation is received of their intention to come. Letters may be addressed to the registrar of the university.

— Since Koch devised his now well-known method of cultivating micro-organisms on plates coated with gelatine, great advances have been made in bacteriological research. Especially is this true of that branch which deals with bacteria in drinking-water. Dr. Frankland has found, that, in the storage and filtration to which London water is subjected, the number of micro-organisms is reduced ninety-five per cent. Dr. Bolton has shown that the spores of anthrax remain alive in distilled water for ninety days, and in polluted well-water for a year, while the bacilli themselves were very short-lived. The comma bacillus of Koch, as is known, will reproduce itself in water. The importance of these observations is evident when it is considered, that, regarding the germ theory as true, zymotic diseases may be spread by means of water thus impregnated with their germs.

— Hydrophobia is said not to be known in Lapland. To determine whether this was due to any peculiarity in the dogs of that country, or to some other cause, two dogs were brought to Paris, and inoculated by Pasteur. They both contracted the disease.

—The state boards of health in convention at Toronto passed a resolution to the effect that it is the duty of boards of health to notify the boards of neighboring states of the existence of contagious diseases within their borders, and they also pledged themselves to issue such notification.

— Mrs. Woerishoffer of New York has just donated twenty-five thousand dollars to the New York academy of medicine, in memory of her husband, recently deceased.

— The theory which has recently been advanced by M. Verneuil, that tetanus had its origin in the horse, is being strongly combated by a number of medical authorities. In support of his theory, Verneuil directs attention to the rarity of this disease at sea. M. Saint-Vel, among others who do not accept this explanation of its origin, states that tetanus is quite frequent in Oceanica, although on many of the islands there are no horses. He also gives a number of instances where the disease developed on shipboard after the receipt of injuries. Altogether, we fear that M. Verneuil will have considerable difficulty in demonstrating the equine origin of tetanus.

— That training-schools for nurses are growing in popularity is shown by the fact that they are being established all over the country, and are largely attended. The authorities of the school on Blackwell's Island have just awarded diplomas to twenty-four women who have completed the prescribed course of instruction, and passed satisfactory examinations.

— A restrictive policy in professional and educational matters is never wise. Tulane university, the medical school of Louisiana, is largely dependent for its medical students upon other states, and one inducement offered to its graduates has been the opportunity of obtaining positions on the staff of Charity hospital in New Orleans. In making an appropriation of ninety thousand dollars to this hospital, the legislature provided that only Louisianians should be permitted to compete for these positions. Such a measure can have but one effect; that is, to reduce the number of students at the university.

— In order to prevent the chafing of those portions of the body on which bed-ridden patients rest, and thus to prevent bed-sores, various methods have been devised. The air-bed and the water-bed are well adapted to this purpose, but are expensive, and not always to be obtained. Dr. Smith of Indianapolis recommends the employment of rubber tubing of about three-quarters of an inch in diameter. This can be coiled into any desirable size, and, if soiled by the discharges, can readily be cleansed. Should the parts be inflamed, cold water could be passed through the tube, and thus the heat be reduced. As rubber tubing is cheap and easily procurable, the suggestion is an admirable one.

— A correspondent of the *Medical record* writes that suicides are greatly on the increase in France, and that the Paris morgue is filled with them. In one day seven persons who had taken their own lives were received at this depository for the unknown dead. In 1884 the number of suicides in France was 7,572. Hanging seems to be the favorite method of self-destruction: next in order come drowning, shooting, suffocation by coal-gas, and poisoning. 1,394 suicides were of persons aged from forty to fifty years; 1,508, from fifty to sixty years; and 2,255, from sixty years onward.

— The results of the exploration of the North Sea by the Prussian vessel Drache in 1881, 1882, and 1884, are summarized from the official monographic report in the July number of the *Annalen der hydrographie*, with the reproduction of several charts. The salinity at the surface shows the highest percentages (3.50+) in the central area, and a belt of lower values (under 3.00) leading out from the Baltic, around the southern end of Norway. The surface chart of absolute specific gravity, at existing temperatures, not reduced to a standard, shows the same distribution of values. But descending to thirty or more metres of depth, — all depths being, in true German scholarly fashion, expressed in metres, — an arm of distinctly dense, salt water (3.52+) is seen under-running the lighter water near the Norwegian coast, and approaching the Baltic. The horizontal and vertical variation of temperature is presented in numerous diagrams, and a table contains a condensed statement of the various physical results of soundings.

— Among recent devices patented in this country is a magazine fire-arm provided with a cooling-chamber surrounding the rear portion of the barrel, connected by suitable pipes with a water-reservoir in the stock. At each discharge of the weapon, a pump forces a current of water from the reservoir through the cooling-chamber, thereby preventing the barrel from heating.

— In strong contrast to this country, France is said to be almost entirely without free dispensaries, there being but three in the city of Paris.

— Several sections of an embankment on the North-western state railway, India, were recently washed away, leaving the rails, with their iron sleepers, festooned in the air, like suspension-bridges, the ends of the rails being held together by the fish-plates. Until the floods subsided, so that the embankments could be rebuilt, the mails were carried over these sections of suspended track in hand-cars, the carriers walking on the sleepers, and pushing the cars up the steep inclines, and riding with the mail-bags on the down-grades, sometimes dashing through the torrent beneath.

— Anhydrous aluminium chloride is now prepared by the following process: aluminium alloy is heated in a retort to between 200° and 300° C., hydrochloric-acid gas is then passed over the heated alloy, and the vaporized aluminium chloride thus obtained is condensed. The right to this process is owned by the Cowles electric smelting company of Cleveland, O., who use it in connection with the reduction of aluminium from clay in the electric furnace.

— A series of articles on the prevention of fire, which first appeared in the columns of an architectural journal, has recently been published in revised pamphlet form by the author, William Paul Gerhard, under the title 'The prevention of fire.' Though written chiefly with reference to hospitals, asylums, and other public institutions, much may be found in the pamphlet that applies equally well to churches, schools, factories, hotels, and even to dwelling-houses.

— The 'Index to the literature of explosives,' part i., by Charles E. Munroe (Baltimore, *Friedenwald*, 1886), is intended to embrace not only such articles as treat of the composition and of the chemical and physical properties of explosives, but also of their manufacture and use in the arts. This part contains the titles of papers appearing in such periodicals as the indexer has been able to review from the date of first issue. Four hundred and forty-two volumes have been thus reviewed for this part. Many other titles of papers have been collected, but the indexer has not yet had access to complete sets of the periodicals from which they have been gathered. A large number of titles of separate publications, treatises, text-books, and the like, have also been collected. It is hoped that it will be possible to eventually publish these, together with a 'subject' and 'author's' index to the entire list.

— During the spring of 1886, Ticknor & Co. began the publication of "Ye olden time series, or, Gleanings from the old newspapers, chiefly of Boston and Salem," with brief comments by Henry M. Brooks of Salem, Mass. In this series there are now ready, vol. i., 'Curiosities of the old lottery;' vol. ii., 'Days of the spinning-wheel in New England;' vol. iii., 'New England Sunday;' vol. iv., 'Quaint and curious advertisements;' and the present vol. v., 'Literary curiosities.' Among those to come are volumes on 'Some strange and curious punishments;' 'New England music in the latter part of the eighteenth and in the beginning of the nineteenth century;' 'Travel in old times, with some account of stages, taverns, etc.:' and 'Curiosities of politics among the old federalists and republicans.'

— The forthcoming volume of the 'Encyclopaedia Britannica' will get down as far as *sia*, and will contain an unusual number of important articles. That on Shakspeare by the editor, with a bibliography supplied by Mr. H. R. Tedder, will attract most attention. Mr. Matthew Arnold writes upon Sainte-Beuve, Mr. James Sims on Schiller, Mr. Rossetti on Shelley, Professor Minto on Sir Walter Scott, Madame Villari on Savonarola, Mr. Saintsbury on Rousseau, and Mr. J. S. Reid on Ruhnken. Of the art articles, M. Hymans contributes that on Rubens, and Professor Middleton that on schools of painting. Russia falls to Prince Krapotkine and Mr. Morfill, and Scotland is treated by no fewer than five writers. Of the scientific articles, that on Rotifera is by Professor Bourne of Madras; that on series, by Professor Cayley; seal, by Professor Flower; and Schizomycetes, by Professor Marshall Ward.

— The *Athenaeum* is authority for the statement that the life of Charles Darwin, by his son, which will be published before Christmas, will contain an autobiographical chapter dealing chiefly with the great naturalist's religious opinions.

— Mr. William Saunders of London, Ontario, has been appointed chief director of the Dominion experimental farms of Canada, and has in consequence given up the editorship of the *Canadian entomologist*, a monthly journal which he has conducted for many years. The former editor, Rev. C. J. S. Bethune of Port Hope, will succeed him.

— An international railway exposition and congress will be held in Paris from May to October, 1887, when a railway jubilee of the fiftieth anniversary of railroads in France will be celebrated. John W. Weston, editor of the *American engineer*, Chicago, has been appointed commissioner-general for the United States.

— Lieut.-Col. W. T. McLeod sends us a brief account of the weather of two summers as observed by him at Nassau on the Bahamas. It would seem from the frequency of heavy rains, thunderstorms, and tropical cyclones, to be quite unlike the mild winter climate of the islands that invalids seek to enjoy. The following description of a passing cyclone reveals the characteristic reversal of its central winds: 'On Thursday, Aug. 19, 1886, at 9 A.M., the barometer began to fall, and continued to do so gradually up to 12 o'clock noon on Sunday, Aug. 22. From this hour it fell rapidly up to 4 A.M. on Monday, to the extent of 7-10 of an inch. The barometer remained steady for half an hour, and then rose as rapidly to its previous height. During this depression a severe gale raged. At about 6 P.M. the sun went down in a yellowish patch, with a purple haze. The cloud-masses were blown out into rain-film. The rain fell and the wind blew in gusts from the east, and continued to blow from east to south-south-east, up to 3.45 A.M. on Aug. 23, with increasing force. A lull occurred, and, as the barometer shot upwards, the wind shifted and blew furiously from west-south-west from 4.30 A.M. up to 7.30 A.M. During this gale several lives were lost and schooners wrecked. Lightning accompanied the gale.

— At a meeting on Oct. 19, of the committee of the subscribers to the British school of archeology at Athens, according to *Nature*, Professor Jebb said the school had been erected and paid for, Mr. F. C. Penrose had been appointed director, and a provisional income of £400 a year for three years had been raised, but additional funds were required. Prof. C. T. Newton, in urging the importance of having a great school of archeology, suggested that there should ultimately be raised a special fund for the payment of the travelling expenses of the students at Athens. On the motion of Professor Jebb, a managing committee was appointed.

— Messrs. Whittaker & Co. have issued a book by Mr. William Anderson, "On the conversion of heat into work, a practical hand-book on heat-engines."

LETTERS TO THE EDITOR.

****Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The deepest fresh-water lake in America.

In the issue of your journal of the 27th of August are contained some remarks on Crater Lake in Oregon, and its remarkable depth. The perusal of these remarks leads me to say a few words with regard to another lake in the extreme eastern portion of the continent, which, though far from approaching that mentioned, has nevertheless a depth, as well as some other features, which are quite exceptional. I refer to Lake Temisconata in the Province of Quebec.

This lake is situated very near the axis of the divide between the waters of the St. Lawrence and those of the St. John, its outlet by the Madawaska River forming one of the main tributaries of the latter stream. Its total length is twenty-eight miles, about eighteen of this having a general direction a little east of south; while the remainder, forming the more northerly position, trends to the north-east nearly at a right angle with the former. The breadth varies from one to three miles. Throughout its length and on both sides, the land is usually high, forming numerous ridges and promontories projecting into the lake, but just at the angle referred to one of these, known as Mount Wissick or Mount Essex, rises almost precipitously to a height of 550 feet, while the opposite shore is here quite low. The height of the lake above tide-water is, by aneroid, about 400 feet; the distance of the upper end from the St. Lawrence being thirty miles, while the length of its actual discharge, by way of the Madawaska and St. John to the Bay of Fundy, is 288 miles.

Having had occasion to spend some time about the lake during the last summer in connection with the work of the Canadian geological survey, and having heard incredible stories as to its depth, means were taken to ascertain the truth by a number of soundings at points which seemed to promise the best results. Of these, three, taken near the foot of the lake, gave a depth varying from 215 to 225 feet; farther north a depth of 410 feet was reached; and midway between Mount Wissick and old Fort Ingalls, 500 feet. It seems probable, however, from the statements of reliable parties, that even this depth is at some places considerably exceeded.

In the case of Crater Lake, if one may judge from its name, its depth is no more than one might expect from the conditions of its origin; but in the case of Lake Temisconata there is absolutely nothing of a volcanic character, and the whole depression is evidently the result of simple erosion. That that erosion should have occurred to a depth fully 100 feet below tide-level, and that, too, directly along the line of the great Appalachian axis, is certainly remarkable. It is further singular, that while the ledges along the shores of the lake are covered with glacial striae, corresponding generally with the course of the depression at the point where they occur, the transportation of bowlders has been largely to the north, blocks of fossiliferous limestone from the beds of Mount Wissick being abundantly scattered about the upper end of the lake, but not to the southward. The country between the head of the lake and the St. Lawrence has not yet been examined, but along certain lines is believed to be low. The Madawaska, on the other hand, flowing almost due south, occupies a drift-filled valley, bordered by high and steep hills similar to those of the lake, and probably marks its former extension in this direction. It would seem as if lake and river formed together a great transverse channel of erosion, the result of sub-aerial action, from the St. Lawrence to the St. John, at a time when the entire region stood several hundred feet higher than now, and that the movement of the ice was in the direction of the former. The fact that the direct northward extension of this depression is coincident with the famous gorge of the Saguenay gives additional interest to the observations mentioned. L. W. Bailey.

Fredericton, N.B., Oct. 23.

Coloring geological maps.

Professor Branner has issued a neat little card containing a colored geological map of the state of Indiana, on a scale of 1:4,878,720, or 77 miles to the inch! In a letter, which, from its having been written in French, is probably designed to be widely distributed in Europe as well as this country, he complains, 1°, that, with the scale of colors provisionally adopted by the International congress, it is not possible to employ a color which shall indicate the Devonian without specifying whether the area be upper, middle, or lower. Professor Branner will be convinced that he is mistaken if he will look at the report of the committee on the geological map of Europe (Amer. com. rep., p. 43, *b*), where in such a case it was suggested (and later approved by the congress) to use the medium shade of color accompanied by the characteristic letter of the system (in this case, *d*), but without any one of the indices 1, 2, or 3 (see Amer. com. rep., p. 103, for the conclusions of the map committee, arrived at after the meeting of the congress).

Professor Branner complains also that the difficulty of indicating four or five divisions in the carboniferous is greater still. This is not surprising on a map-scale of closely one-five-millionth. The congress never contemplated such a problem, though even here the individual geologist is expressly left free to employ his ingenuity to differentiate by means of tints and symbols, the only restriction laid upon him being that the base of the tint used shall be gray. This certainly opens the way to any method of differentiation which he may desire to try.

Professor Branner misunderstands the object of the congress if he supposes that the color-scale was adopted only for the geological map of Europe, and not for the use of all the geologists of the world. The fact is, that the geological map of Europe was simply selected as a lay figure on which to display the present 'provisional system.' If it be found that this system is bad, another will be substituted for it; but it will require more proof than Professor Branner furnishes to convince geologists of this.

If the 'carbonic' of Europe can be adequately represented by the proposed system, there is good ground to hope that the carboniferous of Indiana will not present insuperable difficulty; but not while the human eye remains what it is can any one succeed in displaying geological details at a scale of one-five-millionth and on a paper surface already one-third covered with printer's ink, representing names of towns and counties and railroad lines.

It is only fair to add that the system proposed by the congress will come as near to satisfying this impossible demand as any other. Persifor Frazer.

Air from a cave for house-cooling.

I wish your opinion upon a matter in which I am much interested. Grand Avenue cave, situated four miles from Mammoth cave, contains some nine miles of avenues filled with delightfully cool, pure, dry air; temperature 55°. I propose to erect a house immediately over this cave; make the outside walls and partitions all hollow, so that they may communicate with a cellar, which shall be connected with the cave by a large shaft, say, eight feet square. The question is, will the air between the house and cave take the temperature of the cave by diffusion or otherwise, or will it be necessary to use mechanical means to get the air into the building? I have seen and spoken to several scientific men on the subject, who agree with me that an interchange of air will take place, and continue until equilibrium is restored by making the temperatures the same.

It is proposed to erect a hotel for a cool-air summer resort, and also for a sanitarium. If you think proper, I would like you to put this before the readers of your valuable periodical, and get the benefit of their opinions. It is a matter of some scientific interest, in which physicists, geologists, and sanitarians may be interested. M. H. Crump.

Ogden college, Ky., Oct. 26.

Zinc in Moresnet.

In your issue of this date, on p. 383, you speak of tin ore being found at Moresnet. This is a mistake. The county contains, however, some of the most important zinc-mines of Europe. Almost every collection of minerals contains some specimens of zinc taken from these very interesting and important mines. Thos. Egleston.

New York, Oct. 29.

Ely's Labor movement in America.

A newspaper discussion in criticism of any particular article or review is rarely profitable, but it seems necessary to make a brief reply to the communication of Professor Ely published in *Science* for Oct. 29.

Professor Ely charges that his reviewer, while apparently neither an untruthful nor malevolent person, failed to read the book in question before noticing it. Inasmuch as every statement of Professor Ely's which is mentioned in the review is accredited to the page on which it occurs, his allegation is of course groundless. As a matter of fact, the present writer read Professor Ely's book with more than usual care, not only because it dealt with a question in which he feels a deep personal interest, but because of its general attractiveness of style. When, therefore Professor Ely denies that his reviewer read the book, he evidently is writing in a Pickwickian sense — or else he must mean that his reviewer did not read the book with the author's eyes, which is not beyond the bounds of possibility.

Professor Ely's attention is called to the fact that it is not usually considered candid to eliminate from a quotation any word or clause that distinctly modifies its import. When, therefore, his reviewer wrote, that "while not over-clear on this point, yet he [Professor Ely] seems to uphold the extremists in their contention that all the evils of the present state of society are due to private property and the lack of proper co-operation in production and distribution," he expressed an opinion which the freedom of the press will probably permit him to continue to hold. Professor Ely should have read and quoted it in full. Professor Ely dissents from that opinion, but his reviewer repeats it just as it was first stated. An honest difference of opinion is often serviceable rather than otherwise.

As a further instance of what his reviewer intended by the modest statement that Professor Ely seemed to him to have "committed the not uncommon scientific error of reading his theory into the facts, instead of deducing it from them," may be cited Professor Ely's majestic waving away of one or two well-known facts regarding workmen without grievances striking because of the interference of some walking delegate or other, with some rather eloquent references to a knowledge of human nature.

In fact, it is altogether to be regretted that Professor Ely should consider one of the most favorable notices of his book, that has appeared in any journal of authority, to be 'grossly careless.' Such an attitude seems to ascribe, perhaps, more honor than is their due, to the reviewers for the *Nation*, and for that organ of the socialistic party of which Professor Ely speaks. So we feel doubtful as to just what opinion Professor Ely entertains regarding his book. The general tone of his communication to *Science* would seem to indicate that all criticism of the book, to be just, must be laudatory: the 'grossly careless' phrase inclines us to the belief that the reviewers of the *Nation* and of the organ of the socialistic labor party may have most accurately reflected the judgment of the author. In either case, the present writer must crave Professor Ely's permission to disagree with him.

The published expression of the train of ethical thought to which the same notice of Professor Ely's book gave rise in the mind of 'One of the agitators,' at least calls for the recognition of the honor done your reviewer in coupling his humble initials with the great name of Aristotle. N. M. B.

A manual of lithology.

A critic should carefully inform himself concerning the contents of a book before he attempts to review it, and should criticise the stand-point taken, or adapt his review to that stand-point. This is my excuse for noticing the prodigious mauling of so small a corpse as my 'Lithology.' It is allowable to object to the plane from which a subject is viewed; but, if it be premised that a certain method is to be followed, a criticism of the faults imposed by that method show that the critic failed to familiarize himself with the necessary facts. Had he acquired such a familiarity, he would have seen that it was designed, not for specialists, but for the very classes to whom he says it may be of value; that a knowledge of mineralogy was presupposed (see preface), and that the treatment of that science was in the shape of a brief review of a few of the more common minerals; that the discarding of the microscope swept away all facts dependent upon that instrument for verification, required the use of old-fashioned terms existing before that instrument changed the nomenclature, and opened the doors for many 'blunders' as viewed by the microscopist. While it may be debated whether it be worth while to attempt to impart so brief an idea of the commoner rocks, it is a fact that such a method has been employed here for a score of years in the regular technical and scientific courses, and that the work is to be covered in twenty exercises. Looking at the criticism from this stand-point, it has overshot its mark, and shows that the writer has mistaken the book for a pretentious claimant for recognition on the score of novelty or advanced method of treatment, while, in fact, it is designed for those who would acquire, in the shortest possible time, an idea of the rocks most commonly met with in the field. EDWARD H. WILLIAMS, JR.

Bethlehem, Penn., Oct. 30.

The abuse of dispensaries.

Your editorial on 'The abuse of dispensaries' (*Science*, viii. 380) gives occasion to call attention to the charity organization societies and their function. Such societies exist in the cities you mention, at least in London, Boston, New York, and Philadelphia. These societies are clearing-houses of information in relation to the people who beg or accept gratuitous relief. They keep registries, both alphabetic and geographic (at least, this is the case in New York and in Washington), of such persons, and make it their business to ascertain the condition and needs of all persons about whom inquiry is properly made. The principle upon which they work is the following: every church, institution, or person dispensing relief is invited to report to the society the name and residence of and pertinent information about persons aided; they are advised to dispense no relief before ascertaining from the society what it already knows about these persons. If report is made that relief has been extended to any person who is known by the society to be receiving aid from other sources, all parties giving aid are informed of the duplication. If it is known that any person is not receiving adequate relief, the society directs the attention of some appropriate relief-giving agency to the need, or directs the needy to the appropriate agency. This is the application of scientific methods to the solution of the social problems of pauperism and fraudulent and unnecessary solicitation of alms, and is destined to succeed. The dispensaries could well afford, as could all other relief-giving agencies, to apply a large percentage of their funds to the support of the charity organization societies, for the sake of the economy which would therefrom result in their other expenditures. B: PICKMAN MANN.

Washington, D.C., Oct. 29.

SCIENCE.—SUPPLEMENT.

FRIDAY, NOVEMBER 5, 1886.

CABLE STREET-RAILWAYS.

IT is proposed to 'gridiron' New York City with cable street-railways. The network, as projected, embraces about seventy miles of double-track road, consisting of a number of distinct routes, with branches, all connected together so as to form one comprehensive system. Of this, fifteen miles will be elevated, the rest surface roads, but all operated by cable traction. That this comprehensive scheme will be carried through to completion is not yet certain. There is much opposition to it, not only from property-owners along the proposed routes, but also from railroad companies with whose interests it would conflict. Cable-railways have been in use in San Francisco for thirteen years, giving better satisfaction for street purposes than either horse or steam railways. Many other cities, in both Europe and America, have given cable traction a fair trial, and with results satisfactory to the travelling public as well as to the owners of the roads. There are already several miles of cable-road completed and running in the northern part of this city; and, even if the contemplated network throughout the city should never be constructed, there will be a sufficient number of cable-railways in the city and suburbs, before many years, to enable the general public to judge of their merits.

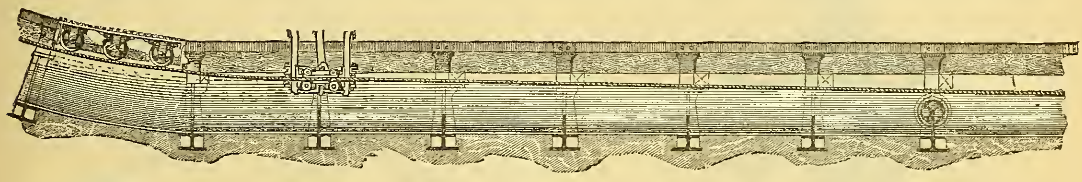


FIG. 1.

The history of cable traction as applied to street-railways dates back only a few years, though cables moved by stationary engines had been used on tramways in the principal collieries of England and Germany long before the advent of the locomotive. In 1830 a railway between Liverpool and Manchester, in England, — the second of the kind constructed, — was approaching completion, and George Stephenson, the eminent engineer, was one of four commissioners appointed to decide whether the road should be worked by stationary engines and wire cables, or by locomotives. It was decided to use locomotives, though two of the commissioners strongly favored the cable system, as the locomotive was still in its infancy. In his report to the officers of the road, Mr. Stephenson said, "Fixed engines with ropes are most suit-

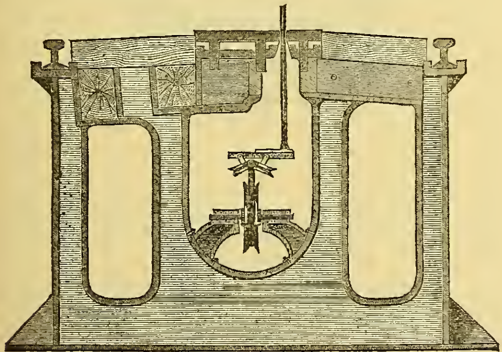


FIG. 2.

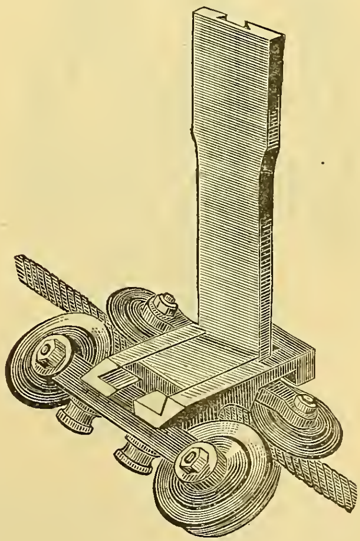


FIG. 3.

able for hilly countries, where the gravity of the horse as well as of the locomotive engine becomes a material part of their whole power." The use of wire cables for haulage purposes on inclined planes, especially in mining regions, had steadily increased as necessity demanded, but no special adaptation of the cable system to street-car traction was made until 1873. In that year what may be termed the 'modern' cable-railway was introduced, the first application of it being made on the Clay Street hill road in San Francisco, Cal. This road was about half a mile long, on a narrow street, with grades of one foot in five and a half feet. That road has been in continuous operation ever since.

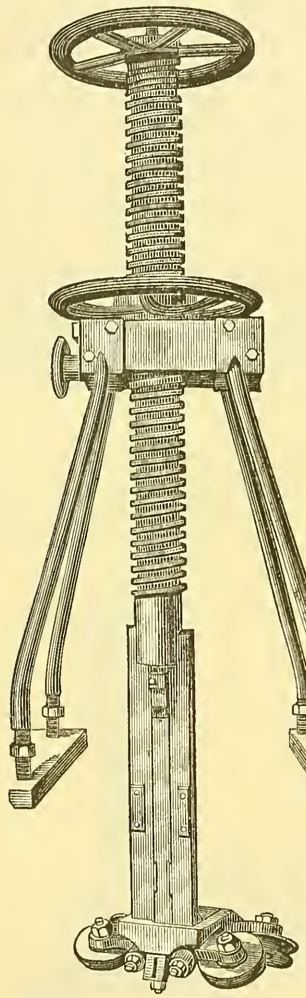


FIG. 4.

It will be seen that this first application of the cable system to street-cars, on a grade too steep for the economical use of either horses or locomotives, was in accordance with the views advanced by Stephenson thirty-three years before; but so many and so obvious are the advantages of cable traction, as demonstrated by the Clay Street and other roads, that it is rapidly taking the place of horses on level streets; and it is even being urged as a substitute for the locomotive on the London underground railways, as well as in other places where the smoke, noise, and gases of the locomotive are objectionable. Among the advantages of the system are, its applicability to steep grades as well as to levels, the ease and gentleness with which cars may be stopped and started, the uniformity of speed, its comparative noiselessness, its almost unlimited capability as regards increase of carrying capacity, and the absence of the uncleanliness, unavoidable, both on the streets and at the stables, wherever horses are used. Although the use of horses for many purposes in cities can never be entirely dispensed with, — unless in such a place as Venice, — the more general use of a mechanical motive power for street-railways would greatly lessen their number.

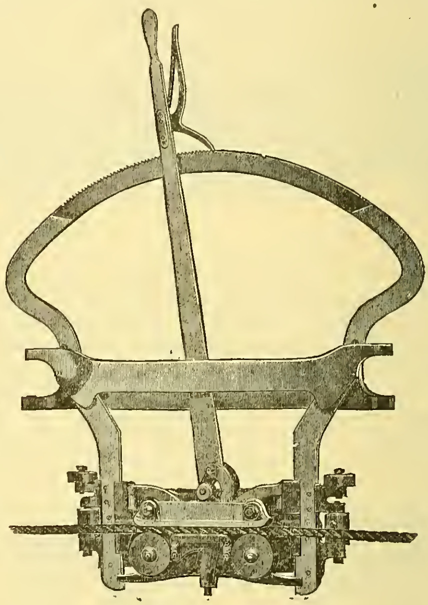


FIG. 5.

The cable system consists of an endless steel or iron wire rope, moving continuously in a slotted tube placed beneath the surface of the street and between the rails. The rope is supported at intervals by pulleys, depressed by smaller pulleys at points where steep grades are crossed by level streets, carried around curves by guide-rollers, and kept in motion by a steam-engine located at any convenient point on the line of the road. A gripping device at the end of a thin vertical steel plate, or combination of plates, connected with the car and passing through the slot in the tube, transmits the motion of the cable to the car, the speed of the car being determined by the speed of the cable, and usually not exceeding about eight miles per hour in city streets. The action of the grip is controlled by a grip-man, who, by the movement of a lever or hand-wheel, can start or stop the car as gently or as suddenly as may be desired. Fig. 1 is a longitudinal section of the slotted tube in use on the Clay Street hill road. At the extreme left are shown the depression pulleys at the intersection of a level cross-street with an ascending grade. The weight of the car on the grip keeps the latter sufficiently depressed at such points to clear the pulleys. At the right is shown a supporting pulley. A transverse section of the tube, with its surrounding framework, which supports the rails, is shown in fig. 2. The gripping device in use on the Clay Street road is shown in fig. 3, and its operating mechanism and supporting framework are shown in fig. 4. The gripping-jaws, which close on the rope between the pairs of guide-sheaves, are moved by the upper hand-wheel, while the grip may be raised or lowered bodily by the lower wheel. The guide-sheaves, which are kept in contact with the cable by springs when the gripping-jaws are released, guide the cable smoothly between the jaws when the car is not in motion, holding it in position for gripping when it is desired to start the car. Many modifications of the grip have been devised, in most of which the jaws move vertically instead of horizontally; but with the exception of the Paine grip, used on the East River bridge, the essential features in all are the same, and they differ only in detail from a grip described and illustrated in a technical journal nearly fifty years ago. Figs. 5 and 6 show two varieties of lever-grip now used on many roads.

As frequent and careful inspections of cables and machinery are required, and as on many roads cars are run continuously night and day, a duplicate or duplex system has been found necessary, of which the Tenth Avenue line in this city may serve as an example. In this system two cables run side by side through the tube, each supported by a separate set of pulleys, and provided with a separate engine. While one cable is running, the other is held in reserve; and, in case of accident to one cable or engine, the other may be immediately started up, the grips, which are made double for the purpose, releasing one cable and taking up the other. The engine-room of the Tenth Avenue line is shown in fig. 7, and the arrangement of duplex cables and pulleys may be seen in fig. 8. The cables may be run alternately, and for any desirable length of time, giving ample

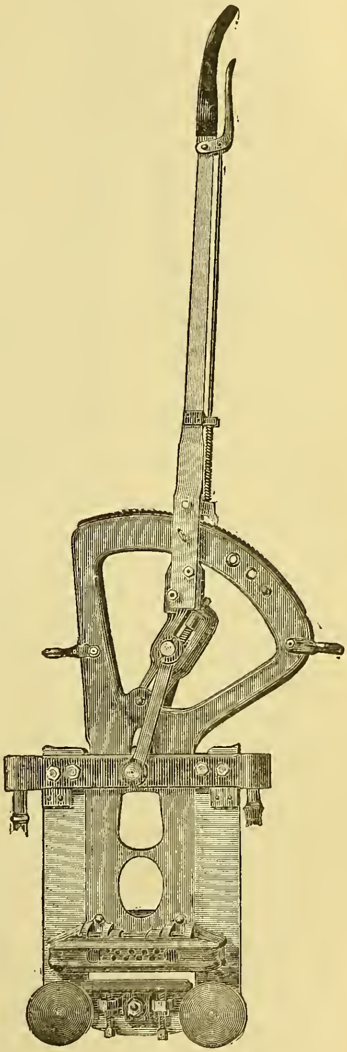


Fig. 6.

opportunity for inspection and repair without interruption of travel. As will be seen in the engraving, there are two complete plants of machinery; and as they are duplicates, a description of one will suffice for both. The motive power for each plant is a Wright automatic cut-off engine of three hundred horse-power. A six-foot wheel on the engine-shaft gears into a thirteen-foot

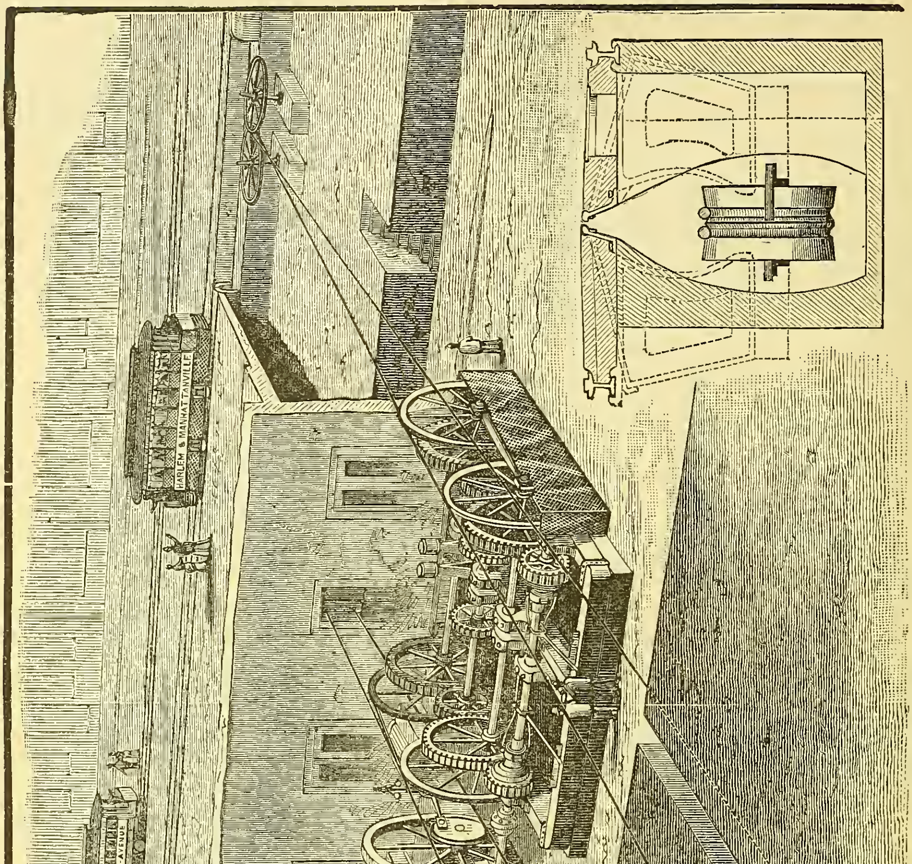


FIG. 8.

FIG. 7. — ENGINE-ROOM OF THE TENTH AVENUE CABLE-RAILWAY.

wheel on the line-shaft, which is a foot in diameter and about fifty feet long. The line-shafts of both plants may be coupled together, so that either engine may be used to drive either section. Each section carries two pairs of cable-drums, either pair of which may be thrown into or out of action by clutches. Thus either engine may be

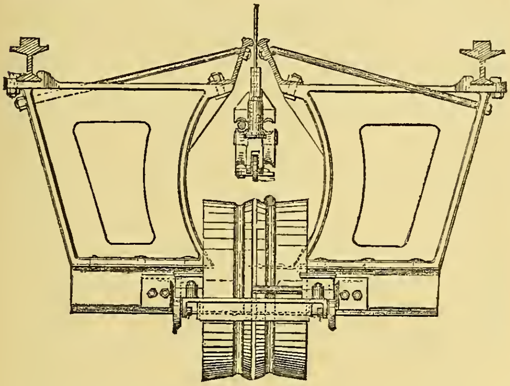


FIG. 9.

used to run any of the four cables shown in the engraving. The section at the right actuates the duplex cables running out Tenth Avenue ; that on the left will be used for the 125th Street branch of the company's line.

The cable, coming from one of the guide-pulleys in the street, shown at the right of the en-

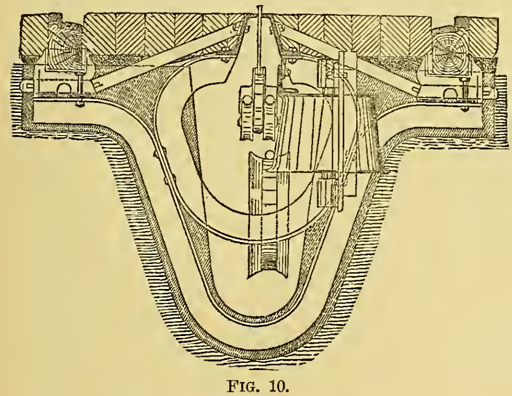


FIG. 10.

graving, passes several times around both cable-drums, thence around a 'slack-pulley,' shown in the foreground, from which it passes back around one of the guide-pulleys in the street, and back on its way through the tube. The 'slack-pulley' is mounted on a car which is moved by a differential lever in such a manner that the cable is always kept at a uniform tension. Thus the lengthening and shortening of the cable through variations of temperature, etc., is compensated for.

The grip used for the duplex system, as well as the tube, pulleys, and track-supporting framework, is shown in fig. 9, which is a transverse section of the Tenth Avenue road. The framework and tube used on the Chicago cable-railway is shown in transverse section in fig. 10, which also shows one of the guide-rollers for carrying the cable around a curve. The road-bed of the cable-railway in this city has a framework of iron, as shown in fig. 9, concrete forming the sides and bottom of the conduit or tube. The transverse trusses are placed five feet apart, with the slot-rails and track-rails bolted to them. The slot-rails form the sides of the longitudinal slot of the tube, and they are held firmly in place by tie-rods which connect them with the outer edge of the truss. Pulley-vaults are provided at intervals of thirty-five feet, affording access to the carrying-pulleys. A system of drainage-pipes connects these vaults with the city sewers, thus securing perfect drainage, which cannot be affected by any dirt that may accumulate in the conduits. The carrying-pulleys are twenty-two inches in diameter, and are placed in pairs, one a little in advance of the other, to support the two cables independently.

The first cable street-railway, that on Clay Street hill, San Francisco, was looked upon as an experiment to a great extent ; but after a satisfactory trial of three years, the system having proved itself a mechanical and financial success, a second road was constructed, also in San Francisco. This was followed by others in rapid succession, until that city has at present upward of twenty miles of cable-road in operation. Other cities followed the lead of San Francisco, St. Louis with sixteen miles, Philadelphia with twelve, Chicago with ten, Kansas City with eight, and many more with shorter lines, so that at present the total length of double-track cable street-railway in the United States will not fall far short of one hundred miles. Taking into consideration with this the fact that cable-roads are making rapid headway in Europe, Mexico, Australia, and New Zealand, it will be seen that the new system of street-car traction has proved its right to a prominent position in railroad economics.

THE PHYSICAL BASIS OF AESTHETICS.

AESTHETIC impressions may be conveniently divided into two classes : in the first it is the appreciation of qualities furnished immediately by sensation that gives rise to beauty, while in the second class the sense-impressions are interpreted and made significant by a guiding thought or emotion. Though the two often go together, there is a class of aesthetic impressions depending preeminently on the sensations furnished by the great aesthetic educators of the race, — the eye and the ear. It is to the explanation of these simple forms of beauty that M. J. L. Soret devoted an address delivered before the Swiss society of natural science.[1] The field is by no means a new one, but perhaps so convenient a statement of the problem has not before been available.

The arts depending upon the eye are those in which form is the predominant element, — sculpture, architecture, etc., — and those in which color plays the important *rôle*. If we look for the physiological basis of beauty of form, we find one great principle in symmetry, especially in symmetry about a vertical axis. If we stand in this plane of the vertical axis, and look at the symmetrical object, the impression on the retina of the right eye will closely correspond to that on the retina of the left eye. The recognition of similarity, so essential and useful as a logical habit of mind, seems at the same time to furnish the emotional element of aesthetic pleasure. The fact that we recognize and enjoy symmetry when not standing opposite the centre of the object is the result of our education: we recognize that the two retinal impressions would be alike if we assumed that position.

It may be well to introduce here a distinction between intellectual and aesthetic pleasure, in which M. Soret has great confidence. It is this: the pleasure caused by the solution of a problem is due to a conscious reasoned analysis; an aesthetic pleasure is caused by an unconscious intuited analysis. The one is laboriously and slowly wrought out: the other is readily and suddenly revealed. This distinction is best illustrated, as will be seen, in the analysis of tone: the analysis of form is so simple that we can readily perform it consciously.

Proceeding with this analysis, we find a second principle in the repetition of design. It leads to the mathematical conception of a periodic function. We see it represented in friezes, in a series of columns, in ornaments, etc., even in those belonging to the most primitive periods of art. As before, there is the recognition of similarity; and, as before, this similarity may be greatly diversified, so long as the artistic education of the beholder enables him to recognize the fundamental regularity. A third character of beauty of form is continuity of lines and surface: a straight line is an important artistic element. This is again a repetition of design, for the several parts of a straight line are again straight.

What, then, is the origin of this intuition that gives rise to aesthetic pleasure? It is the recognition of equality, — the simplest conception furnished by the senses. The ear recognizes when two sounds are of the same pitch, as well as when two intervals of time are alike: equalities of space are appreciated by sight as well as by touch. This recognition of equality, of the identity or the repetition of two sensations, reveals an order in the objective world, and the intuition of this regularity gives pleasure. The degree of pleasure depends on the universality and importance of the regularity thus revealed, and on the vividness and the variety of the sense-impressions. And what we mean by ugliness is not the lack of regularity which we see in a stone, for example: that is aesthetically indifferent. But that is ugly in which we recognize a law, but see that law violated. An unsuccessful attempt at symmetry is ugly. A piece of goods in which the pattern to be repeated shows irregularities in size and execution belongs in the same category.

Passing now to sounds, we have simply to translate the language of space into that of time. The repetition of design finds its parallel in rhythm, and both are capable of endless complications. When we consider that poetry, music, dancing, even ordinary speech, that the organic functions such as the pulse, respiration, sleep, locomotion, and many of the acquired habits of mind and body, are all subject to a periodicity, the importance of rhythm is strongly impressed. Again: the continuity of the straight line is paralleled by that of the musical note. But here and in the consideration of melody we touch upon a fact unparalleled in the world of sight (though there is a slight analogy with color), and which owes its complete discovery to the genius of Helmholtz. The musical notes are not simple in their character, but each is accompanied by a certain series of overtones or harmonics which bear a definite relation to the fundamental note; and it is a wonderful fact that it is just this series of harmonics that give rise to the octave and the musical scale; and the relative importance and distinctness of the notes composing this series of harmonics is exactly mirrored in the historic development of the scale from the earliest times to the present.

Long before it was known that sound was a periodic motion of vibrating air particles, in times when the counting of these minute vibrations would have been regarded as a miracle, the intuitional instinct of the untutored ear had already selected that pair of notes the vibration rates of which had the simplest ratio of one to two, as the basis of aesthetic sounds. It had performed unconsciously but correctly that analysis for the conscious discovery of which we required all the

[1] *Revue scientifique*, Sept. 2, 1886.

refinement and skill that centuries of scientific education could furnish. Does this not suggest a conception of law, of rationality, of an adaptation between the human mind and the external world, which is not yet fully appreciated?

Besides the repetitions due to rhythm and the scale, there are the more complicated ones due to the repetition of phrases and arias. The *Leitmotiv* and the variations of a theme are examples of more complex modes of musical repetition. The laws of harmony reveal the same tendency towards a recognition of identity, in combination with those numerical relations which underlie the formation of the scale. The appreciation of the more complicated harmonies depends on natural gifts as well as on musical training.

M. Soret considers the aesthetic aspects of color as regards mixture, juxtaposition, repetition, in a similar way; and, though there are many suggestive analogies thus brought out, the subject is hardly sufficiently well known to warrant precise statements.

The final portion of the address is devoted to the beautiful in nature. In the animal world symmetry is certainly evident; and though this symmetry is not perfect in various attitudes, still we readily recognize its nature; and, in fact, this mobility is itself pleasure-giving. In the lower forms of life, repetition of design, as the stripes of a zebra, the markings of a caterpillar or a butterfly, is abundant. Continuity and roundness of outline is certainly a prominent feature of animal forms. The mutilation or natural defect of parts of the body spoils the regular effect, and is thus ugly. Of course, as regards man, the animal which we know so intimately, the psychic elements play an active part in the conception of beauty; but these are not now under consideration. By comparison we erect a type, an ideal, and judge of beauty by its conformity to that ideal.

Turning to the vegetable world, we find exquisite symmetry, graceful outline, and repetition of design, represented as before. And into that combination of foliage with sky and earth which forms scenery, these elements enter, but do not sufficiently explain the enchanting effect of beautiful landscape. In short, there is a physical basis of aesthetics; but it is far from perfectly understood, and in part is so closely connected with higher aspects of beauty, that its nature remains unrevealed. J. J.

THE Lehigh valley railroad is to be equipped with the Phelps system of train telegraphy, by which moving trains can be kept in constant communication with headquarters or with any station on the line of the road.

RECENT PALEONTOLOGICAL PUBLICATIONS.

Revision of the Palaeocrinoidea. Part iii. By C. WACHSMUTH and F. SPRINGER. Philadelphia, *W. P. Kildare, pr.*, 1886. 8°.

WACHSMUTH and Springer have issued separately an extract from the Proceedings of the Academy of natural sciences, forming an octavo of some two hundred pages, and containing a discussion of the classification and relations of the brachiate crinoids with the conclusion of the generic descriptions, errata, and a full index. This important work forms part iii. of their revision of the Palaeocrinoidea, and will be indispensable to all students of that remarkable group of animals. The total number of genera recognized is 156; of species, 1,276. Sixty-one of the genera are exclusively American; forty-eight, exclusively European; forty-six are common to both hemispheres; one is peculiar to Australia. The authors do not claim that all the species included and referred to their proper genera in their list are actually well founded: on the contrary, many may prove eventually synonymous with previously described forms. However, there are numerous undescribed species; and the writers claim that at least one hundred such are contained in their own collection, to be hereafter described and completely illustrated in a monograph of the Palaeocrinoidea of North America. The group formerly described by them as the family Ichthyocrinidae, with the addition of Crotalocrinus and Enallocrinus, is now erected into a sub-order, Articulata, containing two families, — the Ichthyocrinidae and Crotalocrinidae. Further indication of the details of a work which is in itself a synopsis are impracticable within the limits to which we are restricted, — a fact which we regret the less, since all those directly interested will, without doubt, possess and profit by the original.

Geological survey of Alabama. Parts i. and ii. By T. H. ALDRICH and O. MEYER. Tuscaloosa, *Geol. surv.*, 1886. 8°.

Bulletin No. 1 of the geological survey of Alabama, directed by Prof. E. A. Smith, forms the first contribution toward a work undertaken by Mr. Truman H. Aldrich, illustrating the paleontology of the tertiary formation in Alabama. This work, which is to be the gift of Mr. Aldrich to the state of Alabama, will embrace figures and descriptions of all the shells found in the tertiary deposits of the state, including reproductions of figures published elsewhere, and, when finished, will be one of the most complete works of the kind published by any state.

In the preparation of this bulletin, Mr. Aldrich has personally gone over the greater part of the ground, and has collected a large part of the material himself. He has thus been able to give to each species, not only its locality, but also its stratigraphical position.

The bulletin contains a preface by the state geologist, together with a summary from his forthcoming report, of the subdivisions of the various deposits which make up the tertiary formation in Alabama, and a description of their stratigraphical and lithological features. Then follows Mr. Aldrich's paper, including notes and descriptions of species, with a summary of their geological and geographical distribution, illustrated by six well-executed plates. Mr. Aldrich, besides many new species, describes a new genus, Expleritoma, which somewhat resembles an ecarinate Magilus with the tube broken off. The species E. prima comes from the Claiborne sands.

Mr. Aldrich's paper is succeeded by one in which Dr. Otto Meyer describes some species of eocene fossils from Alabama and Mississippi. It is illustrated by three plates. Dr. Meyer also gives us a new genus of pteropods, which he calls Bovicornu, differing from Styliola by a slight spiral twist. It is from the eocene of Red Bluff, Mississippi.

These publications will stimulate and encourage the study of the tertiary fossils of the United States, — a field hitherto left to a very few workers, and of late almost neglected. All paleontologists will wish success to Mr. Aldrich in his praiseworthy undertaking.

Brachiopoda and Lamellibranchiata of the Raritan clays and greensand marls of New Jersey. By R. P. WHITFIELD. Washington, *Government*, 1885. 4°.

Volume ix. of the monographs of the U. S. geological survey is a report on the fossil Brachiopoda and Lamellibranchiata of the Raritan clays and greensand marls of New Jersey, by Prof. R. P. Whitfield. It was made to Professor Cook, state geologist of New Jersey, who, deeming it worthy of a place in the series of monographs, transmitted it to the director of the national survey, together with a sketch of the geology of the cretaceous and tertiary formations of New Jersey. This is illustrated by sections. The whole volume comprises three hundred and thirty-eight pages and thirty-five admirable plates, quarto. The Raritan clays are considered to be cretaceous by Professor Cook, though some paleontologists have considered the estuary forms sparingly found in them to closely resemble those of the Wealden or Jurassic age. Mr. Whitfield seems to incline to this view. The greensand marls are unquestionably cretaceous, and overlie, conformably, the clays. The majority of the fossils described in the report are of this age. Those from the plastic clays are mostly internal casts, poorly preserved in a friable matrix, which is also strongly impregnated with pyrites; so that, unless immediately soaked in glue, collections soon decompose and crumble, leaving no organized traces behind. The beds at the top of the marl-bed appear to be eocene, though showing some transitional features.

The types have been gathered from many sources, the state collection having only a small part of them. The earlier types are nearly all lost, owing to the decomposition above referred to, which affects the marl fossils as well as those from the clays.

These fossils attracted the attention of paleontologists at an early day. Morton and Vanuxem began describing them in 1828. The bringing-together of the scattered literature and correcting it to date will prove of much value to students; and the work, representing the labor of the pioneers in paleontology on this continent, will remain a standard of reference for a long time to come.

Ambonicardia is proposed for a form referred to the Veniliidae and related to Veniella; Meleagrinella and Gervilliopsis, for new forms of Aviculidae. The total number of species treated of is two hundred and thirty-two, of which seven belong to the Brachiopoda. An edition of this report with the state imprint has been issued at Trenton, N.J., as 'Paleontology of the cretaceous and tertiary,' vol. i; but it is, for all practical purposes, exactly the same work.

THE glaciation of the Lackawanna and Wyoming valleys, in north-eastern Pennsylvania, has afforded Prof. J. C. Branner interesting material for a detailed local study, published in the recent Proceedings of the American philosophical society. The district is of value as being on the line of farthest glacial advance. The author finds that the ice, when at its greatest thickness, was influenced only by the greater average features of the surface; and consequently what appears to have been an upward movement of the ice is upward only in a local sense. Further, as the ice thinned by melting, its southern margin became more and more under the influence of local topography, and the directions of the striae are changed. Professor Branner does not follow Kjenelf in regarding the preservation of older striae under divergent lines of later formation as evidence of no significant glacial erosion, but rather as showing the small power and short duration of the thin ice-margin that made the later striae. The paper includes two contoured maps, with striae printed in red, and accounts of bowlders, pot holes, new channels, and other related questions.

SCIENCE.

FRIDAY, NOVEMBER 12, 1886.

COMMENT AND CRITICISM.

THE EXERCISES which have just been concluded at Cambridge are memorable. Age is not that of which we can usually boast in this country, but it is a source of genuine pride to be able to chronicle the celebration of the two hundred and fiftieth anniversary of our oldest and greatest university. Founded when the colony was yet a child, Harvard has grown with the nation's growth. From a provincial theological training-school in 1636, living on a colonial grant of four hundred pounds (increased in 1638 by the bequest of John Harvard), it has become in 1886 a many-sided university, expending the annual income of five millions of dollars; and even now its abilities do not keep pace with its desires and its opportunities. Its past and its present, and we trust its future too, are linked with all that is great and noble in our country's history. This splendid story has been fitly told and commemorated during the formal celebration by the chosen orators and poets, and as Harvard enters on her new quarter-millennium the good wishes of the country are with her. May she ever hold her place in the front rank of our great educational institutions.

THE MOVEMENT IN FAVOR of appointing women as members of the board of education in New York city is gaining force, and the prevailing belief is that it will be successful. It is reported, with how much accuracy we do not know, that New York, Brooklyn, and Buffalo are the only cities in New York state that have no female representatives on the school-boards, and Mayor Grace is said to be inclined to favor the new departure. The whole matter is in his hands, for he will shortly have the appointment of successors to the outgoing members of the present board. We fancy that the principal obstacles in the way of the innovation will be political rather than sentimental. It is hardly probable that any of the members whose terms are about to expire will want to be set aside; and even if they should so desire, there are plenty of male candidates, as is usual in New York city, for the places thus made vacant. Under the circumstances Mayor Grace's position is a difficult one, but great pressure is being brought to bear upon him to appoint at least one woman to a vacancy. Numerous petitions to that effect are in circulation, and they are being signed by the most intelligent and influential class of citizens. A large proportion of the female teachers have signed these petitions, and among the host of prominent names appended to them we have noticed those of the president and a large number of the faculty of Columbia college, such clergymen as Bishop Henry C. Potter, Dr. Henry Y. Satterlee, Dr. Howard Crosby, Father McGlynn, and Rev. Heber Newton, and men like William E. Dodge, Senator Evarts, Felix Adler, Joseph H. Choate, and Charles A. Dana.

THE CITY OF HAMILTON, Ontario, has a prosperous society, the Hamilton association, devoted to philosophical and scientific studies, which has lately issued a respectable collection of Proceedings. Besides the inaugural address of the president, the leading papers are: 'On birds and bird matters,' by Thomas McIlwraith; on 'Early Greek philosophy,' by the Rev. I. W. A. Stewart; on 'A remarkable land-slide near Brantford, Ontario,' by J. W. Spenser; on 'Burlington Bay and the city drainage,' by C. S. Chittenden; on 'Race identity of the old and new worlds,' by William Glyndon; on 'The early home, separation, and re-union of the Aryan family,' by the Rev. E. L. Laidlaw; and on 'Some evidences of commercial transactions in prehistoric times,' by William Kennedy. These are all well-written and scholarly papers, evincing much learning and thought. Unfortunately, with the exception of those of Messrs. McIlwraith, Spenser, and Chittenden, none of them are based on original observation, or add any thing to the world's stock of knowledge. Hamilton, near an important dividing-line of formations and climate, is singularly well situated for the study of geology and the biological sciences. It was also, not long ago, a noted centre of the Indian tribes, and some fragments of these still remain in the neighborhood. Its district, therefore, offers a particularly inviting field for the study of American archeology and ethnology. It is disappointing to find that these advantages have been so little utilized by an association numbering evidently members of marked ability. They will do well to bear in mind, that. in the publications of a scientific association, one paragraph describing the results of original investigation is likely to be worth more than many pages of compilation.

Dr. William A. Hammond has been amusing a medical association with some humorous accounts of his experience with cocaine. He is reported to have said that there is no danger of the formation of a cocaine habit. Dr. Hughes, writing in the *Medical review*, takes a different view, and in his summing-up claims that cocaine is a tonic and stimulating exhilarant of considerable power in melancholia, mental depression, and nerve weariness, being more rapid and at the same time more evanescent in its action than morphia. He distinctly says, moreover, that, when used to excess, it intoxicates, and converts melancholia into mania, and that its continuous use is difficult to break off; that it is a dangerous therapeutic toy, and ought not to be used as a sensational play thing; that it will probably help to fill rather than to deplete the asylums, both inebriate and insane, if it should come into as general use as the other intoxicants of its class; that as an intoxicant it is more dangerous, if continuously given, than alcohol or opium, and more difficult to abandon.

The friends of technical education in the New York public schools are evidently not permitting themselves to be discouraged by the disposition by the board of education of the special committee's report on that subject, of which mention was made in *Science* (viii. No. 195) at the time. At the meeting of the board of education last week, a communication was received from the Industrial education association, of which Gen. Alexander S. Webb is president, and Miss Grace H. Dodge vice-president, offering to make a practical test of the value of instruction in certain branches of manual labor, by giving instruction to a number of public-school children this year during school hours and under school discipline. The number of pupils that can be accommodated by the association in their building at No. 21 University Place is, in industrial drawing and modelling, forty; in carpentry, twenty-four; in sewing, forty; in cooking, forty-eight; in domestic economy, three hundred. In addition to this offer, it was stated that a series of lectures on industrial education is to be given at an early date, and will be open to public-school teachers. The proposition of the association is a generous one, and will serve admirably for a beginning in this important matter. We trust that the committee on the course of studies, to which the communication was referred, will recommend that the offer be accepted, and the necessary arrangements made for carrying it out.

We have pointed out from time to time the important bearing that the study of local institutions has on historical science in general, and have found frequent evidence of a growing appreciation of this fact. To be sure, the best of things may be carried to excess, and this probably has given rise to the complaints that have been made by some critics, that this 'history of the town-pump business' is being overdone. We believe, however, that such critics are mistaken, and forget that the chroniclers of the fortunes of the town-pump are not writing a history in the broad sense of the word, but are furnishing accurate data for wide-reaching historical generalizations. A recent reviewer in the *Athenaeum*, writing of Mr. Gomme's book on 'The literature of local institutions,' may be quoted as giving evidence on this point. He says that Mr. Gomme holds the opinion that many of the English boroughs existed long before their earliest charters, which were royal confirmations of existing customs. not the creation of something new. "This, in our opinion," he continues, "does not admit of doubt. The battle now rages between those who hold them to be survivals from the time of the Roman occupation, and a strong and learned body who affirm that the evidence we have points in most cases, though not in all, to their being of Teutonic origin. We feel assured" — this is the significant sentence for our purpose — "that, if all corporation and manorial documents were made accessible, the war would soon come to an end."

A circular from Prof. Geo. H. Cook, state geologist of New Jersey, announces the formation there of a state weather service, after the kind of those already existing in other parts of the country. Two hundred volunteers are desired: they will be supplied with forms for records, and with certain publications of the signal office. Instruments have to be, for the present at least, bought by the observer. In the list of prices, the rain-gauge is marked at $1.25, and we doubt whether it can be of desirable accuracy at so low a price. It is strange that states as advanced as New York and Pennsylvania do not join their neighbors in meteorological work.

THE EXPERIMENT of making optional the attendance at the daily chapel service at Harvard college is being watched with interest by college authorities all over the country. Professor Peabody, the Plummer professor of Christian morals, and his five coadjutors, took charge of the chapel service on Oct. 3, under the new regulations; and now Dr. D. G. Lyon, Hollis professor of divinity at Harvard, writing in last week's *Independent*, tells of the new plan and its results so far as they have already been developed. The chapel services are more interesting and more inspiring than they ever were, for now no student attends who does not go from choice. The average attendance is between 400 and 450, as against about 600 under the compulsory system, but the gain in force and spirituality is enormous. Professor Lyon assures us that so far the predictions of the conservative party, which opposed the change, remain unfulfilled, and he firmly believes that they will remain so.

A RECENT NEWSPAPER REPORT (*Chicago journal*, Oct. 26) tells the story of a remarkable case of fracture of the spine and cord. Mr. Andrew Hamilton was 'coaching' some college men in the gymnasium, and, while showing some simple performance on a low cross-bar, dropped about four or five feet on the mattress. By some peculiar wrenching of the neck, he cracked the fifth cervical bone and compressed the spinal cord. From that moment on, the whole of the body below the neck was completely insensible; nor could he move a single muscle, except to contract two fingers on each hand. He had to call the attendant to open the hand. He was kept alive on milk, which was poured down the mouth; and his body was supported by floating it on a rubber sheet in a tub of water. His mind was perfectly clear; he talked, read the daily papers, and even consulted his professor on reading a mathematical work. This continued for fourteen days. He then broke down, and died on the sixteenth day after the fall. It seemed hardly possible that life should continue, and the brain go on acting, if the cord were severed, and yet the post-mortem examination showed plainly that the cord was reduced to a mass of pus.

FROM OHIO comes a report that the authorities in that state propose to construct an intermediate penitentiary to which shall be committed prisoners sentenced for the first time or for short periods, in the hope that their reformation may be effected. That this is a thorougly practicable plan is shown by the success of the Elmira reformatory in New York state, under the efficient management of Mr. Brockway. The harm done to convicts who are imprisoned for the first time by confining them together with older and hardened criminals can hardly be estimated, and Ohio is taking a step in the right direction. Its example should be widely imitated, and probably will be when the results of the experiment are made known.

THE SEVENTH ORIENTAL CONGRESS, held at Vienna last month, was thoroughly successful, and its proceedings were deemed of sufficient interest to warrant general notice in the newspapers. The congress numbers about five hundred members, three hundred of whom were present. They came from all quarters, — Japan, China, India, Persia, Arabia, Asia Minor, Egypt, Tunis, and every country of Europe and America. Vienna is so situated that many eastern representatives could conveniently be present. The official languages of the congress were German, French, English, and Italian. Latin was permissible, and by special permission some papers were read in Arabic. The list of members of the congress comprises the names of all the great professors of oriental languages in Europe. The members from this country are not many, and among them are Professors Briggs and Brown of Union theological seminary, Haupt of Johns Hopkins university, and Dr. William Hayes Ward. The congress was divided by the committee on organization into five sections, — 1°, Semitic, which was subdivided into a section for Arabic and one for the Semitic languages other than Arabic; 2°, Aryan; 3°, African; 4°, central and east Asian; 5°, Polynesian, — of which the Aryan section was the most interesting. This section passed a resolution asking the government of India to make a thorough and systematic survey of the languages of India. By invitation of the King of Sweden the next congress will be held at Stockholm in August, 1888.

THE HEALTH OF NEW YORK DURING SEPTEMBER.

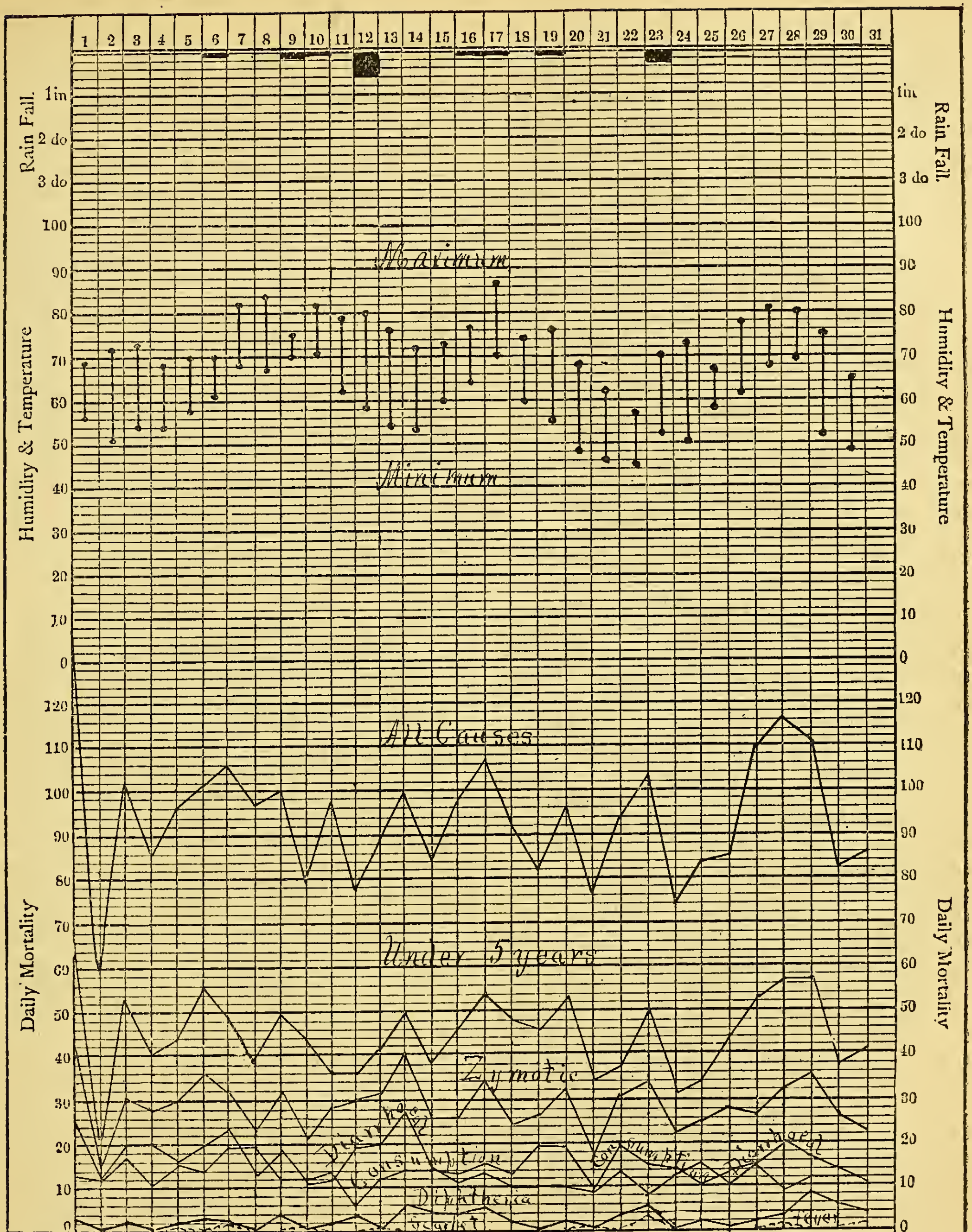
THE number of deaths which occurred in the city of New York during the month of September was 2,767, or 479 less than in the preceding month. The deaths among children under five years of age were 1,217: as compared with August, this represents a saving of 343 lives of children of this tender age. This improvement in the public health becomes still more evident if we compare September with July. In the latter the total mortality of this portion of the population mounted up to 2,499, more than double that which occurred during the former. This progressive gain is mainly to be attributed to the lower temperatures which prevail in the early autumn as compared with midsummer. In July, 240 persons died in a single day, the 8th, while the largest daily mortality of September was but 117, on the 27th. Diarrhoeal diseases claimed fewer victims by 226 than in August, and 903 less than in July. The deaths from consumption were 374, as compared with 443 in August. The September mortality from consumption was less than that of any other month of the year. Diphtheria also shows a diminution, the deaths from this cause being but 85, while in August they were 104. A similar reduction is noticeable in the deaths from scarlet-fever; 11 being recorded for September, as against 15 in August. Taken as a whole, the condition of the public health in the city of New York during the month of September was most satisfactory. That so few deaths should have been caused by such diseases as scarlet-fever and diphtheria in a population of one million and a half of people is certainly a noteworthy event.

The mean temperature for the month was 65.25° F. This was below the mean for the past ten years, which was 67.04° F. The maximum reached by the mercury was 87° F., on the 17th, at 4 P.M. The average for the past decade was 88° F.; so that, so far as its temperature was concerned, September may be regarded as an average month. The rainfall during the month was but 1.17 inches. That for the corresponding month in 1885 was .41 of an inch; in 1884, .21 of an inch; and in 1881, .97 of an inch. With these exceptions, the September rainfall has not been so small since 1869 as it was this year. Indeed, the average for ten years was 3.24 inches, while in one year, 1882, 16.85 inches of rain fell in the same month. The rainfall for the month of June was 3.35 inches, a little above the average for that month during a long series of years; in July, but 2.75 inches fell, the lowest for ten years, with the exception of 1881; in August, only .95 of an inch of rain fell: and in September we had another exceedingly small rainfall. The total amount of rain, therefore, which has fallen during the past three months, has been much below the average; and yet, as will be seen by a study of the records of the meteorological observatory at Central park, the rainfall for the nine months of this year, 29.10 inches, does not differ much from the average of the ten years just passed, which was 30.97 inches. The following table gives the rainfall for each of these months during the past ten years.

	1886	1885	1884	1883	1882	1881	1880	1879	1878	1877
January.	3.91	3.06	5.22	2.68	5.08	4.80	2.02	2.63	4.46	2.62
February	4.89	4.56	4.92	4.21	3.43	4.93	2.12	2.02	3.75	1.24
March...	2.83	.90	4.62	1.49	2.53	5.81	4.66	3.41	3.27	5.56
April....	3.85	2.19	2.82	3.71	1.64	.95	2.90	4.33	1.97	2.73
May......	5.40	1.86	3.74	2.83	4.20	3.20	.62	2.02	3.19	.95
June.....	3.35	1.32	4.98	3.32	2.52	5.35	1.14	3.15	3.08	2.80
July......	2.75	3.59	4.74	3.21	3.21	1.25	8.53	3.58	4.62	5.73
August..	.95	5.67	7.90	1.82	1.14	.86	5.26	7.95	7.97	2.77
Sept'ber..	1.17	.41	.21	3.25	16.85	.97	1.85	2.37	4.05	1.33
Total for 9 months	29.10	23.56	39.15	26.52	40.60	28.12	29.10	31.46	36.36	25.73

ACCLIMATIZATION IN NEW ZEALAND.

No country presents such a field for experiments in acclimatization as New Zealand does, and in none have the results of such experiments been so marked. Previous to Captain Cook's visits, no mammalia — with the exception of a black rat and the dogs brought by the Maoris — were to be found in these islands. That intrepid navigator gave the natives pigs, and these animals soon became wild in many places, and are still to be found in the more inaccessible parts of the colony. But they have never become so numerous as to interfere in any way with settlement, — a remark which also applies to the stray cattle and sheep which have run wild in similar regions. The native rat has long been extinct, having been completely exterminated by the common brown species, which was early introduced by ships. The latter animals are extremely abundant, not only in settled districts and towns, but even in the remotest parts. They have probably had a share in exterminating many of the ground birds, such as native quail, which are not to be found now at all. The food of those which swarm in the back country must, however, be chiefly of a vegetable nature, for they periodically migrate in great numbers. The march of settlement is



Weekly Mortality	655	652	608	
Weekly mean Thermometer	70.6	66.9	59.2	
Weekly mean Barometer	30.062	29.887	30.032	

breaking up their feeding-ground in many parts, but it was not an uncommon occurrence, twenty or thirty years ago, for the traveller to come upon a huge army of rats on the march for new fields.

The most important mammalian introduction into these islands has certainly been that of the rabbit. In the southern portion of the South Island the responsibility of introducing these animals certainly rests with the Otago acclimatization society, which imported them from Tasmania in 1867. It must be said for the members of the society, that they acted in good faith, under the impression that they were doing a useful work, and little realizing what a curse their protegés were to become. Their action furnishes an illustration of the difficulty of foreseeing what effect changed conditions may produce upon any organism. Brought into a country where only a few sluggish hawks existed as natural enemies, the rabbits have increased almost without let or hinderance, and now occur in millions. Ten years ago they were almost rare : now many districts of the South Island are quite alive with them. It is impossible to realize their abundance in parts such as the Clutha valley without seeing them. The surface of the ground is honeycombed, the vegetation in places eaten nearly as bare as a macadamized road, while the animals towards evening are met with by thousands. Their effect on the stock-carrying capacity of the country has been ruinous, and their abundance has seriously retarded settlement. All sorts of devices have been tried in order to keep them down ; the larger holders chiefly employing traps and dogs, and others resorting to grain poisoned by phosphorus. At considerable expense the pest is being kept in check in the populated districts ; but in wild, unbroken country they multiply unchecked. The government is now trying what is generally considered to be a very dangerous experiment, viz., the liberation of weasels and stoats. If these creatures increase at all freely they will prove even a worse pest than the rabbits.

Hares, red-deer, axis-deer, and fallow-deer have been introduced by various acclimatization societies. The former are common, and are coursed regularly, but the phosphorus has nearly exterminated them in many parts. The deer are still only kept in preserves, being strictly looked after ; but they are increasing steadily, and will probably furnish good sport, ere many years are past, to those who can afford the luxury of shooting them. The latest move in this direction is the proposed introduction of the chamois, as it is thought the southern Alps will be most suitable for these animals. The government has commissioned Sir Julius von Haast, who is at present in Europe, to make inquiry for these animals at the royal preserves in Bavaria and the Austrian Tyrol.

Native birds show a tendency to disappear rapidly before the European settler. The quail, formerly so abundant as to be shot by scores, are now quite extinct, this being partly due to the introduction of rats, cats, and dogs, but chiefly to the tremendous grass fires which have swept the country from side to side, and before which all ground animals disappear like smoke. Hence the necessity was early felt by the settlers, of introducing not only game-birds, but suitable insectivorous birds. Of the former, pheasant, partridge, and California quail have become well established in many parts. In Auckland particularly, pheasants became extremely common. But in other parts the peculiar results of the rabbit question have again manifested themselves ; for, in adopting the phosphorized grain-cure for rabbits, these introduced game-birds have been exterminated in whole districts. This is the case, for instance, in southern and central Otago, where ten years ago pheasants were to be seen on every hillside, and now it is rare to come across one. It is probable also, that, if weasels increase, it will be almost futile to attempt the further introduction of game-birds.

A visitor to Dunedin at the present time, strolling into the forest-clad town-belt, might see or hear a few tuis (parson-birds) or korimakos (bell-birds), but these would probably be the only native birds to be met with. But on every side he would hear the pipe of the blackbird and thrush, and see abundance of house and hedge sparrows, chaffinches, linnets, and goldfinches. In the more open ground, sky-larks would be met with in abundance, while numerous flocks of starlings would be seen busily at work in the fields. Besides these, yellow-hammers and greenfinches are common, while very recently robin-redbreasts have been liberated. In most cases the introduced birds have developed no new habits here, remaining true to their traditional instincts of robbing gardens when there was any thing worth robbing in them, but for the greater part of the year depending upon outside supplies, which are sufficiently abundant in this land of plenty. But it is difficult in many districts to get a crop of cherries or strawberries, while the farmers are annually engaged in a crusade on the small birds. The linnets, yellow-hammers, and greenfinches in particular, attack the grain-crops as soon as the young grain is well formed ; and long before it is ripe, wide stretches of the fields, especially near hedgerows, are thrashed clean. This has already led to war, the farmers offering rewards for dead birds and for eggs. Whether the good these birds do by eating insects and seeds of weeds during eleven months of the year, is balanced by the evil they do during early harvest, is a question which has never been properly investigated. The starling is the bird whose record is most unsullied, as no one has aught but good to say about it. Immense flocks of them are now to be met with in all populated parts ; and it is difficult to realize what insect devastation the country would be subject to, but for their presence. Australian magpies, minahs, and laughing jackasses have been introduced, but don't increase.

The attempts to acclimatize fish in this country have been in great part successful, though some notable failures have also been made. Several shipments of salmon ova have been made from Britain and America : in several instances all were dead on arrival in the colony. As long ago as 1874 some of these fish were successfully hatched out in the ponds on the Makarewa, a small tributary of the Oreti, and they grew well. A number of them were placed in the Aparima, a beautiful stream which flows into Foveaux Straits ; but from that day to this they have never been heard of. Others were washed out of the ponds by a heavy flood, and these also have failed to put in an appearance again.

In 1878 California salmon were also turned out in large numbers in several South Island rivers, as many as 31,000 fry being liberated in two of the Otago streams ; but these likewise have not been met with again. Whether they have all been destroyed or not is difficult, if not impossible, to find out. The previously introduced brown trout, the enormous indigenous eels, and the ubiquitous shags (cormorants) probably made great havoc in their ranks ; but, presuming that some got away to sea, it is certainly remarkable that they do not seem to have found their way back to the rivers again. Had they done so, they would almost certainly have been met with by the numerous anglers who fish the southern streams for six months of the year, Only this year a most successful importation of Scotch salmon ova was made by the government, and young fish are now in the ponds of half a dozen of the local societies. The Otago society have about 4,000 of these. When at an age fit to turn out, it is intended to liberate all but a few hundred, which will be retained in the ponds. It is thought, that, though in opposition to their usual and instinctive habits, it may be possible to retain these fish, and breed from them in confinement. Should this prove to be the case, it will only be a question of time before the colony is well stocked with salmon.

The most remarkable results in fish acclimatization have certainly been achieved in regard to brown trout. These fish were introduced in 1868, partly from Britain, but chiefly from Tasmania, where they had been introduced a short time previously. The rate at which they have increased in the New Zealand rivers and lakes has simply been marvellous. Fish only five years old have frequently been found to weigh from ten to fourteen pounds, while in the lakes they have reached still larger dimensions. This remarkable rate of growth appears to have been due to the fact that there was a great abundance of suitable food in the streams, and few native fish to compete with them. Of late years the size of the fish taken has not been so large, showing partly that the food-supply has fallen off, and partly that the larger fish are being caught. These ten- and twenty-pound trout are themselves the greatest destroyers of ova and young fish, and are therefore not encouraged.

To show how remarkably changes of condition may affect the fish-supply in these waters, one case may be cited. The Lea stream, a tributary of the Taieri River, and a typically perfect trout-stream, was stocked in 1869 with 98 small trout. These increased in numbers very rapidly, so that in ten years the stream was full of splendid large fish, and it became the favorite stream of Dunedin anglers. Since 1880 some 19,000 young fish have been liberated, but the fishing has gradually fallen off, and now it is difficult to get a good basket. Some attribute this to the eels, which are large and numerous ; others to the shags. Both surmises are probably incorrect, as eels and shags are destroyed whenever opportunity offers, and are not apparently more abundant than they were ten years ago. The real reason seems to be, that with the enormous increase of starlings, which has already been referred to, there has been, in all parts where these birds abound, an almost total disappearance of grasshoppers and other large insects. The food-supply in the smaller streams has thus been greatly diminished, and they cannot support the number of fish they did at first.

Of late years other varieties of trout have been introduced, such as Scotch burn and Loch Leven trout. It will be an interesting study for the naturalist of the future to observe whether the varietal differences which characterize these forms will remain persistent, or whether all will revert to one common and indistinguishable type. Other fish, such as American white-fish, perch, tench, etc., have also been introduced, but up to the present they have not made any remarkable progress.

From the foregoing record of facts, it will be seen that a remarkable field of observation for the naturalist exists in these southern isles. Fortunately, in almost every instance, the date and locality of introduction of nearly every form of animal colonist can be exactly ascertained, and by careful observation and record it will be possible to chronicle every important change. We have already seen in New Zealand the remarkable case of a fruit-eating parrot, the kea (Nestor notabilis), becoming a true bird of prey. Learning to pick at the skins and offal of slaughtered sheep lying about stations and stock-yards, this bird has actually acquired the art of killing sheep. So greatly has this faculty been developed, that great tracts of mountain country in the interior of the South Island are now rendered uninhabitable for the sheep. It is thought that the chamois or any other active smooth-backed animal will prove too much for the kea; but the poor sheep, with its thick matted fleece, is at the mercy of the powerful bills and claws of these birds.

Similar cases, of altered habits under altered conditions, are more likely to occur in a new conntry, with so peculiar an indigenous fauna as New Zealand possesses, than in any other part of the globe: hence the importance of keeping a good record from the very beginning.

GEO. M. THOMSON.

Dunedin, Oct. 8.

LONDON LETTER.

THE movement for the establishment of a British school of archeology at Athens seems in a fair way to succeed. A meeting of the general committee and subscribers to the scheme was held a day or two ago, at which it was stated that a director's house, with library and lecture-room attached, had been built at Athens, on a site presented by the Greek government. The University of Oxford, the Hellenic society, and other public bodies contributed towards the annual expenses, and Mr. F. C. Penrose was to assume the directorship of the school for one year from this present November. Among those present at the meeting were the head masters of several of the great English public schools, the minister for Greece, and other influential persons.

Several of the most distinguished medical men in London assembled at the College of physicians recently, to hear the Harveian oration (instituted by Harvey himself) pronounced by Dr. Pavy. Harvey's object in establishing this was that members of the college should 'search and study out the secrets of nature by experiment.' After referring to the bacillus, and the attack upon it by processes of disinfection, Dr. Pavy stated that another way of attacking it was due to researches recently conducted. It had been found that the bacillus required virgin soil for its growth, and by certain means it might be brought into such a weakened state as only to occasion, when introduced into the system of an animal, an effect of a mild nature, not dangerous to life, instead of the ordinary form of disease; but the effect produced — and this was the great point of practical importance — was as protective against a subsequent attack as the fully developed disease. The knowledge recently acquired had been already practically turned to account upon a large scale for checking the ravages of that exceedingly fatal disease among cattle known as anthrax, or splenic fever; and, if that could be accomplished for one disease, — and more than one could be mentioned, — was there not ground for believing that means would be found for placing others of the class in the same position? Attempts were being made in that direction. All eyes throughout the civilized world were, indeed, fixed upon the work of Pasteur in Paris with reference to hydrophobia. Looking at the nature of the disease, there was nothing inconsistent with its being dependent upon a bacillus, or microbe as Pasteur called it. He had been an eye-witness of Pasteur's work. Judgment, it must be stated, still stands in suspense, but it must also be said that the results obtained tell decidedly in favor of the views advanced.

Two more volumes (xv. and xvi.) of the zoölogical reports of the Challenger expedition have been issued during the last few weeks; and several others may be expected within the next six months, as the treasury grant for the publication of these reports expires on the 31st of March, 1887, so that the various memoirs must be out of the printer's hands before that date.

The removal of the natural history collections from Bloomsbury to South Kensington has been accompanied by a steady increase in the publications both of the zoölogical and of the geological departments. The fossil mammalia are being catalogued by Mr. Lyddeker, formerly paleontologist to the geological survey of India; the fourth part of his work, which deals with the Proboscidea, being now in the press. Mr. R. Kidston has made a valuable contribution to paleo-botany by his catalogue of the palaeozoic plants, which is especially complete as regards the literature of the subject. The last volume issued by the geological department is the catalogue of Blastoidea, which is the joint work of Mr. R. Etheridge, jun., and Dr. P. H. Carpenter, and is illustrated by twenty quarto plates. The museum contains several remarkably fine types of this class, which were collected some years ago by Messrs. Eilkertson and Rofe respectively from the carboniferous limestone of Lancashire and Yorkshire, and have never been properly described; while the liberality of several American paleontologists, especially Mr. Charles Wachsmuth of Burlington, has enabled the authors to make their work a nearly complete monograph of the group. They recognize nineteen genera, which are arranged into six families, and these fall into two orders, the Regulares and Irregulares. The latter contains the singular Devonian genus eleutherocrenies, which was so well described by the late Dr. Shumard, together with two equally aberrant types from the carboniferous of England and Ireland respectively. These three genera differ altogether from the familiar Pentremites in having no trace of a stem and in the asymmetry of the calyx.

The reports recently made to the local government board by public analysts indicate in a very striking way the good effected by the adulteration act of 1875 as regards food and drugs. When public attention was first directed to this question (by the *Lancet*), one-half the samples of food analyzed were found to be adulterated. The returns for a twelvemonth, just published, show that only 13.2 per cent had been thus tampered with. The adulteration seems greatest in spirits, being 537 out of 2.321, or 23.1 per cent. Butter comes next, with 18.8 per cent. Then follow in order, coffee, mustard, and milk. The adulteration of bread has almost ceased, only 31 samples out of 1,168 tested (not 3 per cent) being faulty. Confectionery and beer are practically unadulterated, while not a single suspicious case occurred among the numerous samples of flour, sugar, pickles, tinned vegetables, jam, and wine, which were examined.

There are many signs that the electric lighting industry, so long under a cloud, has at last taken a very decided turn in the right direction, notwithstanding the fact that the removal by parliament of the legislative restrictions imposed upon it by the electric lighting act of 1882 seems as far off as ever. Numerous celebrations are projected in connection with the jubilee year of the accession of Queen Victoria, in many of which the electric light is to play a very prominent part. The battle of the patents still continues in connection with incandescent lamps, a monopoly in the manufacture of which is claimed by the Edison company, and is stoutly opposed by a number of manufacturers, headed by Messrs. Woodhouse and Rawson, who, beaten in the first trial, have appealed against the judgment of the courts, and will probably carry the matter, if necessary, up to the house of lords. That great competitor of the electric light, the gas industry, is now seriously hampered by the difficulty in disposing of its tar. The quantity of coal carbonized for gas-making in the United Kingdom is about 8,450,000 tons per year; and if the yield of tar be taken at 12.5 gallons per ton, specific gravity 1.165, it follows that 558,780 tons of tar are annually produced. Attention, therefore, is being directed to the best conditions under which tar can be burnt as fuel; and its injection into the furnace by means of steam, with an atomizing apparatus, is found to be one of the best methods. Such 'tar-steam' evaporates 10.7 pounds of water per pound of fuel, as against from 7 to 8 pounds evaporated by 1 pound of coal.

W.

London, Oct. 13.

NOTES AND NEWS.

Cornell university, taking up the plan outlined by President Adams last spring, will establish a law school, with a course of study extending over two years. The faculty will consist of a resident dean, a professor and an assistant professor, together with non-resident professors of special subjects. The faculty will be chosen in January, 1887, and a formal announcement of the new school will be made at that time. Cornell reports this fall 33 graduate students and 304 freshmen. The total enrollment is 794.

— Dr. Wiedermann, so long the amanuensis and pupil of von Ranke, is in an asylum near Berlin. He suffered so much from overwork on the last volume of Ranke's history, and from the nervous excitement attending the last illness and death of his master, that his mental powers became unsettled.

— The first of the Lowell free courses of lectures in Boston this winter given under the auspices of the Teachers' school of science of the Boston society of natural history, will be by Prof. W. M. Davis of Harvard college, on 'Problems in physical geography.' The program is as follows: — first and second lectures, 'Geographical classification,' illustrated by the classification of lakes according to the mode of origin of their basins; third lecture, 'Geographical evolution,' illustrated by the development of plains, plateaus, and their derivatives; fourth and fifth lectures, 'Geographical evolution, as seen in the volcanic series of geographic forms, all structures consisting of rock thrust up while molten from a deep subterranean source may be considered under this heading; the characteristic series of topographic forms developed during their wasting-away will be described. The lectures will be illustrated by maps, diagrams, and models: they will be given, as usual, in Huntington hall, at the Massachusetts institute of technology, beginning on Nov. 6.

— The council of the University of the city of New York has chosen Mr. Charles Butler to fill the office of president, made vacant by the resignation of Mr. John Taylor Johnston on account of ill health. The university has this year a total of 800 students, — 70 in the law school, 600 in the medical school, and 130 in the college proper.

— According to Prof. F. H. Snow of the University of Kansas, from observations taken at Lawrence, last month, with one exception (1879), was the warmest October in nineteen years. The rainfall was but little more than half the average, this being the fifth successive month with deficient rainfall. The total rainfall from Jan. 1 to Nov. 1 was more than two inches less than for the same period in any previous year of our record.

— Messrs. Cupples, Upham & Co., Boston, announce 'Harvard: the first American university,' by George Gary Bush, Ph.D.

— Mr. Percy Fitzgerald has just published, through Messrs. Scribner & Welford, New York, "The book fancier; or, The romance of book collecting."

— Messrs. Ticknor & Company announce for publication, on Nov. 6, 'A muramasa blade,' a story of feudalism in old Japan, by Louis Wertheimber; also monographs of American architecture, No. 4, 'The memorial hall at Harvard university,' Ware & Van Brunt, architects, 13 gelatine plates (from nature) 13x16 inches, also one photo-lithograph, in portfolio.

— *Nature* states that Messrs. Taylor and Francis of London will shortly publish a work by Mr. T. Mellard Reade, F.G.S., entitled 'The origin of mountain-ranges.' In addition to containing a systematic theory of mountain-building, with detailed experimental illustrations, the structure and geological history of the great mountain-masses of the globe will be discussed. The work will also contain many maps and sections of mountain-ranges, and a contoured map of the North Atlantic Ocean, together with numerous sketches of mountain-structure and scenery, from nature, by the author.

— At the close of the present year *Van Nostrand's engineering magazine* will pass into the hands of Mr. M. N. Forney, and be consolidated with the *Railroad journal*, which has also become the property of Mr. Forney. In January the magazine will appear in its new form, under the somewhat formidable title of the *American engineering magazine and railroad journal*. An editorial and news department will be added, more illustrations will be given, the pages will be enlarged, and the price reduced to three dollars per year.

— An opportunity for the publication of geographic studies and monographs is offered in a series of volumes, to be entitled '*Geographische abhandlungen*,' edited by Prof. Albrecht Penck, and published by Hölzel of Vienna, — two names that insure good material and good work. The *Abhandlungen* are designed to contain essays that are too long for acceptance in *Petermann's mittheilungen* or in the Berlin *Zeitschrift für erdkunde*, unless in disjointed form, and to continue such studies as were encouraged in Kettler's *Zeitschrift für wissenschaftliche geographie*. The papers promised for this year are by Brückner, on 'The glaciation of the Salzach district;' Neumann, on 'Orometry of the Black Forest;' and Böhm, on 'The division of the eastern Alps.'

— A gold medal and money amounting to $165 have been offered by a scientific society of Holland for the best treatise on the work of Pasteur.

— Twenty-five thousand dollars have already been expended in digging an artesian well at Northampton, Mass., and although a depth of 3,024 feet has been attained water has not been found in quantity sufficient to be of use.

— It may be cited as an evidence of the prevalence of morbid curiosity, that the first edition of Inspector Byrne's forthcoming book on the 'Professional criminals of America' has been exhausted by advance orders, and a second edition of five thousand copies is on the press.

— The death is announced of Prof. H. A. Bayne, Ph.D., of the Royal military college, Kingston, Ontario. Professor Bayne was a native of Nova Scotia, and after graduating at Dalhousie college, Halifax, studied under Liebig, Bunsen, and Dumas.

— The population of Queensland, Australia, was on the 31st of December, 1885, 326,916, of whom 191,450 were males, and 135,466 females. This is an increase of about 17,000 over the population in December, 1884.

— Dr. H. G. Beyer, U.S.N., has recently been repeating Hueppe's experiments as to the causation of lactic acid fermentation, or the process of the souring of milk. Lister believed that this was caused by a microbe, and proved it satisfactorily. Dr. Hueppe has demonstrated that there is a particular organism, described by him as bacillus lactic, which is constantly associated with lactic acid fermentation, and he has separated this organism from others. The experiments of Hueppe and Beyer appear to have demonstrated that during lactic acid fermentation the sugar of the milk is converted into lactic and carbonic acids, and that this process is directly dependent on or caused by the life and growth of a micro-organism which so differs from all others that it may properly be named bacterium lactis. This is a short, thick, ovoid rod, about half as broad as long, from .001 to .002 mm. in length. The germ does not liquefy gelatine. It is as yet undetermined whether it forms spores.

— Professor Cantani some months ago recommended the inhalation of a spray consisting of a pure culture of bacterium termo for the cure of consumption. This method of treatment was fully described in the *British medical journal* some time ago. Dr. Filipovitch of Odessa has recently tried this plan upon six cases of advanced consumption. Four of the patients died, and the other two left without having been perceptibly benefited. He came to the conclusion as the result of his personal observation that no good whatever may be expected from the treatment of tuberculosis by the inoculation of the bacterium termo. In one of the cases the expectoration became more profuse and offensive after the treatment was commenced, and it is questionable whether harm may not be done by inhaling these bacteria of putrefaction.

— The *Medical record* is authority for the report that Professor Windle concludes from his researches that man's original dentition included six incisors in either jaw; that two from each jaw have gradually disappeared; that this loss is due to the contraction of the anterior part of the palate; that this process of contraction will probably go on and result in the loss of two further incisors, and that the conical shape of many of the supernumerary teeth indicates a reversion to the primitive type of tooth.

— The sale of nickel-plated cooking-vessels has been prohibited in Lower Austria on the ground that vinegar and other food substances dissolve the nickel, producing a poison.

— The bacillus of bread-fermentation has been cultivated by Laurent (*Bull. acad. roy. Belg.* x. 763) and described under the name of B. panificus. The spores are found on the surface of grain and remain in the flour when ground. They develop rapidly in dough, as well as in gelatine, saccharose, and boiled starch, and are capable of withstanding the temperature of boiling water, when not situated within a half inch of the surface of the bread while cooking. The bacilli occur richly in bread, and may be found in great numbers in the intestinal canal. In bread they may attack the starch, converting it into a substance resembling erythrodextrine, and producing a viscosity or heaviness, easily checked, however, by the addition of a quantity of an organic acid.

— Dr. W. Müller describes in *Kosmos* the remarkable habits of a Brazilian long-horn beetle (Oncideres) of less than an inch in length, which gnaws off branches, from one to two inches in diameter, of the hard-wooded camphor-tree, for the purpose of inserting its eggs into the twigs, which is done after the branches have fallen to the ground.

— A successful attempt at crossing wheat and rye is mentioned in Biedermann's *Centralblatt.* The grain capsules of the wheat were carefully opened, and the stamens removed before they were developed. The pollen from the rye was afterwards placed upon the stigmas, and the whole head carefully tied up. The seeds resulting from this process were planted and readily germinated, producing plants that partook of the characters of both parent forms, though with those of the wheat predominating. Some of the ears had long glumes, while others had short ones. The seeds themselves showed a resemblance to rye, but less than to wheat.

— A strange effect of light transmitted through a solution of sulphate of quinine upon the blossoming of plants has been made known by Sachs. From a series of experiments he has shown that plants germinated and grown under the influence of such light, while thriving otherwise, develop only small, imperfect, and speedily perishable flowers. Light transmitted in a similar way through pure water impaired in no way the blossoming powers.

— Since the discovery of the independence of the physiological senses of heat, pain, cold, and touch, a special interest has attached to the ascertainment of the different ways in which these sensations are transmitted to the brain. Professor Herzen has recently shown (*Arch. sc. phys. et nat.* xv. 580), from vivisectional experiments, the intimate relation between cold and touch, and that an injury to the cortex of the brain that destroys the sense of touch in any region will usually also abolish correspondingly the sense of cold. Accidentally, however, in one case, through cutting less deep than he had intended, he found that the sense of cold was abolished while that of touch remained uninjured, proving the ultimate distinction between the brain centres of these two senses.

— Dr. M. J. Roberts of New York, after drilling holes in bone to investigate the existence of diseased conditions, introduces a small incandescent lamp of half-candle power into the opening, and by this means illuminates the cavity.

LETTERS TO THE EDITOR.

**Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The source of the Mississippi.

THE recent discussion, in your columns and elsewhere, of the sources of the Mississippi River, must have suggested to many of your readers the thought that this is an especially fitting time to supplement and complete the work of the early explorers and the government surveyors by a careful examination of the Itasca basin in the light of all previous explorations. There are certain elements in the region that are permanent, and certain others that are temporary and will soon undergo the changes which accompany the settlement and subjection of the wilderness. The Lake Itasca of Schoolcraft and Nicollet, in the main, survives to the present day. A few years more will see many of its features changed past recognition.

If such an exploration is worth the making, it should not be long delayed; and that it is well worth making, the interest of the public already enlisted in this discussion clearly proves. Further, the fact that a mere adventurer and charlatan has been able to lead astray and befog the press and the scientific bodies of almost the entire country, east and west, is no small proof that it is desirable to settle, once for all, the questions at issue.

We have taken this view of the case ever since Captain Glazier's friends first presented his claims for our consideration. The matter was fully investigated by the head of our editorial department, and we became satisfied that nothing short of a thorough exploration of the region in question would satisfy us as educational publishers or justify us in making any changes in our geographical publications. We believe that we, as publishers of geographies and atlases which are widely used and approved, owe this much of service to the public. We therefore some weeks ago arranged to dispatch a competent exploring party to Lake Itasca, fully equipped with instruments for the complete survey and delineation of the region which supplies the feeders of the lake.

The first letters from this expedition are at hand, and consist of a general statement of the character of the work accomplished. The detailed report we expect will be forwarded to us in the course of a week or two, when we shall be glad to place them at the service of your readers as soon as the proper maps can be drawn and engraved. The following extracts from a letter before us shows the nature of the work accomplished: —

"Every stream flowing into Lake Itasca and Elk Lake was followed to its source and located. The area drained by each stream was found, as well as the volume of water discharged. The heights of land were located and elevations taken, as well as the elevation of the sources of all the streams flowing into both lakes."

We have also received by express specimens of the water from both lakes, and a number of small evergreen trees taken from Schoolcraft Island and from various points on the shores of Itasca.

Our instructions were that the exploration be made so thorough as to satisfy every inquiry, and we believe that it has so been made.

IVISON, BLAKEMAN, TAYLOR & CO.

New York, Nov. 3.

On the figures illustrating zoological literature.

In the course of some remarks on the figures illustrating zoölogical literature in *Science* for Oct. 29, Dr. R. W. Shufeldt justly pleads that proper credit be given to original authors of zoölogical illustrations; but in the course of his remarks he occupies considerable space in accusing me of carelessness in such matters, in the case of my 'Zoölogy' and 'First lessons in zoölogy.' I am charged with making 'a very shiftless acknowledgment of some of the authorities for the illustrations.' I am surprised at this reckless statement, as I intended to, and think I did, make full, proper, and circumstantial acknowledgment of the authorities and works from which most of the cuts were borrowed. Over two-thirds of a page of the preface is devoted to such acknowledgment, and a paragraph is given to the names of standard authors and their works. I regret to learn that two sketches drawn by Dr. Shufeldt himself were not credited. The mistake can easily be corrected in a second edition. I have prided myself on giving proper credit, on this and other occasions, to other naturalists and authors, and to those who have in other ways been of assistance.

Now, let us see if Dr. Shufeldt has been as careful, exact, and guarded as a critic should be. He lectures me for not, in my larger 'Zoölogy,' giving credit to the original artist as well as the author of the book who borrowed the figure. If Dr. Shufeldt had carefully looked through the larger 'Zoölogy,' he would have found that I had done so in the case of twenty figures (figs. 63, 75, 109, 141, 232, 279, 280, 284, 386[6], 387, 394, 434, 437, 457, 460, 461, 491, 500, 515, 516). Now, is this fair, candid criticism? Do not Dr. Shufeldt's sweeping statements, like those of another critic of the 'First lessons,' mislead the reader? Is such carelessness just to the author of the book?

Again: Dr. Shufeldt states that at least fourteen of the cuts from either Audubon or Wilson are accredited to Coues's 'Key.' This statement is based on an inspection of the first edition of the 'Zoölogy:' in the third and later editions, thirteen of these figures are credited to Tenney's 'Zoölogy.' Our critic should refer to the latest edition of the work with which he finds fault. It has certainly, however, been my wish to credit the figures borrowed to the original artist. It is not alway easy to do so in copying from foreign works: in the case of Audubon and Wilson it could have been done, and may be in a later edition.

Coming to the 'First lessons in zoölogy,' Dr. Shufeldt charges me with ignoring the artists in a large number of figures. In the preface I say, "Of the 265 woodcuts, 111 have not appeared in the author's other books." Subtracting 111 from 265, leaves 154 figures. The sources of these are acknowledged in my two larger books; i.e., the 'Zoölogy,' and the 'Briefer zoölogy.' It seemed to me unnecessary to make the acknowledgment again in a smaller book designed for younger pupils. If this was an error, it was not from an intention to mislead. Leaving out the 154 figures previously acknowledged, then taking into account over 100 fully acknowledged, it would be easy for the critical reader to detect the eight figures drawn by the author. Is Dr. Shufeldt's insinuation a manly one, that I would leave the students to "choose from among the most trustworthy and best of the unacknowledged ones these eight, and accredit the author with them"?

The figures after Morse, Riley, Coues, Hornaday, Rymer Jones, Owen, 'and many others,' are among the 154 previously acknowledged in my other two earlier books.

To further illustrate Dr. Shufeldt's reckless manner of writing: he remarks that fig. 212, after Graber, "looks to my mind far more like the claw of a young lobster than the head of a cockatoo." The figure is a diagram sufficiently well drawn to answer the purpose intended.

One who did not have the book before him would naturally infer, from Dr. Shufeldt's statement, that the skeleton of the wild ass was the only mammalian skeleton figured, whereas there are illustrations of those of the cow, whale, cat, bat, and walrus, with sketches of the limbs and skulls of other forms.

There are other reckless charges of 'carelessness' which seem undeserved. The 'First lessons' was not hastily written. Spare time during a period of over two years was given to its preparation. The manuscript was read, revised, and reread; some chapters were read over several times; it was also read aloud to two children of fourteen and seventeen years, to make sure that it should be intelligible. The borrowed illustrations were chosen with care: they are necessarily uneven in character, where drawn by artists of unequal ability, and copied from authors of varying merit.

In closing let me say that I believe in searching, sharp criticism of text and illustrations; it tends to greater care and accuracy: but let it be fair, manly, and ingenuous; and let the critic be at least as guarded and exact in his statements as the author with whom he finds fault. A. S. Packard.

Providence, Oct. 30.

The teaching of natural history.

Two works intended for 'beginners' in zoölogy have been criticised in recent numbers of *Science*, — Packard's 'First lessons in zoölogy' and French's 'Butterflies of the eastern United States.' These criticisms have been in the line of the prevailing fashion, in that the one which begins with microscopic animals, and shows such parts as can be seen only by the aid of first-class objectives, manipulated by first-class microscopists, is highly commended; while the other, which takes up animals that can be seen, and treats of parts and changes that can be observed by any student with the naked eye, is utterly condemned.

As a teacher of many years' experience with beginners in zoölogy, I hope you will let me be heard, though my remarks are not at all in the fashion.

The critic of French's work begins by saying, "The whole aim of the author seems to be to enable his reader to find out the name of a specimen in hand; and to this end his analytical key is fairly good, so far as the perfect insect goes, excepting, that as no tables are given for genera, families, etc., it would not help the student if species not included in the book were to turn up." The 'whole aim,' etc. Only 25½ pages are devoted to the key, and the book contains over 400. 'To find out the name of a specimen.' This seems, in the eyes of the fashionable critic, an unpardonable sin. What does any one want the name for? I can but think that there are a few good reasons for knowing the name quite early in the progress of acquaintanceship with an animal or plant: 1°, it will enable the worker to read what is already known about it, and thus know whether he has discovered any thing new; 2°, if he has found out something new, he can tell or write the news, and say what he is talking or writing about; 3°, information fastened to something, be it only a name, can be kept in mind or in a note-book. The key analyzes only the 'perfect insect.' What work, either with or without a key, would enable one to determine either animals or plants at all stages? How would Coues's 'Key' or Gray's 'Manual' stand this test? For 'genera, families,' etc. The key does trace into the families, the genera, and the species; and all the families and genera are more or less fully characterized either in the key or in the body of the work. 'Species not included.' The book gives all the known species of the region: who could give the unknown ones?

I quote again from the critic. "Third, the whole aim of the author appears to be to enable the user to answer the question, 'What is the name of my butterfly?' — for pedagogical purposes, not even a worthy, far less the best end." Of course, he had said all this before, but the 'whole' is represented by the fraction $\frac{1}{16}$. The author does not make it a 'worthy' and 'best end,' but he does make it just what it is, a worthy and best beginning; and from this good beginning he goes on to tell of its different stages of growth through egg, larva, pupa, and perfect form; of its food; and of its seasonal changes; thus helping the pupil to become a true, original investigator by discovering new facts of growth and development.

A little later in the criticism, the book is said not to contain all that has been published about every species. The critic has twice said it didn't contain any thing but key. I know of no dozen works which together contain so many important facts as this one; and, on account of its size, the publisher probably had the author pay for the plates. I am thankful that he has been good enough to give this much for 'pedagogical purposes.'

The criticism is finally clinched by this remark, 'It is but the rehabilitation of the dry husks of a past generation.' If there are any dry husks in science, it is well illustrated by many of the late works for beginners in botany and zoölogy in which the classification and characterization of orders, families, etc., are given, from bacteria to a buttercup in the one, and to man in the other, — dry husks, 1°, because classification is ever changing; 2°, it is a classification of unknown things, and necessarily so, as nearly all students in schools live away from the sea, and have no chance to work with good microscopes, and more than half of classification pertains to marine and microscopic forms; 3°, such condensed classification as is possible in a 300-page book is so faulty as to be useless or worse. Take the other method for determining classification, i.e., by the use of a key. The pupil begins with something to classify, and as soon as he reaches the name of an order, family, etc., has an example to illustrate it. He knows what he is studying, and has determined by actual observation the arrangement and parts of its organs. He has been changed from a book-worm to an original observer.

Listen to a prig who says he has worked himself into a naturalist by means of the plan advocated in most of the late books on botany and zoölogy. "How did you become so great a naturalist?" — "Why, you see, when I was about twelve years old, I received a free ticket to a lecture on natural history by Professor ——, and, as it was free, I of course went, and there I heard how a beginner should start. At this time I did not know the name of any animal. I properly despised those who did. I did not know a cat from a dog. When bitten, I simply cried, and ran home. I did not ask, I did not care whether it was a mosquito, a bumblebee, or a rattlesnake that bit me, or by which end I was bitten. I went home from the lecture, and purchased a compound microscope, a dissecting microscope, a set of dissecting instruments, a set of injecting instruments, a microtome, and forty bottles of hardening, staining, and mounting fluids. On account of the discounts, I was able to purchase them for two hundred dollars. Then I went and gathered some Protomonas, amoebae, and other protozoans, and from these I worked out the whole problem of life. I was very careful to take but little notice of the external organs, since great harm always arises from looking at outside parts. The proper way is always to begin with the insides. After this good and proper beginning, I soon became a great naturalist." This is all nonsense. No naturalist ever began in this way. As well try to make a child learn all about the letters and syllables which form a word — its root, derivation, and history, and all its prefixes and suffixes — before allowing him to use it, as to try the same plan in zoölogy. Prof. L. Agassiz said that all the great naturalists he ever knew, both in Europe and America, began their work by making and naming collections. The critic will say again 'that science had changed within the last eventful quarter-century.' Some things cannot be reversed, and this is one of them. Those who have recently had so much to say about teaching beginners are the ones who never have beginners to teach: they are university professors, with plenty of time at their command, scores of microscopes to work with, and, as students, only those who elect to take the subject because they have passed through all the necessary preliminary stages. A TEACHER.

For what purpose mosquitoes were created.

Your mention of Dr. Finlay's view that yellow-fever may be propagated by mosquito-bites reminds me of the following: In 1839, during a yellow-fever epidemic in Augusta, Ga., no case originated at Summerville, a neighboring suburb among the sand hills. There were then no mosquitoes at Summerville, which was approached by a rather circuitous route from Augusta. Some years after, a straight, broad road was built through swamps directly to the sand hills; cisterns were also built, and mosquitoes appeared and became an intolerable pest. During the yellow-fever epidemic of 1854 a number of cases originated at the sand hills, now abounding with mosquitoes. Mosquitoes often invade sections where they were previously unknown and make permanent settlement. Mr. Mimms of Aiken, S.C., told me that the first mosquito seen in that town came from the cars on the South Carolina railroad. They are abundant there now. Dr. I. P. Garrin satisfied the medical faculty and authorities of Augusta that the yellow-fever in 1839 reached the town in freight cars on this railroad. Dr. Roe, late of Alabama, informed me that once when quarantined for yellow-fever near Staten Island he collected a dozen or more varieties of mosquitoes from the holds of as many vessels there in quarantine from yellow-fever ports. They had evidently taken passage from the infected ports. I do not remember a locality subject to malarial fever that is not infested with mosquitoes.

HARRY HAMMOND.

Beech Island, S.C., Nov. 3.

A long skull.

I was much struck with the very long and narrow proportions of a skull in the collection of W. W. Adams of Mapleton, N. Y., and which was exhumed with others in Cayuga county. I had not time to make a thorough examination of it, but Mr. Adams has kindly sent me a photograph, and also an outline.

The photograph shows what to him was the most interesting feature, a circular hole, of a little over a quarter of an inch in diameter, in the anterior section, which he supposed to be made by a bullet, and which was doubtless the cause of death, from its general character. The proportions interested me more, and these the photograph does not clearly show. Impressed by the elongated character of the cranium, I sent to Mr. Adams for accurate measurements, and he gives the length as eight inches, and the width four and a half. The narrowest skull mentioned in Dr. Morton's 'Crania Americana' is that of a Cayuga chief, in which the longitudinal diameter was 7.8, and the parietal 5.1; the cephalic index being 65.4. In this Cayuga skull the cephalic index would be 5.625, if the measurements are exact, as I suppose they are.

I announced some time ago my discovery of the barb of a horn fish-hook, which supplemented the figure I furnished for Dr. Rau's 'Prehistoric fishing.' It gives me pleasure to say that Mr. J. L. Twining of Copenhagen, N. Y., has another of these rare articles, found near Watertown. It closely resembles Mr. Ledyard's specimen, but is more compressed.

W. M. BEAUCHAMP.

Baldwinsville, N.Y.

SCIENCE.—SUPPLEMENT.

FRIDAY, NOVEMBER 12, 1886.

THE RELIGION OF THE UAPÉ.

HENRI COUDREAU, whose geographical work in South America has won deserved tribute, gives an interesting account of the beliefs and observances of religion among the Uapé. We have already on various occasions referred to his notes on the manners and customs of this primitive Brazilian people. Only recently has any thing been definitely known of their mythology, a subject upon which they maintain a resolute silence to the whites. The orgies called 'dabucuri' were known to have a religious significance, but beyond this little was understood of their spiritual character, if, indeed, such an adjective may be applied to them.

The Uapé religion differs, according to Coudreau, from that of any of the adjacent people. There are for them two deities, — Tupan (from *Tupá*, 'thunder') and Jurupary. The former is good or inactive, universal, vague, representing, as much as may be, the general idea of deity; while Jurupary, active, terrible, the progenitor, is the particular god of the Uapé, as Yahveh was to the ancient Hebrews. Tupan created Jurupary, who is in some sort his minister of evil. There is, however, no antagonism between them. When Tupan visits the earth, and especially the Uapé country, Jurupary accompanies him as his guide. Once upon a time there was a virgin, but with no external attributes of her sex. The people were much troubled about her, and the shamans met at her lodge, smoked, and drank the sacred liquor of a fruit called ipadù. Then they left her. She drank much of that which remained, and thus conceived the deity. At the proper time the infant was released by the intervention of a fish. When born, the shamans put the uncanny babe into the forest, where he grew rapidly. Light issued from his body, and when he rubbed his fingers together, sounds like thunder startled everybody.

A feast was made, at which he appeared and ordered that all should fast, or he would kill the men and boys. Some children a little later ate of fallen fruit, notwithstanding the warning. Indignant at this, Jurupary killed and ate the children. The men came together, made a feast with a great quantity of fermented fruit-juice, made the god drunk, and threw him in the fire. From his ashes grew the palms from which are made the 'paxiuba,' or trumps, with which his devotees make their religious noises, for the sounds cannot be called music by any stretch of courtesy. During the night of his incineration, the spirit of Jurupary was able to reach heaven by the miraculous growth of the palm. Before morning, in order that the women should see no living relic of Jurupary, the men cut down the tree, and fashioned of it the first sacred pipes and other implements. The sound of them, when properly prepared, is his voice. When living on earth, he dressed in a monkey's skin: therefore the sacred mantle (to see which is death for any female) is made of monkey-skins (hence its name 'macacaraua'), and is the especial symbol of Jurupary. At first the women sounded the paxiuba and evoked the god; but one day he pursued a priestess and deprived her of the insignia of office, and ever since, death by poison in this world, and the nethermost hell in the other, has been the portion of the unfortunate woman, who, willingly or otherwise, set eyes on the insignia of the priesthood. All these events are inscribed at large on the stones of Arapapa, at Papuri.

After this time the god revealed through the shamans his regulations for the solemn exercise of his religion in feasts and flagellations, fasts and dances. The sacred mantle is made of monkey skin or hair, mixed with the hair of young girls, woven with a particular fibre. It is without sleeves, and reaches to the waist. A truncate-conical hood, with eye and mouth holes, serves as a mask. It is surmounted by a coronet of feathers, and diversely ornamented. The sacred garment is securely hidden in the shamanic repository. A profane or secular robe, sometimes called by the same name, consists of a tunic of fantastically colored bark surmounted by a casque attached at the neck. These are common, but of the other only one or two are in existence in any single community.

The paxiubas are six feet long, four inches in diameter, hollow, with a lateral aperture surrounded with leaves, which rustle when the instrument is blown through. They are painted black, and the sound they emit resembles the roaring of a bull. They are not held so important as the mantle, being kept in running water near the village, where the women must often see them. This is not spoken of, and the shamans ignore it if they chance to know it. But the sentence of death is formal on any woman who sees the mantle. The shamans administer 'taya,' which infallibly kills the culprit, either directly or within a few weeks, or even months, a point under the control of the poisoner. Naturally the Uapé women regard Jurupary and his mantle with becoming terror, which centres about the celebrations called 'dabucuri,' at which the mantle is exhibited to the males of the community.

These occasions are prepared for by a fast of two or three days. There are six dabucuri in the year, each determined by the ripening of a certain fruit, of which an intoxicating drink is made. They come in January, February, March, May, July, and November. The ceremonies last three days, and people come from fifty miles around to attend.

The time come, the adults paint themselves with black and red, and sing monotonous and dismal chants ; and the shamans perform, for those desiring such service, the marriage rites, which seem to much resemble the civil rites of European marriage.

Later all the women are sent into the forest, and watched by a keeper. At the end of an hour, after the paxiuba has been sounded by men in festal attire, two or three shamans dressed as Jurupary, and covered with the sacred mantle, with thumbs and two toes on each foot hidden, the other fingers and toes fitted with long claws like the legendary god, appear in the feast-house, jumping on all fours, and striking with a stick, right and left, blows on the spectators, which are not returned. All this takes place in perfect silence, and terminates by the disappearance of the shamans. After sounding the paxiuba for a quarter of an hour, the women are recalled. All carry rods, with which the men and women whip each other. If a white man arrives, he may be admitted provided he will consent to receive a few blows, which he may afterward return with usury. After the flagellation, the women form concentric circles, and the men a large circle, each with the right hand on the shoulder of the one in front of him. Each dancer has a shrill flute, which he sounds, and moves up and down, right and left, by action of the lips. They move with measured step, at first slowly, afterward according to their state of excitement. The dancers drink the intoxicating beverage prepared for the occasion, and soon begin to jump, gesticulate, and act as if possessed by some frenzy ; the shamans calling on Jurupary to present himself, which, through them, he excuses himself from doing on the ground that the women would become changed into, or would give birth to, serpents. The dress of the dancers is at first as usual ; but, as the saturnalia progresses, it is gradually dropped as incommodious. Promiscuous intercourse between the sexes follows, with intervals of flagellation and inebriety, until exhaustion or daylight closes the performance for the time.

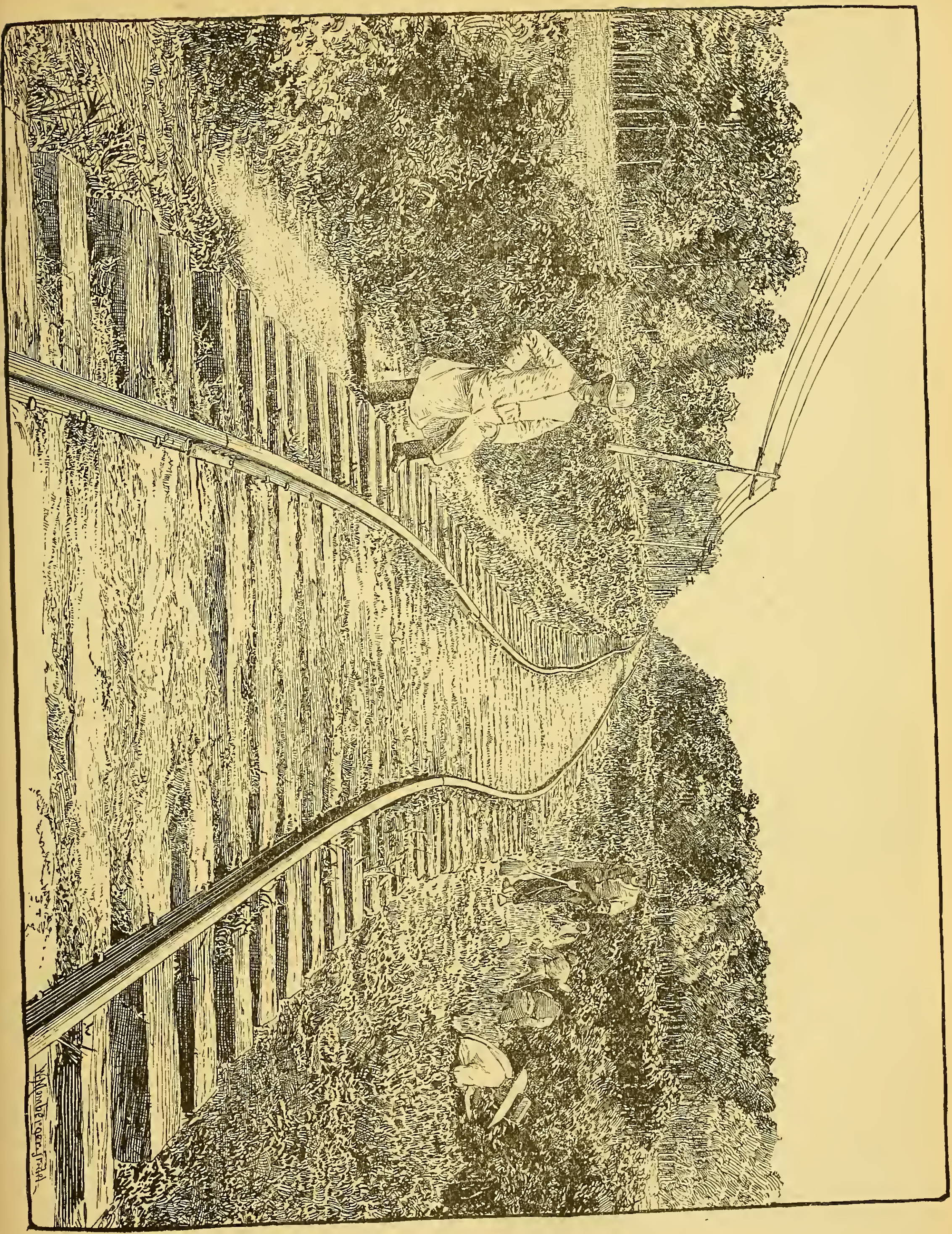
These horrible orgies are supposed to have been directed and planned by Jurupary himself, and to represent the character of the heaven to which his faithful devotees will be translated after death. The fasts by which they are preceded are rigid and painful, well adapted to produce halluncinations and visions. Men who have adored the god will reach him after death : those who have not will lose themselves on the long and difficult way. Halfway is the abode of Bishiu, an inferior spirit, where are detained the souls of those women who have unintentionally gazed upon the sacred mantle, — a sort of purgatory, — or, according to others, they are turned into serpents or caimans. There is also an ill-defined inferno at the bottom of the earth, where the worst people bring up, after being lost on the way to heaven. Here they suffer frightfully, and are controlled by a sort of demon.

Although Coudreau rejects the idea of a civilized origin for these myths and practices, it must be allowed that there is a decided flavor of mediaeval Europe in the virgin mother of the god, the sacrifice of the god himself by men, the purgatory, hell, and heaven, and even in the fasts and flagellations. It is much what might be expected from the reception at a distant period of some ill-understood and misconceived notions of Christianity, befouled, modified, and mixed with native myth ; especially if we suppose that the reception of the original attempt at instruction was separated from the present time, as it must have been, if there were such, by a long period of non-intercourse with missionaries or civilization. This seems to us the most natural explanation of an isolated development, such as these myths are represented to be ; and as such it would form a most interesting chapter in the history of the evolution of religions.

ANOTHER FEATURE OF THE RECENT EARTHQUAKE.

SOME remarkable features of the recent earthquake on our southern seaboard were illustrated and described in *Science* of Sept. 24. Through the kindness of the *Railroad gazette* we are enabled to present a view of the effect of the same earthquake upon a section of railroad-track. The view is an exact reproduction of a photograph taken near Ten-Mile Hill, on the South Carolina railroad, after the earthquake of Aug. 31.

According to the statements of persons familiar



with the locality, the track at the point shown was previously straight and level: the sharp double curve in the foreground, and the abrupt change of grade in the middle distance, being wholly due to the sudden movement of the earth's surface. A press despatch from Charleston on Sept. 2, in relation to a railroad accident at a point near that shown in the engraving, states, that, at the moment the shock was felt, it seemed to those on the train that the earth had suddenly given way; that the train plunged with frightful velocity down a steep declivity, was then raised by a terrestrial undulation, and, having reached the top of the wave, was hurled down an embankment by a sudden swerving of the earth to the right and left.

In many places along the lines of the railroads near the centre of disturbance, the track had the appearance of having been alternately raised and depressed, like a line of frozen waves. The movement of the earth had also been from east to west, bending the tracks in reverse curves, many of the curves taking the shape of a single, others of a double letter S.

A train near Jedburg was running along at the usual speed, at the time of the earthquake, when it suddenly seemed to leave the track and go up into the air. This was the upward wave. It descended with equal suddenness, and as it came down it was flung violently over to the east, the wheels apparently being raised some distance from the rail on the west side of the track. Then there was a reflex action: the train righted, and was hurled violently to the west, finally subsiding to the track and taking a downward plunge, evidently the descending wave. It was afterwards found that the train had passed over one of these serpentine curves with undulating surface, and very probably at the instant the movement of the earth was taking place.

THE TIMBER OF THE ENGLISH COLONIES.

ON Oct. 8 a large number of colonial visitors, together with some of the leading civil engineers, builders, timber merchants, and others interested in the employment of timber, assembled by invitation at the Chelsea works of Messrs. A. Ransome & Co., London, in order to witness a series of practical experiments with different varieties of colonial timber at present commercially unknown in England.

After the experiments, which were conducted with more than forty different varieties of timber from India and the colonies, and comprised tree-felling, cross-cutting, sawing, planing, moulding, morticing, tenoning, and boring, while the manufacture of such things as casks, doors, pick-handles, carriage-spokes, and railway-sleepers, was carried to its completion, and the articles exhibited to the assembled guests, Mr. Allan Ransome opened the proceedings by announcing the conclusions at which the recent experiments had enabled him to arrive in respect to the qualities of the different varieties of colonial timber submitted to his notice. He said, that, among the forty different species, some stood out as pre-eminently suitable for the English market. There were iron bark and mountain ash, from New South Wales, both suitable for wheelwrights' work, and the former, owing to its peculiar hardness, for piles and railway-sleepers as well; black-wood, from Victoria, suitable for carriage-building, cabinet-work, and case-making; Karri-wood and Jarrah, from western Australia, both useful for joiners' work, sleepers, furniture, and piles, of which he could say that there was no fault to be found; black-pine, red-pine, totara, and kauri, from New Zealand, which could be employed for furniture, cabinet-work, house-building, and general purposes, kauri being especially useful; Douglas fir and the swamp ash, from Canada, both suitable for building, joiners' work, etc., the latter being particularly sound, strong, tough, and cheap; yellow-wood, stink-wood, and sneeze-wood, from the Cape of Good Hope, the two former species suitable for furniture, building, and joiners' work, and the latter, from its unusual durability, for piles, posts, telegraph-poles, etc.; Billian and Serayah, from British North Borneo, the former suitable for beams, piles, and every purpose where durability was necessary, and the latter for furniture, veneers, etc.; and, lastly, Padouk-wood, from India, which was suitable for joinery, carriage-building, and furniture, was exceedingly plentiful, and was grown near the coast. Many samples of wood sent had unfortunately been too small for experiment; but of those operated upon he could say that they had all been found suitable, so far as quality was concerned, for their various purposes.

The Hon. Malcolm Frazer (western Australia) said, that, of the Karri and Jarrah timbers, there was a considerable supply in London at the present moment. Large quantities of several hundred loads of these species might be obtained at £7 per load, or in smaller quantities at a slightly higher price. Their cost was only half that of teak.

Prof. P. L. Simmonds (New Zealand) said that New Zealand produced a vast number of ornamental woods, as well as many useful ones. In the latter line, however, the colonists of New Zealand would not be able to compete with other colonies in the home market, partly because of the local demand for their woods, and partly because the cost of carriage would be too great.

Professor Macoum (Canada) said that the reason the English merchant knew so few of the Canadian timbers was the natural indisposition existing in both countries to take a new departure from old habits. The Douglas fir of Canada was fully equal to the white-pine now employed, and when the supplies of the latter were exhausted, the former would of necessity take its place. The Douglas fir grew in vast quantities, attained a great height, and tapered very gradually. In their black-ash, too, the Canadians possessed a species of timber which would some day be very widely employed, for it had all the qualities of the now favorite white-ash, and its supply was unlimited. The Douglas fir could be supplied in England at £5 a load, and the black-ash at the same price as elm or white-pine.

Mr. E. A. Cooper (the Cape) said that the umzumbit of that colony was, from its remarkable hardness and durability, a very desirable wood, offering more resistance to wear and tear than lignum vitae itself, and being impervious to the attacks of the teredos. The Cape yellow-wood could be supplied as cheaply as any, the price being about £6 10s. a load. The stink-wood, however, which was very useful for furniture, could not find a market here, owing to the high prices it commanded in the colony; namely, 3s. to 4s. a cube.

Mr. Alfred Dent (British North Borneo) said that the Billian of that country offered great attractions to the English merchant. It grew in enormous quantities, was very easy of access, and exceedingly hard and durable. Companies were wanted to undertake the supply of the wood in large quantities, at present an impossibility. As to the cost of the wood, he remarked that one firm already was prepared to supply it alongsideship at £3 10s. per ton, a price which freightage, etc., would probably increase by about fifty per cent. But competition would, no doubt, reduce these charges considerably.

THE PEOPLE ON THE KONGO.

Walcke, on his return from five years on the Kongo, has given some interesting details in regard to the people of its banks. Those of the lower river have been brutalized by the importation of liquor, and form a strong contrast with the people of the interior, who have so far escaped such demoralization. On the upper river the Bassunde are the first people who dress their hair. It is noted that those tribes who neglect their hair are deficient in physical and moral qualities. With the Bassunde it takes several hours to perform the toilet. They are polygamous, the wives living in pairs in little huts grouped around the principal house, where the head of the family resides. Marriage is simply a matter of bargain and sale. The number of wives in some sort gauges the importance of the husband. They have no ceremony in connection with marriage or birth, but a funeral is the occasion of much display. It is fortunate for the traders that these people, who wear hardly any thing but a breech-clout in life, when dead consume immense quantities of cloth. A man who has not worn twenty yards of cloth in his whole life will be rolled in four hundred yards to be buried.

When a death occurs, the body is energetically washed, half the village joining in the work with loud cries and howls, and distribution of rum. The body is put in a sitting posture, and painted red. The chief depressions are then stuffed out with dead leaves, and the whole is rolled with cloth into a cylindrical bale. The process goes on sometimes for three months, as the body is not put under ground until all the dead man's estate is exhausted in the purchase of material. Meanwhile it is placed in a specially constructed hut. The bigger the bale, the greater the dead man's credit; so that, in case of a chief, the people of the village will sometimes contribute to enlarge his wrappings. Finally the bale is wrapped in a particularly fine piece reserved for the purpose, and is carried in triumph about the village, and then buried with salvos of musketry, which, if the powder holds out, are repeated nightly over the grave for some time. As usual among the negroes, the death is always ascribed to sorcery, any one suspected being obliged to undergo the ordeal of drinking a certain preparation. If within a certain time the suspect is overcome by the effects of the draught, he is put to death as a murderer. The cult of the people is pure fetichism: they have a fetich for each sort of danger to which they may be by chance exposed, — one for serpents, one for crocodiles, etc. A native, being told that he must be happy at being safe from crocodiles, replied, 'Not at all: the fetich loses its power when brought near water.' They appear to serve merely as a sort of reminder what dangers are to be avoided.

They have certain medicaments which are of real efficacy, as against fevers, but will not reveal their nature: for the rest, diseases are treated by conjuration. Circumcision and excision of the clitoris are practised, and admit the patient to the privileges of maturity, as one of the tribe. They are performed with a good deal of ceremony. If by any chance either operation is not performed, the individual could not obtain a partner in marriage, and would be avoided as uncanny. Besides individual fetiches, there are those which belong to the village. If by any means a European is robbed, he goes to the chief and gets him to beat or abuse the village fetich, which can usually be accomplished by diplomacy. The fetich is accordingly ceremoniously beaten: and the culprit, fearing retribution, soon finds means to return the spoil, and thus avert the wrath of the fetich, which might otherwise be visited on himself. They have also an ill-defined belief in some power of which the fetiches are merely the servants. This is called 'zambic,' but is supposed to be above any personal interest in human affairs.

The trade in ivory is the principal business, and is carried on chiefly by the Bateke as intermediaries between the interior and river tribes. The Batekes are not agriculturalists, but the division of labor between the sexes is more even than between those of the other peoples. Another race is found along the banks, who cultivate the soil, and furnish the Bateke with provisions in trade. These are the Bonbundos. Their habits are much like the other tribes. The Buenses are especially navigators, and make long canoe voyages in search of ivory. The Bangalas are cannibals, and wear ornaments of human phalanges. Their victims are always prisoners of war, for whom they go on hunting expeditions. From Bengala to Buensé, the most interior point reached by the traders, the most numerous tribe is the Basuco. Most of the tribes mentioned wear more or less clothing, at least a waistclout; but among the Basucos only the men wear any thing. They have the practice of human sacrifices. A certain number of slaves are designated to be put to death at the obsequies of any chief. The idea seems to be that their fidelity for life is thus insured, since their own life depends on that of the master.

The traders do their best, and to some extent have succeeded in ameliorating these customs. Progress is pacific, and force never resorted to. The friendship of the blacks is necessary for the maintenance of their business. The negro is lazy and childish; but, treated with fairness, he does the work required of him, and which would be impossible for whites to perform in that climate. Two hundred and eighty-four special agreements have been made with different chiefs, some of whom control only twenty or thirty men. The process is tedious, but each one gained over is one friend more for the trader, and they cannot be dispensed with.

EVOLUTION VERSUS INVOLUTION.

THE growing acceptance of the theory of evolution has led in the last few years to the publication of a large number of books upon the subject, of a more or less popular nature. These are not, as a rule, scientific arguments, for science no longer considers it worth while to discuss a question now so universally accepted. From various stand-points the subject is treated. Now we find a review of its scientific aspects, now of its relation to theology, and now of its metaphysical content. The present book has three objects: it is "a popular exposition of the doctrines of true evolution, a refutation of the theories of Herbert Spencer, and a vindication of theism." In pursuance of the first object, the author gives us an historical review of the question from the time of the Greek philosophers, and then very cursorily reviews the application of the general theory to the development of worlds, of life, of the organic kingdoms, of mind and soul, and of society in its various phases. In this brief summary the evolution theory is accepted in its fullest extent as applying universally. The review is a very hurried one, however, only touching upon a few of the salient points, and recognizing no difficulties in the way of the onward tendency of thought. It would, indeed, hardly give one who was not already acquainted with the subject a very comprehensive idea of the theory of evolution, or the reasons for accepting it. In some parts it is somewhat strained; as, for instance, where a detailed comparison is drawn between the vertebrates, the mollusks and annulosa, the coelenterata, the sponges and protozoa, on the one hand, and the exogens, the endogens, the acrogens, and the fungi and lichens, on the other.

This part of the book, however, though taking up the most space, is secondary to the other two objects running through the whole; viz., the vindication of theism, and the refutation of Spencer. As a vindication of theism, the book is an illustration of the growing conception that evolution is not at all out of harmony with theism. The question of evolution is one which deals entirely with secondary causes, and even Spencer's theory does not attempt to fathom the first cause; while theism deals primarily with first cause. It is fortunate for true science and true theism that this is becoming so fully recognized, — for science, because it removes the feeling of hostility which has been accustomed to be raised in the minds of most people by the simple word 'evolution;' for theism, because it no longer makes it necessary to try to disprove this growing theory of science.

Evolution versus involution. By A. Z. REED. New York, *Pott*, 1885. 8°.

That there is no contradiction between theism and evolution our author clearly shows. But he goes even further than this, and claims to prove that evolution is radically inconsistent with atheism. He thinks that the two thoughts, when carried to legitimate extremes, lead to suicidal contradictions; leading, in fact, to the extremes of Comptism, and its necessary worship of human nature as the loftiest thing in existence. Now, whatever may be said of this discussion, it is plain that the reader's judgment of this part of the work will depend largely upon his willingness to accept the conclusion. If he reads with a predisposition against the conclusion, the whole argument will be regarded with the same indifference as are all other arguments which try to prove the existence of God. But if he reads, accepting the conclusion, and wishing to find a justification for a belief in theism, he will be abundantly satisfied; for the arguments are keen and forcible, and plainly show that theism is exalted by the conceptions of evolution.

In his attempt to refute Spencer, our author has not been quite so successful. To refute such a system of philosophy as that of Spencer is as difficult as to demonstrate it. It may be easy to criticise Spencer, to show his false deductions and an amount of inconsistency in his writings. This our author has succeeded in doing well enough. But to refute his philosophy is a different matter. An examination of this criticism shows that it is chiefly upon Spencer's ideas of primal cause, and therefore upon his conception of the significance of law, and not at all upon his theory as to the development of the visible universe. Our author first shows that Spencer's philosophy is one of involution, and not evolution, — a fact which Spencer himself recognized. Our author gives a definition of evolution which completely reverses that of Spencer. He makes it a passage from the complex to the simple, rather than from the simple to the complex. What he means by this is not that nature has not seemed to grow more complex, but that this growth has been only the unfolding of forces and tendencies which have existed from the beginning. Evolution is therefore a revealing of that which is hidden, and is thus really a simplification. An egg is more complex than the adult, since, though seemingly simple, it contains in a small space, in addition to that which we can see, forces and tendencies which regulate the growth of the adult. Its development is simply the unfolding of this potentiality. And so the original nebula was really infinitely complex, since it contained in its laws and tendencies the possibility of the system which has arisen from it. This, our author claims, is in direct contradiction to Spencer's philosophy of a passage from the simple to the complex, and this philosophy is therefore false at its foundation. It is a restatement of the old saying that evolution cannot exceed involution. Now, in reality, our author and Spencer do not disagree so much as at first seems. Spencer has only attempted to explain the visible universe by his philosophy, recognizing his inability to explain or comprehend law. In the visible universe there has undoubtedly been an increase in complexity. Spencer would not for an instant deny that the original nebula contained in its laws and tendencies the potential system. The difference between our author and Spencer is thus only in their metaphysical conception of the significance of these laws and their relation to the first cause which lies beneath them. It is the difference between theism and agnosticism again. Spencer regards the universe as without design: our author regards the working of law as the unfolding of a plan. Spencer looks upon the seeming design in nature as resulting from the natural working of law, without attempting to go beneath this statement: our author goes a step further, and puts the plan in the nature of the laws themselves. These two positions are not necessarily contradictory, though when regarded in certain lights they may be so.

This discussion of Mr. Rred's is therefore valuable as an exposition of the meaning of theistic evolution. It shows that theistic evolution is consistent with all the facts of science, and that the law of evolution, when viewed from the theistic stand-point, contains a significance which is utterly wanting to it when regarded from the stand-point of atheism. But as a refutation of Spencer it is hardly a success; for it has only shown that the conception of Spencer's Unknowable as an intelligent personality is preferable to the agnostic position of Spencer.

TWO SCHOOL-BOOKS ON GEOLOGY.

THERE can hardly be found a greater contrast in the methods of treatment of a subject than is presented by a comparison of the school-books on geology lately prepared by Professors Geikie and Winchell. The authors seem to have had scholars of about the same high-school age in mind. Their objects are similar, — for one makes 'an appeal to the powers of observation,' and the other wishes 'to foster a habit of observation,' — and yet how different are their paths to this common end! Professor Winchell begins, after advising teachers

Class-book of geology. By ARCHIBALD GEIKIE. London, *Macmillan*, 1886. 8°.

Geological studies; or, Elements of geology. By ALEXANDER WINCHELL. Chicago, *Griggs*, 1886. 8°.

to 'adhere scrupulously to the *method* of the book,' with so complex and difficult a formation as the drift, collects specimens from it, tells a little about chemistry, more about minerals and rocks, describes eruptive rocks before considering eruptions, briefly discusses sedimentation and erosion, describes geological maps and sections, and so on through the first part of his book, the outcome of which may very likely be, as he suggests, "a somewhat chaotic and undigested mass of facts and doctrines, buried in a considerable volume of verbiage." Then follows part ii., attempting to give as a complement to the first a methodical re-presentation of what has already been encountered, but in extremely condensed form. So fundamental a matter as cycles of sedimentation are quickly passed over, with very brief illustration; and even the lesson of unconformability is given little emphasis, although more than four pages are devoted to the recent theories of ancient tides and tidal action. Altogether too much is attempted under the heading of formational geology, considering the small space allowed it: much of this might be omitted to the advantage of the rest, as the book is not intended for a manual. But the greatest difficulty seems to be that the book tries to take the place of the teacher. For example: on p. 128 we read, "You ought to take a great deal of exercise on the geological map, and especially in the construction of sections, no matter if it requires two or three days to finish one study." Any teacher whose instruction needs to be supplemented by such dictation as this can hardly be expected to have ability enough to use and explain the rest of the book properly; and certainly no teacher of independence and originality can wish to have questions of method so minutely defined for him by some one else. In the hands of the author, with the inspiration of his enthusiasm and knowledge before the class, such instructions may serve a purpose; but inspiration in teaching is seldom transmitted through the medium of printer's ink.

The plan of Professor Geikie's book is preferable, because, while it gives a simple, attractive presentation of facts, arranged in a very natural order, it leaves the teacher free, if he desire to arrange a course for himself, to plan his own method on minor points, and gain inspiration with originality; or, on the other hand, it provides chapters that can be read with entertainment and used as bases for set recitations, if the teacher is satisfied, or is obliged merely to follow a book. The physical chapters run about as follows: action of atmosphere and water, effects of lakes and springs, ice and the sea, fossils, volcanoes, and earthquakes. Then come minerals and rocks; rock-structures, original and secondary; and, finally, the historical view, occupying a third of the book. The proportion is somewhat less in Professor Winchell's book: it might be in both still further reduced to the advantage of the class of students addressed, for the first view of historical geology is too much encumbered with meaningless fact to develop thought or to train the understanding. Instead of reviewing in condensed form the whole column from archaean to present, the student would learn more from the deliberate description, illustration, and discussion of a small part of it, which might then serve as a key to the understanding of the rest in later years of study.

The illustrations are, as a rule, better in the English than in the American book, though the latter are good, on the whole. The only bad picture that has Professor Geikie's tacit approval is his fig. 10, that tries to represent torrent-cut gullies on a mountain-side: it has the 'made-to-order' look. The vertical exaggeration allowed in the sections is the most serious defect in the illustration of Professor Winchell's book: it is true that these are generally copied from venerable state reports, and have authoritative names to justify their use, but they are bad, for all that. No proper idea of the geological structure of Tennessee can be gained from the section on p. 93; and the original section across Michigan, p. 126, might well be labored over to bring it somewhat nearer the true scale, no matter if it required two or three days to finish it.

THE annual report of the commissioner of pensions for the fiscal year ending June 30, 1886, shows the vast extent of our pension system. At the close of the year there were on the rolls 365,783 pensioners, of whom 265,854 are classified as army invalids; 80,162 as army widows, minor children, and dependent relatives; 2,953 as navy invalids; 1,878 as navy widows, minor children, and dependent relatives; 1,539 as survivors of the war of 1812; and 13,397 as widows of those who served in that war. 1,406 survivors of the war of 1812, and 3,815 widows of soldiers of that war, died during the year. 40,857 new pensioners were added to the roll during the year, and 2,229 whose pensions had been dropped were re-instated. As 22,089 were dropped for various causes, the net increase was 20,658. The average annual value of each pension is $122.23, and the aggregate annual value amounts to $44,708,041.51. The amount paid during the year, including the arrearages, was $63,797,831.61. In all but 118 of the 2,647 counties in the United States, pensions are being paid, and 1,691 pensions are paid in 35 foreign countries. Verily, republics are not always ungrateful.

SCIENCE.

FRIDAY, NOVEMBER 19, 1886.

COMMENT AND CRITICISM.

OUR RECENT CELEBRATION of the two hundred and fiftieth anniversary of the founding of Harvard college seemed to refer us back to the dim past; but that past seems very recent when we read of the celebration in England of the eight hundredth anniversary of the completion of Domesday book. The celebration took the form of a series of meetings for the inspection of manuscripts and literary productions, and for the reading of papers more or less connected with matters affecting the contents of Domesday book. A great attraction was the exhibition of the volumes themselves that compose the Domesday book. The Record office kindly aided by all means in its power the committee having the celebration in charge, and gathered together in one room a vast number of manuscripts and relics. Among these was a document concerning the number of hides in different districts in England, the date of which, as originally written, is placed in the eighth century. Three Anglo-Saxon manuscripts of the eleventh century were exhibited, which showed the method of ploughing. The papers read discussed the history and fortunes of Domesday book as a volume, and its employment as evidence in the courts. There were also some statistical tables read concerning the contents of the book. It is believed that the Royal historical society will issue a full bibliography of Domesday book, including not only printed portions of the texts and separate papers and essays, but also notices of matter referred to by the record.

BY THE DEATH of M. Paul Bert, which was announced on Friday last, France loses one of her most radical and aggressive statesmen, as well as one of her foremost educators and ablest scientific investigators. However much we may differ from some or all of M. Bert's doctrines, we cannot but admire his power, his vigor, and his enthusiasm. Born in 1833, he received a broad and thorough education, becoming a doctor of medicine in 1863, a doctor of science in 1866, and a licentiate in law about the same time. He was for a time assistant to Claude Bernard, and in 1867 was called to the chair of physiology at Bordeaux. In 1869 he was called to the Sorbonne, and became professor of physiology there. After Napoleon's downfall he entered politics, and, after holding several departmental offices, entered the chamber of deputies in 1874 as a representative for Yonne, his native department. He immediately took a prominent part in the debates, and during the discussion of the Ferry law his voice was raised often and vigorously in behalf of lay instruction, compulsory education laws, and the abolition of all school fees. M. Bert was a great friend and admirer of Gambetta, and when that statesman became premier, in 1881, M. Bert was made minister of public instruction in his cabinet. M. Bert's avowed atheism and vigorous radicalism made him many enemies, and he was in no small degree contributory to the speedy downfall of the Gambetta ministry. M. Bert's best-known writings are 'De la greffe animale' (1863), 'De la vitalité des tissus animaux' (1866), 'Revue des travaux d'anatomie et de physiologie publies en France pendant l'année 1864' (1864), 'Notes d'anatomie et de physiologie comparée' (2 vols., 1867–70), 'Recherches de physiologie experimentale' (1877), — crowned by the French academy, — and 'La morale des Jésuites' (1880). At the time of his death M. Bert was governor-general of Tonquin, and minister to Anam, and much was expected from his able and vigorous administration of the interests of France in the orient.

MR. JAMES RUSSELL LOWELL'S great oration at the Harvard celebration calls for notice more special than that which we were able to give last week. Those who had the privilege of hearing the orator report that he spoke with wonderful grace and elegance for almost two hours, holding his audience spell-bound. The oration is in itself a justification of a classical and literary education, and a living argument for a culture loftier and deeper than that which strictly utilitarian theories would provide. Mr. Lowell perhaps overstates himself, but there is more than a kernel of truth in his definition of a university as "a place where nothing useful is taught; but a university is possible only where a man may get his livelihood by digging Sanscrit roots." Mr. Lowell's generous but just estimate of the vigor, ability, and uprightness of the early Puritans, and his brief but not superficial sketch of the influence of Harvard in the past, will not have escaped the attention of any who have read the oration. Speaking for that class of educated men who, while not behind the times, are not radical, Mr. Lowell uttered some weighty and eloquent words concerning the study of Greek. Speaking of the Greeks, the orator continued, "If their language is dead, yet the literature it enshrines is crammed with life as perhaps no other writing, except Shakspeare's, ever was or will be. It is as contemporary with to-day as with the ears it first enraptured, for it appears, not to the man of then or now, but to the entire round of human nature itself. Men are ephemeral or evanescent; but whatever page the authentic soul of man has touched with her immortalizing finger, no matter how long ago, is still young and fair as it was to the world's gray fathers. Oblivion looks in the face of the Grecian muse only to forget her purpose." Then, too, his description of what a diploma should stand for was exceedingly happy. "Let it [Harvard] continue to give such a training as will fit the rich to be trusted with riches, and the poor to withstand the temptations of poverty. Give to history, give to political economy, the ample verge the times demand, but with no detriment to those liberal arts which have formed open-minded men and good citizens in the past, nor have lost the skill to form them. Let it be our hope to make a gentleman of every youth who is put under our charge, not a conventional gentleman, but a man of culture, a man of intellectual resource, a man of public spirit, a man of refinement, with that good taste which is the conscience of the mind, and that conscience which is the good taste of the soul." In its calm and lofty eloquence, its graceful and pungent diction, the oration was worthy of the occasion that called it forth, and will rank among the masterpieces of American oratory.

NOT TO BE BEHIND the knights of labor, the trades-unionists propose to hold a national council for organization and discussion. The call for the council has been issued to all the trades-unions in the United States and Canada, and the meeting will be held at Columbus, O., on Dec. 8. The basis of representation is to be one delegate from every national or international union of less than four thousand members, two delegates from every union having more than four and less than eight thousand members, and one additional delegate for each additional four thousand members; but no trades-union, not organized for at least three months prior to the session of the convention, can be represented. The call for the meeting sets forth as its objects, establishment of a trades-congress for the formation of trades-unions and the encouragement of the trades-union movement in America; the organization of trades-assemblies, trades-councils, or central labor-unions in every city in America; the founding of state trades-assemblies or state labor-congresses to influence state legislation in the interest of the working masses; the establishment of national and international trades-unions, based upon the strict recognition of the autonomy of each trade, and the promotion and advancement of such bodies; an American federation or alliance of all national and international trades-unions, to aid and assist each other, to secure national legislation in the interest of the working people, and to influence public opinion by peaceful and legal methods in favor of organized labor; to aid and encourage the labor press of America, and to disseminate tracts and literature on the labor movement.

DR. J. E. WINTERS of New York, in a paper read before the Academy of medicine, condemned in no mild way the practice, now so common among society women, of employing wet-nurses instead of themselves performing the duties of a mother. He proves most satisfactorily that the practice is not only demoralizing, but actually increases the mortality among infants, and is often the channel through which diseases of a most loathsome nature are contracted. Dr. Winters informs us that Queen Victoria was nursed by her mother, the Duchess of Kent, and in her turn has performed the same office for her nine children. The lives of nine-tenths of the wet-nursed children are purchased at the expense of the lives of other children. The practice, therefore, of placing children to dry-nurse, either in families or institutions, in order that the mother may go as wet-nurse, he regards as iniquitous. He sums up his argument in the following language: "Briefly, then, we usually select a hireling to perform the mother's most sacred duty; one who occupies the lowest place in the social scale, and in whom there is an absence of moral qualities; usually one who has been, in some degree at least, a prostitute; one who can forsake her own child, and take a stranger's to her breast; one who can witness the gradual starvation and death of her own child, and who may be a double murderess by poisoning her foster-child with opiates or alcohol. If, after being nourished from such a fountain, our child is perverse, froward, insolent, and has no regard for truth, who is accountable? Is not the mother, who deprived him of her own pure, untainted breast, and who purchased for him instead a polluted and debauched stream?" It is lamentable that a system so pernicious and injurious to the best interests of society should be tolerated, and even encouraged, by the most eminent and honorable members of the medical profession. Dr. Winters deserves the thanks of all right-minded persons for the able and convincing manner in which he puts his arguments, and it is to be hoped, that, attention having been thus directed to what may be regarded as a great and growing evil, this abominable practice which he so justly condemns may be, to some degree at least, mitigated and lessened.

IT APPEARS TO US that the New York county medical society, in its efforts to prevent quackery, is in danger of estranging many members of the medical profession who have thus far given it their cordial support. The law of 1880, requiring the registration of physicians in the office of the clerk of the county in which they intend to practise, would not have been enacted without such opposition as would in our judgment have been fatal, had it been known that regular physicians, whose professional attainments were unquestioned, would be arrested and imprisoned, if, having registered in one county in the state, they should commence practice in another county without registering again. And yet this has been done in the case of a regular graduate of medicine, who, having practised for eight years in Richmond county, removed to New York City, and entered practice there, neglecting to register his name anew. It is absurd as a matter of common sense that registration in one county should not be sufficient, rather than that a man should be required to register in all the counties of the state if he desired to practise in them; and, as appears from an unwritten opinion given by two judges of the supreme court of this state, it is equally absurd as a matter of law. As a matter of fact, the practice seems to vary in the different counties, the clerk of Kings county refusing to allow the re-registration of a physician who is already registered elsewhere in the state. In the case to which we refer, where a physician was prosecuted by the county society, we understand he has brought a suit against the counsel of the society who caused his arrest, for damages.

THE STATISTICS RELATING to the defective, dependent, and delinquent classes collected in the tenth United States census, and prepared for publication by Mr. F. H. Wines, editor of the *International record of charities and correction*, have been ready for the press for more than two years. But the reduction of the clerical force of the census bureau seemed to postpone their publication indefinitely. Senator Cullom of Illinois, however, came to the rescue, and on his motion the senate called for them, and ordered them printed as a senate document. It is hoped that they will be given to the public early in 1887. This suggests the reflection that the newly elected congress will probably be the one which will have to make provision for the taking of the eleventh census, and it is not businesslike to have the publications of one census stringing along in a go-as-you-please way until the time for the next census comes round.

WE HAD OCCASION, in a recent number of *Science* (p. 433), to refer to a new treatment for consumption, consisting in the inhalation of bacteria in the form of spray. Another method of treatment which is now attracting the attention of physicians is by injecting remedies directly into the lungs by means of the hypodermic syringe, the needle of which is passed through the wall of the chest, the effort being made to apply the medicinal agent as nearly as possible to the affected portion of the lungs. Some very encouraging cases are reported, in some of which the improvement has been so great as almost to justify one in speaking of them as cures. Carbolized iodine appears to have produced the best results, causing the complete cessation of cough and expectoration, and the further progress of the disease.

A CIRCULAR ISSUED by the chief signal officer, under date of Nov. 10, announces that on March 1, 1887, a new system of weather-signals will be adopted for general use at local and volunteer display stations. The new system is based on the one in use in Alabama, and designed by Professor Mell, director of the Alabama weather-service: it is of four flags, — a square white flag, for clear or fair weather; a square blue flag, for rain or snow;

a triangular black flag, for temperature, to be hoisted above the other flag for higher temperature, below for lower temperature; and a square white flag, with square black centre, for a cold wave, as at present. When suspended from a horizontal pole or rope, a small white streamer will be used to indicate the end from which the flags are to be read. This system of signals is superior to the Ohio system, — red and blue, sun, star, moon, — now in general use, by reason of its simplicity, visibility, and cheapness; and the absence of red among its colors removes the objection that many railway managers have felt to the display of the other signals on the sides of cars.

THE FALL MEETING OF THE NATIONAL ACADEMY.

THE semi-annual meeting of the National academy of sciences was held Nov. 9–11, 1886, in Boston. By the kindness of the Massachusetts institute of technology, the academy was accommodated in its spacious buildings on Boylston Street. More than half the members of the academy were present, the number being larger than usual, owing to the interest taken by many in the two hundred and fiftieth celebration of the founding of Harvard college, which event was celebrated on the preceding days. The only business of general interest related to the publication of the annual volumes of memoirs. The president announced that the text of vol. iii. was nearly all printed, and that authors are cautioned to see that the manuscript and illustrations are always in proper shape, and complete for the printer when handed in to congress early in December of each year, as otherwise they are likely to be rejected. Of the scientific papers read, a full list of which is given on another page, we note the following: —

S. P. Langley, in a paper on 'The solar-lunar spectrum,' stated that for some years past we have suspected, but never actually been able to demonstrate, the existence of radiations from the sun of wave-lengths greater than three microns, and have been in doubt whether our atmosphere had entirely absorbed these if they really existed, or whether they were absorbed already in the sun's atmosphere and never reached ours at all. He has during the last year shown that the former hypothesis is more probable, and that the trouble lay partly in the fact that the terrestrial absorption here was almost total; partly in the apparatus, wherein diffused solar radiation of shorter wave-lengths entirely obscured the almost infinitely feeble portion of these longer waves, which our atmosphere had in fact transmitted. By the use of very perfect rock-salt trains, and by an elaborate device for sifting out extraneous radiations, he has now been able to show the existence of certain of the longer solar waves, even down to the extreme length of seventeen microns, to which waves lamp-black is as transparent as glass is to the shorter or light waves. This selective absorption of lamp-black has been before surmised, but its existence to this degree is a new fact. On examining the radiation of the moon, Langley finds, in spite of the feeble heat, some of these long waves more easily distinguished than in solar radiation, owing to the fact that in the case of the moon, whose radiation, he observes, is mainly dark heat of these very great wave-lengths, he is not troubled with the enormous disturbances due to the diffusion of the intense shorter waves in the case of the sun. He states then that there is found, by the aid of the rock-salt trains, a minute amount of solar heat between three and five microns, below which the cold bands which have been growing closer and closer, and letting less and less heat between them, practically coalesce into one almost unlimited cold band, extending to eleven microns; and that probably the earth's atmosphere absorbs practically all the solar radiation between five and eleven microns, and, indeed, beyond; except that there is one band of most feeble transmission from this point to about sixteen microns. This transmission is here so feeble that the energy of the strongest radiations in this latter part of the normal spectrum is less than one one-thousandth of that in the visible region, and the total radiation here even less in proportion to that in regions already known.

These new researches, then, while enlarging the extent to which the solar infra-red spectrum has been examined, to the great probable length of over seventeen microns, and while confirming the previously announced fact that almost no solar heat reaches us in this region, are chiefly interesting in their bearing on the question of the transmissibility of our atmosphere, and as showing that its apparent action in allowing lunar heat to pass where no solar heat was found is consistent with the possible existence of the latter, outside our atmosphere, of every wave-length. Professor Langley's researches on lunar heat are not completed, but he announced the conclusion as probable that the temperature of the moon's sunlit surface is neither as high as assumed by Lord Rosse nor as low as he himself was once inclined to think, and probably may be little higher than that of melting ice.

T. Sterry Hunt read a paper on 'A basis for chemistry.' Herein he resumed the conclusions of a series of papers on chemical philosophy from 1848 to 1886. He defined chemical changes as interpretation or differentiation resulting in new species; distinguished in the chemical process metagenesis and metamorphosis, the latter embracing homogeneous changes only; sought to define the limits between chemistry and dynamics, and to exclude the atomic hypothesis from the former; discussed the genesis of chemical species from a primal element; maintained that not only solution but fusion, solidification, volatilization, and condensation are chemical processes, liquid and solid species being polymers of their respective vapors; and showed that the law of homologous or progressive series extends to mineral species, as oxides and silicates, which are not only of high equivalent weights and complex formulas, but are polymers whose degree of condensation it is possible to fix. The values got by dividing the received equivalents (hydrogen being unity) by the density (water being unity) represent, not the volumes of molecules, but the contraction in passing from the gaseous to the solid or liquid state, being the reciprocals of the coefficients of condensation. Water, whose density at +4° is 1.000 (being formed by the condensation of 1,628 volumes of steam at 100°, with an equivalent weight of 17.9633, to a single volume at the same temperature), has itself an equivalent weight of 29.244 instead of 29.304 (which corresponds to $H_2O = 18$), as given by the author in *Science* for Sept. 10, 1886. From this figure the equivalent weights of all spheres whose specific gravities are known may be calculated; the law of volumes being universal, and extending alike to gases and vapors, to liquids and solids.

F. W. Putnam, in a paper on 'Archeological explorations in the Little Miami valley,' illustrated by elaborate drawings and photographs, showed that the exhaustive method adopted during the past five years is the only one that can possibly give results of any value relative to the early occupants of this continent. Professor Putnam's researches show that there have been at least two types of people, — first, those whose graves are the so-called ash-pits; second, those who built great mounds over the remains of their chiefs and great leaders, while the mass of the common people were buried in trenches lately discovered by him. Both these occupied the central regions, and were spreading northward when they were met and overthrown by the Indian races of modern times, who have spread from east to west. Professor Putnam's paper was but a small selection from the large volume now preparing by him.

E. C. Pickering read a paper on the 'Draper memorial photographs,' in which he stated that photographs of the spectra of the stars had been studied by himself first with a small telescope, the exposures lasting generally five minutes, next with a larger telescope, and finally with the magnificent eleven-inch glass belonging to Dr. Draper, and loaned by his widow, in front of which are placed two wedges or prisms of glass eleven inches square, and whose construction must be considered as the greatest triumph hitherto attained by the opticians. With this latter apparatus, which has now been in operation only a few weeks, photographs of the stellar spectra have been made by exposures of from five minutes up to one hour. The bright and dark lines in these photographs, as shown by high magnifying powers, are to be counted by hundreds testifying to the wonderful perfection of the optician's work, and give us for the first time assurance that the problem of the movement of the fixed stars to and from the earth can now be attacked with hopes of success. By means of the lantern, Professor Pickering showed upon the screen the result of some of his most recent photographs, among them the entire group of the Pleiades, in which the agreement among the spectra of certain stars strongly confirmed the results announced by Dr. Elkins as to their physical connection.

C. Abbe, in a paper on 'The question of barometer exposure,' stated that the influence of the wind upon the barometer is not a new question, but has long since been recognized as an important matter. Its actual treatment had, however, been so difficult as to lead to its neglect. This is one of a series of difficult questions in aerodynamics which are intimately connected with each other. For instance: the rain-gauge is an obstacle to the wind; the currents about its mouth deflect the rain; the proper gauge must be so constructed that there shall be no currents about its mouth; the best gauge has the least deflection. On the other hand, a cowl on a chimney-top to increase the draught or ventilation is an obstacle to the wind, so arranged that it shall give the greatest disturbance: its province is to diminish the static pressure at the top of the chimney, and allow the static pressure in the room below to push the air upward. Elaborate experiments on this subject were made in Boston in 1848, and the apparatus is still preserved by the chairman of the committee, Dr. Morrill Wyman: illustrations of their results were given by the author. The problem of measuring the force of the wind is very distinct from that of measuring the velocity, since the force varies with the shape of the obstacle and its size. Illustrations of various apparatus and results were given. If now a barometer could be carried along with the wind, it would indicate the static pressure within that mass of moving air; but as soon as the barometer is fixed, it, or the building within which it is contained, becomes an obstacle, and a dynamic effect is added to the static pressure. A barometer on the windward side of an obstacle gives too high, and on the leeward side too low, a result. Our only practicable method of determining the static pressure is to measure these two compound results relative to any obstacle, and then from theory or experiment obtain a third relation between the two dynamic effects, whence by elimination we find the separate items. The author showed the application of this idea to the apparatus of Pitot, Darcy, Arson, and, further, that the simplest solution consisted in exposing a sphere as the obstacle, and measuring the pressures shown by barometers that are connected by small tubes with the windward and leeward sides of the sphere, the sphere being chosen as one of the few bodies whose stream lines have been satisfactorily determined by mathematical analysis.

Alfred Russell Wallace read a paper on 'The wind as a seed-carrier,' in which he stated that he would by request submit some ideas and ask for data in relation to the ability of the winds, to explain the known distribution of plants. He stated that a large number of arctic plants are now widely distributed throughout the southern and northern hemispheres, so that plants living in New Zealand, Australia, and extreme southern America, are nearly identical with those in high northern latitudes, as also with those found on the high mountains of temperate zones. These occurrences might be explained by the glacial epoch, as Darwin suggested, but that no such glacial epoch is known to have occurred in the torrid zone. His own studies on the fauna of the islands of the ocean had shown that a single occurrence, under favorable auspices, could explain the introduction of a new species in any out-of-the-way place, as illustrated by transfers of seed by sea-currents, by birds in various ways, by human agencies, and especially by the wind. Strong winds carry the heavier seeds short distances, and drop them, to be lifted up and carried again on some future occasion; but the lighter seeds, when once elevated, fall so slowly that even a moderate wind will carry them to great distances. In this way the arctic fauna may be easily transferred toward the torrid zone, and possibly an occasional storm (even one in a century will suffice) may transfer the seeds across the equator, so as to initiate the spread of the same species in the southern hemisphere.

THE HARVARD CELEBRATION.

Two hundred and fifty years ago on the 7th of November, 1636 (new style), the great and general court of the Massachusetts Bay colony agreed to give four hundred pounds towards a college or school. That vote was the founding of Harvard university,— a foundation which was, to use Mr. Lowell's words, "a quite unexampled thing." "Surely," he added, "never were the bases of such a structure as this has become, and was meant to be, laid by a community of men so poor, in circumstances so unprecedented, and under what seemed such sullen and averted stars. . . . The prevision of those men must have been as clear as their faith was steadfast. Well they knew and had laid to heart the wise man's precept, 'Take fast hold of instruction; let her not go, for she is thy life.'"

The anniversary exercises began on Friday, when the law school alumni listened to an address from Oliver Wendell Holmes the younger, and then dined together. Saturday was devoted to the undergraduates, — literary exercises and a boat-race in the morning, with a foot-ball game in the afternoon. The torch-light procession assigned for the evening of this day was postponed to the following Monday. Sunday the true anniversary of the foundation was divided between two services in the college chapel, in which Presidents Dwight and McCosh assisted Phillips Brooks and the university pastor, F. G. Peabody. Sandwiched in, as it were, between these sacred services, was a concert by the Boston symphony orchestra.

But Monday was the interesting day, the most notable event of which was the splendid oration delivered by James Russell Lowell, a graduate of and a professor in Harvard college. The theme was one to inspire any orator, and what an audience was gathered to hear him! The alumni were out in force, and filled every nook and corner of Sanders theatre, while on the platform was an assemblage of distinguished men such as one seldom sees. First and foremost among the invited guests was the President of the republic; and the enthusiasm with which Mr. Cleveland was greeted showed that Harvard men appreciate true manliness. With him were Secretaries Bayard, Lamar, and Whitney, while Endicott occupied his chair as a fellow of the corporation. When the conferring of honorary degrees was reached, the name of Lamar was found to be second on the list, and the demonstration which greeted the announcement was very marked. Among educators should be mentioned the delegate from John Harvard's college, Emmanuel, and from his university, Cambridge. In truth, Cambridge was the mother of the New England university, while from Emmanuel came many of the most illustrious of the founders of Massachusetts. College presidents, too, were numerous; among the rest, Dwight of Yale, Gilman of Johns Hopkins, Angell of Ann Arbor, McCosh of Princeton, Adams of Cornell, and the youthful head of old Bowdoin, William De Witt Hyde, of the Harvard class of 1879. The degree of doctor of laws was conferred on most of those who had not already received it, and also on Leidy of Pennsylvania, Charles Deane of Cambridge, and Gildersleeve of Baltimore.

Mr. Lowell's oration contained that happy mixture of wit and scholarly wisdom so essential to an interesting address. As an example of this, was the remark that the college buildings, unlike those of the old country, never looked old, and never would. "Time refuses to console them," he said. "They all look as though they meant business, and nothing more. And it is precisely because this college meant business, — business of the gravest import,— and did that business as thoroughly as it might with no means that were not niggardly, except an abundant purpose to do its best, — it is precisely for this that we are gathered to-day." Further on, after describing the Puritan society of the early time, Mr. Lowell said, "It was a community without charm, or with a homely charm at best, and the life it led was visited by no muse, not even in dream; but it was the stuff out of which fortunate ancestors are made, and twenty-five years ago their sons showed in no diminished measure the qualities of the breed." But the portion that aroused the most enthusiasm was at the close, when he referred to the President of our country. "We have no politics here," he said, "but the sons of Harvard all belong to the party which admires courage, strength of purpose, and fidelity to duty. . . . He has left the helm of state to be with us here; and so long as it is intrusted to his hands, we are sure, that, should the storm come, he will say with Seneca's pilot, 'O Neptune, you may save me if you will, you may sink me if you will; but, whatever happens, I shall keep my rudder true.'" Coming after this oration, Dr. Holmes's poem proved disappointing to many.

In the afternoon the alumni dined in the great hall, and, after satisfying the inner man as well as they could, they listened to more speeches. Especially deserving of remembrance was that of President Angell of the University of Michigan. In brief he declared that all American colleges were indebted to Harvard for "her brave experimentations in college and university problems. . . . Especially under the present vigorous administration, there have been such exhaustive study and such courageous experimenting, that the excitement and stir have reached the remotest country college and the most secluded village academy. . . . This has made an epoch. Never before did the college and the people get so near together. Those who do not accept the doctrines in favor here, and those who do, are alike indebted to you, for we have all been stirred."

While the men were thus passing their time, Mrs. Eliot was introducing Mrs. Cleveland to the ladies of Cambridge. In the evening a public reception was held in the Hemenway gymnasium, and the festival so happily conceived and so admirably conducted was brought to a close. Indeed, perhaps not the least fruitful part of the whole celebration were the social relations which were begun or continued in the hospitable parlors of the college town.

NOTES AND NEWS.

THE semi-annual meeting of the trustees of Princeton college last week was the occasion for the presentation of a report on the state of the college by President McCosh. This year the college has more students than any previous year in its history. Eighty-nine graduates are attending classes, fifty of whom follow Dr. McCosh's lectures on contemporary philosophy. The trustees adopted a scheme similar to that in operation at Amherst and Harvard, by which the students choose a standing committee to represent them in conferences with the faculty. This plan goes into effect at once. The plans of President McCosh looking to the transformation of the college into a thoroughly equipped university were listened to with approval, and referred to a special committee consisting of the standing committee on curriculum and two other members of the board of trustees.

— The following is a complete list of the papers entered to be read before the National sciences academy at the recent session in Boston, Nov. 9–11: S. P. Langley, The solar-lunar spectrum; T. Sterry Hunt, A basis of chemistry; Alpheus Hyatt, Primitive forms of Cephalopoda; Alpheus Hyatt, A case of evolution in the migration of forms; Alpheus Hyatt. Lituites of the limestones of Phillipsburg, Canada; F. W. Putnam, Archeological explorations in the Little Miami valley, Ohio, conducted by F. W. Putnam and C. L. Metz; E. C. Pickering, Draper memorial photographs; E. D. Cope, On lemurine reversion in human dentition; E. D. Cope, On the columella auris of the tailed Batrachia; Edw'd S. Morse, Change in Mya since the pliocene; A. S. Packard, The cave fauna of North America, with remarks on the anatomy and origin of blind forms; C. H. F. Peters, A chart of the stars in the group Praesepe; C. H. F. Peters, A catalogue of stars from positions in various astronomical periodicals; O. T. Sherman, A catalogue of bright lines, observed in the atmosphere of β Lyrae; W. L. Elkin, On the relative motions of the Pleiades group deduced from measurements made with the Königsberg and Yale college heliometers; C. A. Young, Some observations with Pritchard's wedge photometer; C. Abbe, The question of barometer exposure; G. W. Hill, On the construction of new tables of Saturn; R. Pumpelly, On the relation of the Green Mountain rocks to the Taconic; T. Sterry Hunt, Hardness and chemical indifference in solids; Alfred Russell Wallace, On wind as a seed-carrier in relation to one of the most difficult problems in geographical distribution; W. M. Davis, The mechanical orgin of the triassic monoclinal in the Connecticut valley.

— The committee having in charge the presentation to Prof. Edward Zeller of Berlin, as a commemoration of the fiftieth anniversary of his attainment of his doctorate, of the bust of the celebrated historian and philosopher himself, moulded by Professor Schaper, met and presented the bust to Professor Zeller on Oct. 31. On the long list of subscribers to the commemoration are a number of English and American professors and students of philosophy, among them those of President Angell of the University of Michigan, Professor Bain of Aberdeen, President Bascom of the University of Wisconsin, Professor Burt of Ann Arbor, Dr. Nicholas Murray Butler of Columbia college, Prof. Edward Caird of Glasgow, Prof. G. H. Howison of the University of California, Prof. T. H. Huxley of London, Prof. Benjamin Jowett of Oxford, Prof. George T. Ladd of Yale college, Dr. James Martineau of London, Prof. George S. Morris of Ann Arbor, Prof. George H. Palmer of Harvard college, Prof. W. H. Payne of Ann Arbor, ex-President Noah Porter of Yale, President Robinson of Brown university, Prof. J. G. Schurman of Cornell university, and Prof. C. W. Shields of Princeton college.

— *Appalachia*, vol. i. No. 1, has been republished, and copies will be furnished by the sales-agents, W. B. Clarke & Carruth, Boston, Mass.

— The London literary journals announce that two interesting manuscripts have lately been presented to the British museum by her majesty's consul at Chungking, China. The larger of the two fills seventy-three folios, and is in the Lolo character, being written in verse of five characters to a line. The smaller one is of thirteen folios, and is in the writing of the Shin-kia, a Shan tribe of the southern portion of the province Kwei-chow. This is the first specimen of the writing of this tribe to reach Europe. The characters are adaptations of contracted forms of an early kind of Chinese writing, with an admixture of pictorial signs. The work is one on divination, each sentence closing with words of good or evil augury.

— Previous to 1879 typhoid-fever was very prevalent in Vienna, Austria. At that time the drinking-water was the water of the Danube. In that year a new source for the city's water was drawn upon, and since then the disease has very much decreased.

— The citizens and authorities of Chicago are very much interested at the present time in the solution of the problem of preventing the further contamination of the water-supply of that city. The plan which seems to promise the best results is to divert all the sewage from the lake to the river, and to pump from the river into the canal 12,000 cubic feet per minute for every 1,000 of the population. The report of Dr. Rauch, submitted to the Illinois state board of health at its last meeting, shows that by the adoption of such a plan the water of the lake would be in all respects adapted for domestic purposes, and would be entirely free from contamination, while at the same time no contamination will result in the water of the river at points where other cities take their water-supply.

— The Russian government is about to have constructed a petroleum pipe-line, with a capacity of 160,000,000 gallons of oil a year, extending from Baku, on the Caspian, to the Black Sea, a distance of about six hundred miles.

— Mr. Daniel G. Brinton has been elected professor of American linguistics and archeology in the University of Pennsylvania.

— A lady aged sixty-two had for many years suffered from neuralgia of the face and ear, and had also had an abscess form in the right ear. She subsequently contracted what she supposed was a severe cold in the head, and, while blowing the nose forcibly, expelled what proved to be a wisdom-tooth. She remembered that some thirty years before, she had suffered from 'cutting a wisdom-tooth,' but she was at that time relieved without the appearance of the tooth. It doubtless found its way upward into the upper jaw, and finally liberated itself by ulceration through the nose in the manner described.

— From a series of experiments by Zott, of

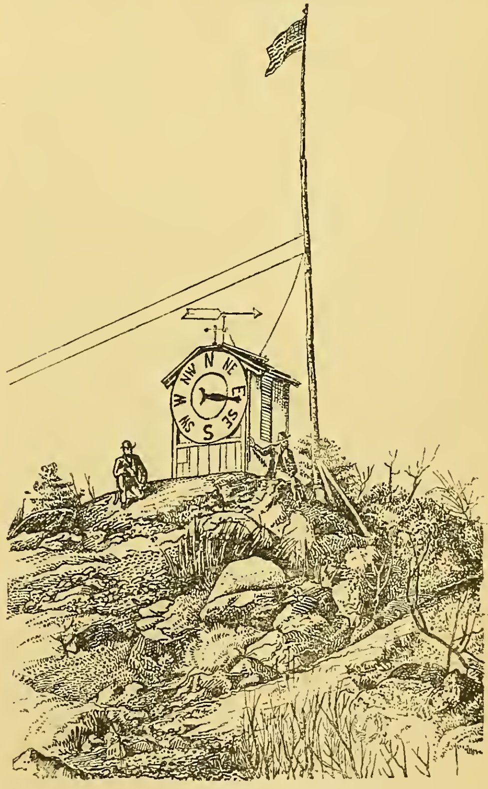
Munich, it would appear that gold-beater's skin is a much better dialyzer than parchment paper, so extensively employed for that purpose in chemical and other laboratories. Taking gold-beater's skin as the unit, Zott ascribes the following figures of effectiveness to the substances named : gold-beater's skin, 1 ; sow-bladder, 0.7 ; parchment paper, 0.5 ; leather 2 mm. thick, 0.02 ; caoutchouc, 0.001. Porous earthenware cells, employed as dialyzers, are but one-sixtieth as effective as gold-beater's skin.

— T. B. Stowell, Ph.D., in a paper read before the American philosophical society, has given in a most concise and thorough manner the anatomy of the trigeminous nerve of the domestic cat. Dr. Stowell has in this contribution to comparative neurology cleared up many points which have hitherto been obscure, and has thus indirectly been of great service to students of human physiology. His paper on the vagus nerve in the same animal, read before the same society some years ago, was equally valuable, and together they will have an important bearing on the future of neurological science.

— Professor Vogel calls attention to the effect upon plants of growing them under unnatural conditions. He states the hemlock does not produce conine in Scotland, and that the cinchona plants will not yield quinine when grown in hot-houses. He finds that tannin is produced in greatest quantity in those which have had a full supply of direct sunlight.

— Dr. Shoemaker of Philadelphia records in the *Therapeutic gazette* his experiences under the influence of ether. In the first period, which was brief and without excitement, he was able to ask a rational question about the sheet with which he was to be covered ; but immediately thereupon control over the vocal apparatus was lost. Of this he was conscious. Then came the second or unconscious period. Throughout this time there was present the single impression of "two endless parallel lines in swift longitudinal motion, each line being deflected at a certain point to form a wave." All this was set on a misty background, showing little of the lines at once, though the lower line was clearly moving from left to right. The lower line gave ascending waves, which intersected with the descending waves of the upper line. There was also a low but distinct, constant whir, as if due to the running lines. These lines occupied the whole mental field. There were no visions, no dreams of past experiences, not even a conception as to what being it was that was regarding the two lines, or that there was any such being. All trace of personality was gone. Then the lines began to move irregularly ; the patient drew a deep breath ; it dawned upon him that *he* was looking at the lines, and the third period (of recovery) was begun. Then came, in an order which could not be remembered, a series of curious impressions. He felt that he had glimpsed the essential nature of human existence. The lines were the existence of the soul, of his soul ; and the waves were his animal life, and were thus a temporary modification of a primary condition. The idea was felt to be new and important, and ought by all means to be remembered. But the attempt was in vain ; there was a spiritual power controlling him and preventing it. Though an unimaginative man, it took days to shake off the feeling that another phase of existence had been revealed.

— The accompanying cut illustrates a meteorological observatory for automatic instruments, erected by Mr. W. H. Childs last May on Mount



Wantastiquet, over the eastern side of the Connecticut River, opposite Brattleboro', Vt. It is 1,060 feet above the river, or about 1,500 feet above sea-level. The wind-vane turns the pointer on the dial (seven feet in diameter) so that the wind-direction can be read with a glass from the town below. The Robinson anemometer is connected by wire with Mr. Child's office, where it has made continuous record since June 1. During the summer, there has been a Draper thermograph belonging to the New England meteorological society inside the shelter, and a corresponding instrument belonging to Mr. Childs in the town below. Next summer it is proposed to add self-recording instruments of the Richard-frères pattern. During the winter, the weekly ascents of the mountain, required for attention to the thermograph, have to be given up.

— M. Meguin claims to be able to determine the date of death by studying the generations of Acarina which have been at work upon the body. Brouardel produced the cadaver of a young woman before the French academy of medicine, which had lain in a cellar for a year. He was able to trace five different species of Acarina, and the order of succession and duration of each species. He found dermestes sarcophagus, laticrus, and lucina cadaverina. One species consumes the fatty acids, another absorbs the fluids, and each dies when its work is ended. The period of life of each in summer is from six to eight weeks. In a case of murder in which the remains of the victim were discovered in a garden, Meguin was able to establish the date of burial with great accuracy. The value of these observations and deductions, if confirmed, cannot be overestimated, as hardly a month passes without the discovery of a murdered body, and in the course of the prosecution the probable date of death is always an important factor. So far as we know, no one has taken up this work of Meguin, Brouardel, and Laboutbene in this country, and yet it would seem that no field offers more inducements to the medico-legal expert than the one just opened by these enterprising French *savants.*

— Dr. Lemuseau, in *Le moniteur du practicien,* gives a *résumé* of the progress made in the examination of blood and its detection during the last fifty years. At the present time there are four methods employed for the determination of the presence of blood. The first is that by means of the haematine crystals, due to Teichman, and improved by Struve and Morache. The second method is spectroscopic examination. The third is that of Taylor, consisting in the employment of tincture of guaiacum, which, combined with the essence of turpentine or ozonized ether, yields a beautiful blue color if blood be present. The fourth is microscopic examination. In reference to the possibility of determining whether a given specimen of blood is human or not, Vibet says it remains impossible to assert with positiveness that a blood-stain is formed of human blood. It is in certain cases only admissible to say that it may be caused by human blood. Sometimes it can be affirmed that the stain is of the blood of some other kind of mammalia, but not of man; but in order to justify this opinion it will be necessary that the blood-corpuscles of the alleged animal be much smaller than those of man.

— Dr. Tipton of Selma, Ala., in the *Sanitarian,* gives some very interesting facts and figures, the result of his life among the blacks of the south. He claims that their death-rate exceeds their birth-rate, the mortality being 30 per 1,000. While during the slave state consumption was practically unknown, now it is the principal factor in the diminution of the race. One-half the male population is syphilitic, and most of the women have uterine disease. Hysteria, rheumatism, and alcoholism are common. If Dr. Tipton's opinions are correct, it is only a question of time when the whole race becomes extinct, unless by intermarriage with the whites the otherwise inevitable result is altered. Even this will but postpone the blotting-out of this people, if disease prevails to the extent indicated.

— Lieutenant Yate, who accompanied the Anglo-Russian boundary commission as a correspondent, has in press a book entitled 'England and Russia face to face in Asia.' It will describe the work of the boundary commission, the topography of the country, and the character of the native tribes. Lieutenant Yate is expected to throw new light on what the diplomatists unite in calling the 'affair' at Penjdeh.

LETTERS TO THE EDITOR.

The teaching of natural history.

In the last number of *Science* 'A teacher' complains rather bitterly of your review of French's 'Butterflies,' and adds some comments on methods of instruction in natural history. I have never had any experience as a teacher, but the method of teaching natural history has too much influence on the future growth of that science to fail to interest any naturalist, even if he be unconnected with a school or college.

Without now inquiring whether the demand expresses what is best for the advancement of knowledge, it seems to me that the actual demand of teachers and learners in entomology in this country is for a handbook of some group of insects on some such plan as is followed in Gray's 'Manual of botany,' in which, by analysis and by the characterization of each category of groups, the *relative affinities* of the objects under treatment are throughout brought to view. That Gray's 'Manual' is often used for the mere determination of names of plants does not interfere with this its higher and primary use. This distinction 'A teacher' seems to ignore. If he will call to mind that it is not from finding out mere names of objects, or giving them, but from weighing and discussing the nature, meaning, and causes of the relative affinities of organized beings, that the whole philosophy of natural history has arisen, he will perhaps agree that it is not best to teach pupils to think that they have gained the least knowlege of nature, when they merely know what their elders name a given object. The name may be called a necessary evil; and unless, with it, is more emphatically acquired a knowledge of the structural and biological relations of the object which it bears to other objects, it is worse than useless knowledge. This idea should underlie every manual for instruction. SAMUEL H. SCUDDER.

Coloring geological maps.

Having occasion recently to have printed a miniature geological map of Indiana, I endeavored to use the colors recommended by the International congress of geologists. Supposing that my endeavor might be more or less suggestive to those interested in the subject, I sent specimens of the map to the members present at the Berlin meeting of the congress, and with them a letter in which I pointed out the difficulties I had encountered in using these colors. I am indebted to Dr. Persifor Frazer for calling attention to my oversight in using them. My apology is, that I selected the colors from the specimen sheet printed in Berlin, and sent out with the American committee's report of the work of the congress. This sheet is entitled the "*Gamme des couleurs (provisoire) pour la carte géologique internationale de l'Europe.*" Upon it the colors for the Devonian are for its three subdivisions, while no colors or modifications of colors are given for subdivisions of the subcarboniferous, and no reference is made to explanations elsewhere. On its face this sheet claims to be complete in itself.

Had I referred, as I see that I should have done, now that Dr. Frazer calls my attention to the matter, to the report of the international committee, and then again to the proceedings of the congress, to ascertain whether or not certain recommendations of the committee were adopted, I should have found that my difficulties had been anticipated, and should have saved myself the trouble of mentioning them. It seems to me, however, that the very fact that such a process is necessary — that one cannot safely use this color-scheme without explanations other than those to be found upon the sheet — is evidence that this system is not all that one might reasonably expect.

As to the purpose of the scheme, I supposed from the first that it was intended for geology the world over; but, after my maps were partly printed, a member of the American committee, to whom I mentioned my difficulty, suggested that these colors were intended only for European geology, and called my attention to the title of the specimen sheet given above.

Dr. Frazer seems to think it unreasonable to expect any system of colors to give entire satisfaction on so small a map. I have no fault to find with the international system on this score, especially as the geology of Indiana is very simple.

The difficulty in subdividing the carboniferous does not come from the scale of the map, but simply from the absence of any fixed method of indicating the subdivisions. To be sure, geologists are left to differentiate as they choose, provided they all use gray; but I may use one method, and another person may use a very different one, the result of which is the absence of uniformity; and uniformity, I take it, is the prime object of a color scheme. In such cases the subdivisions require explanations. My idea of a universal color-system is, that, once introduced, it would need no explanations.

The report of the committee upon the map of Europe suggests that in such a case as the one I refer to in the letter sent out, when the terrane is of a known system, but unknown subdivisions, an initial letter be used in connection with the mean shade of color.

If, instead of colors, we are to use letters, I submit whether we can fairly call such a method of representation a *color* scheme. JOHN C. BRANNER.

Bloomington, Ind., Nov. 10.

Butter and fats.

Science (Sept. 10, p. 223) says: "Dr. Thomas Taylor's microscopic method for detecting the adulterations of butter with foreign fats seems destined to assume as many shapes as Proteus." Were this even so, it should not excite surprise, considering that about sixty different compositions have been secured under United States patents for butter substitutes, from which it will be seen that oleomargarine has itself become a veritable 'Proteus.' *Science* further says: "At first the globose forms obtained by the boiling and subsequent slow cooling of butter, and exhibiting the Saint Andrew's cross under polarized light, were brought prominently forward as distinguishing marks of pure butter." Answer: What I have stated is, that, when pure butter is boiled, cooled, and viewed as described, globose bodies (butter crystals) appear, exhibiting the Saint Andrew's cross, a fact not now disputed; that lard similarly treated yields a crystal, spinous, without cross; that beef-fat gives a branched and foliated crystal, without cross, — all of which Professor Weber admits, summing up the results of his first three experiments in the following words: "Thus far the results and statements of Dr. Taylor are fully corroborated."

If, however, *Science* intends the inference that I have represented that globose bodies with cross, discovered in any butter-like material when boiled, is a proof that said material is butter, I have only to say that no such idea has ever been entertained by me, or published over my signature. If the inference is intended that the discovery of the butter crystal and cross has some relation to my method of distinguishing oleomargarine from butter, nothing could be farther from the truth. My method of distinguishing oleomargarine from butter consists simply in demonstrating that certain forms of fatty crystals not known to pure butter are constantly found in oleomargarine; and in order to accomplish this, I examine the suspected material, as found in the market, unboiled. By this means I can generally detect at once the lard or other foreign fats, if the material is an oleomargarine. It is manifest that the Saint Andrew's cross found in pure butter would not help me to discover crystals of lard in oleomargarine.

But *Science* says, 'at first.' Am I to understand by the words 'at first' that when I, for the first time, announced publicly that I could detect oleomargarine, it was owing to my discovery of the globose crystals of butter showing the Saint Andrew's cross? If such is the meaning intended, nothing could be more erroneous. I did not discover the Saint Andrew's cross until May, 1884, while the record shows that from July, 1879, until May, 1884, I was determining between butter and oleomargarine by the simple method described. Other helps were sometimes employed, such as testing by acids, boiling to get the odor of butter or other fats, etc.; but I have always considered the presence of highly developed fatty crystals in the material conclusive evidence that the substance is oleomargarine.

In a communication to Hitchcock and Wall's *Quarterly microscopical journal* (vol. ii. July, 1879), published in New York, I set forth, among other statements about butter and oleomargarine, that I was able to detect the latter, owing to particles of cellular tissue, microscopic blood-vessels, and stellar crystals of fat found in it. This paper is illustrated with several cuts, exhibiting respectively the stellar crystals and portions of adipose tissue.

In a bulletin of the microscopical division of the department of agriculture, published in 1884, by direction of Commissioner George B. Loring, a paper of mine appears, with six chromo-lithographic illustrations, two of which relate to the detection of oleomargarine, and show the stellated crystals of lard as seen under the microscope. On p. 6, same bulletin, the following appears: "Aware of the fact that all artificial butter was made directly from crystallized fats, I devised a method by which it could be distinguished from true butter. . . . To carry out this plan, I used the low powers of the microscope with Nicols prisms. In this way I found that I had a method of detecting the crystals, whether in perfect starry form or as fragments of these forms, exhibiting all the colors of the rainbow."

In public debate at the late meeting of the American society of microscopists, at Chautauqua, N.Y., I said that all the convictions obtained in the courts of Washington, D.C., on my evidence, had been founded on my detection of lard or beef-fat in the fatty compounds sold as butter. Thus, first and last, my most important test has been the detection of crystals of foreign fats in butter substitutes sold as pure butter.

On p. 224, *Science* observes further: "Prof. H. H. Weber, however, upon testing the method described by Dr. Taylor, found, that, although the so-called butter crystals could be readily prepared from butter, they could be as readily prepared from beef-fat, or mixtures of beef-fat and lard, under like conditions." Answer: According to Professor Weber's own statement (see bulletin 13 of the Ohio experiment station), he did not use *beef-fat*, but a substance known to the trade as 'oleo,' said to be a manufactured product, containing a much smaller proportion of stearine and palmatine than does beef-fat, and made purposely by oleomargarine manufacturers to resemble butter as nearly as possible in its chemical composition. The professor triturated this butter-like substance with salt and water, boiled it, and when it was cooled discovered that it formed into globose bodies showing a cross; and he says that the crystal thus formed cannot be distinguished from that of pure butter. In this the professor is greatly mistaken. When 'oleo' crystals are observed under a half-inch objective, they can at once be distinguished from butter by their highly spinous character. But, I ask, what bearing has this experiment upon the question of my method of detecting oleomargarine? since crystals resembling those of boiled butter are never found in oleomargarine or butterine as sold.

Science further says (second paragraph): "After the publication of these results, the 'butter crystal' and its Saint Andrew's cross were relegated to a subordinate position." Answer: The Saint Andrew's cross of butter has never been and cannot be 'relegated' from its original position, viz., that of a constant factor of the globose butter crystal; nor can it be used as a means of detecting crystals of lard or of beef-fat in oleomargarine. Pure *unboiled* butter never exhibits either globose or stellar crystals, while oleomargarine and butterine, as sold, show the crystals of fats foreign to butter. *Science* says further: "Dr. Taylor insisted that his most important test has been neglected, viz., the appearance of the unboiled material under polarized light with selenite plate. According to Dr. Taylor, butter shows a uniform tint, while lard and tallow show prismatic colors." Answer: The assertion that the above is my most important test is found nowhere in my writings. In my open letter to Professor Sturtevant of the New York experiment station (March 21, 1886), I say: "The crystals of lard or of tallow generally observed in great numbers are easily distinguished from the mass of amorphous fats with which they are combined. This is one of my most important tests of oleomargarine and butterine." My assertion, 'This is one of my most important tests,' is thus made the foundation of a statement that something else is my most important test. In my publications relating to the detection of oleomargarine, from 1879 to the present time, I have reiterated the necessity of finding in the suspected material crystals of foreign fats in order to prove beyond a doubt its spurious character. *Science* further says: "Here again, however, he [Dr. Taylor] has been pursued by Professor Weber, who shows that either butter-fat or lard or tallow, when cooled quickly, will show a uniform tint, while if cooled slowly, so as to admit of the formation of larger crystals, prismatic tints are shown by both. Since imitation butter is . . . liable to undergo sufficient changes of temperature after manufacture to allow of a partial re-crystallization, the test is plainly fallacious." As regards the first sentence of the above quotation, it may be stated that *large crystals* of *butter* can never be found in unboiled oleomargarine, from the very nature of its manufacture, since the only butter it contains is derived from the milk with which it is churned. In the manufacture of butterine, however, butter, melted at the lowest possible temperature, is added to liquid 'oleo' and 'neutral lard' and churned. Even in this case the butter does not crystallize. Were the butter melted at a high temperature, its odor and taste would be objectionable; it would also crystallize in large globose forms, giving the butterine the granular appearance of lard, which would render it unsalable.

In the latter sentence of the above quotation, *Science* acknowledges that imitation butter is liable to undergo sufficient changes of temperature after manufacture to allow of a partial re-crystallization. For years past I have been endeavoring to convince those interested in this subject of this very fact thus acknowledged by *Science*. But be it remembered, that, in the re-crystallization that takes place after manufacture, it is not the 'oleo' crystal with cross that re-appears, but a stellated body resembling lard. Normal butter always shows a uniform tint; lard and tallow, as sold everywhere, show prismatic colors. What Professor Weber alludes to is strictly neither lard nor tallow, but a specially prepared material known as 'oleo' and 'neutral lard.' These he chills suddenly to prevent crystallization, a condition not suggested by the broad statement contained in my paper. No unbiassed mind would compare the evanescent results of this experiment with an ounce of 'neutral lard' or 'oleo,' with the constant crystalline condition of the million of pounds sold daily in our markets.

With regard to the optical test of oleomargarine observed in the use of polarized light and selenite plate, I have said: "If the sample is submitted to the action of polarized light and selenite plate, and appears of a uniform color according to the color of the selenite used, we have another *indication* that the substance is *pure normal butter*, which, under these conditions, never exhibits prismatic colors. Sometimes large crystals of salt cause the appearance of prismatic colors in pure butter, by refraction: these should be removed. Butter that has been exposed to light until it is bleached, or butter that has been in immediate contact, for a long time, with a substance that absorbs its oil, as when placed in wooden tubs, has undergone a chemical change, and should not be considered as normal butter" (extract from the Sturtevant open letter, which Professor Weber professes to have reviewed). But even butter of this description never exhibits crystals resembling those of either lard or 'oleo.' The prismatic colors of an abnormal butter, described by Professor Weber, and accounted for by me in my earlier papers as observed in decomposing or over-heated butters, etc., could not be mistaken by any but a novice for the gorgeous tints seen, with and without the aid of selenite plate, in butter substitutes in general. In a letter addressed to me, April 8, current year, Professor Sturtevant says: "Your claim for the selenite plate received our attention a long time ago, as we observed it in Professor Wiley's report for 1884. This test seems to offer promise of value." Professor Wiley, chemist of the department of agriculture, says: "Pure unmelted butter, when viewed through a selenite plate by polarized light, presents a uniform tint over the whole field of vision. On the other hand, butter substitutes give a field of vision mottled in appearance. This phenomenon is so marked, that, with a little experience, the observer will be able to tell a genuine from an artificial butter with a fair degree of accuracy. While the examination should never stop with this optical test above, it can be advantageously used as a preliminary step." My bulletin was issued in 1884; the agricultural report for 1884 was issued in 1885.

In a footnote to my paper already mentioned (Hitchcock and Wall's *Journal*), the following appears: "Well-made oleomargarine may be quite free from any crystalline appearance, at least while fresh. . . . The sudden cooling on ice seems to prevent the immediate formation of crystals, but it is not unlikely that these will gradually form in course of time." Thus it is shown that Professor Weber was anticipated by seven years in this case. A tub of fresh oleomargarine, direct from Armour's factory, Chicago, the present month, was examined as soon as received. Stellated crystals were at once observed in it, and the entire field was covered with prismatic colors.

Professor Weber states that a sample of butter subjected to heat and cold in his laboratory, but which did not actually melt, showed under the microscope prismatic colors, and he pointedly, although mistakenly, asserts that this butter fairly represents the condition of butter generally. In a paper read before the American society of microscopists, August, 1885, published in the Proceedings of the society, I say: "When oleomargarine or butterine is newly made, crystals of fat are seldom observed in it when viewed under the microscope; but in course of time, owing to its being subjected to light and increase of temperature in stores, it exhibits crystals of fat more or less. In butter substitutes of commerce the crystals are seldom absent."

Science further says: "Apparently, Dr. Taylor prepared his annual report with these results in mind, for there, and in his paper before the annual meeting of the American society of microscopists at Chautauqua, Aug. 10–16, he gives his method a still different exposition." Answer: The most important part of this sentence, to me, is its personal character. It contains an indirect charge that I so altered my official report to the commissioner of agriculture as that it might appear that I had anticipated Professor Weber in his novel views and experiments. It is sufficient to say that my official report was placed in the hands of Colonel Nesbit, chief clerk of the department of agriculture, at least six months before Professor Weber made his experiments. The points to which *Science* alludes are all contained in my report to Professor Kellicott, secretary to the American society of microscopists, at Buffalo, N.Y., sent him by mail Oct. 7, 1885, and were not afterwards altered by me, as the publishing committee will testify. Independently of all this, there is on file in the department of agriculture a copy of my original report, made by one of the clerks of the statistical bureau, over one year ago, which agrees with my published official report. *Science* further says: "Dr. Taylor's first step is now to search for fat crystals in the test sample by plain transmitted light." Answer: As has been shown, this was my method for the first several years, for the simple reason that lard crystals are by this means easily detected, but I subsequently discovered that the crystals of beef-fat could not be properly defined without the aid of polarized light. *Science* further says: "By the application of polarized light, 'amorphous crystals,' whatever these may be, may be detected." Answer: I have applied this term, 'amorphous crystals,' to mottled fats which, seen by polarized light without selenite, exhibit no particular form or structure, but, seen by polarized light with selenite plate, exhibit specks and prismatic colors, thereby showing their crystalline condition. *Science* further says: "To determine whether these amorphous crystals are of beef-fat or of lard, the sample is boiled and slowly cooled, as already described, and mounted in oil." Answer: In my official report I say: "Having *first* examined the suspected material under the microscope, it may be boiled." The precaution of a preliminary examination by polarized light is highly necessary, for, should the sample contain a large per cent of butter, boiling might cause it to crystallize in large globose bodies, by which the small crystals of lard and other fats might be absorbed and thereby escape detection. In the case of a true oleomargarine, which consists almost wholly of 'oleo,' the process of boiling would develop beef-fat crystals without cross, which would not be modified in form by the small quantity of butter in the compound.

Science further says: "Under these conditions, he now finds, in accordance with Professor Weber, that butter, lard, and beef-fat all give globular crystalline bodies which (apparently with the exception of lard) show the St. Andrew's cross." Answer: *Science* is misinformed in this case. The above statement is not in accordance with the facts. Professor Weber's language, in bulletin 13, is: "The butter revealed a well marked black cross;" "the lard, small irregular stellated bodies;" "beef-fat, only small stellate crystals." The last is an erroneous description of beef-fat, however, which has a branched and foliated crystal. It must be confessed that Professor Weber has an odd way of 'corroborating' the correctness of my experiments, — employing 'oleo oil' instead of rendered beef kidney fat, according to the statement in my 'abstract.' 'Oleo,' a substance not mentioned in my experiments, is no more beef-fat than phenic alcohol is coal-tar, although the one is a product of the other. *Science* says: "The above account of Dr. Taylor's method, as at present described by him, is drawn mainly from his last annual report to the commissioner of agriculture." Answer: *Science* is in error on this point. The points referred to by *Science* are taken mostly from my open letter to Professor Sturtevant, and from Professor Weber's bulletins 13 and 15, of the Ohio experiment station. My method of detecting oleomargarine has nowhere appeared in the columns of *Science*, nor in the reports of Professor Weber. My official report for 1885 was not issued when Professor Weber published the paper of March 1, 1886, nor does he seem to have been aware of my other publications mentioned in this paper. In point of fact, Professor Weber, unfortunately, undertook to discuss my method of detecting oleomargarine, by reviewing an abstract that did not so much as mention the subject. In conclusion, *Science* says: "We shall endeavor to keep our readers informed of the changes which the method undergoes in the future." This last is to me the most gratifying sentence in the whole article.

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Anemometer exposure.

I have been allowed space in recent issues of *Science* to call attention to errors which may arise from the position of thermometers and barometers relative to surrounding objects: may I now call attention to similar errors which may arise from badly placed anemometers? The subject is not a new one, but I wish to urge the necessity of a more uniform exposure than that now used by our signal service. According to the Associated press reports of the storm of Oct. 14 and 15 in the lake region, the wind tore through the trees of the Chicago public parks, on the morning of the 14th, with the fury of a hurricane, twisting saplings off and hurling them over the tops of large trees, littering the streets with broken trees and shattered sign-boards, and demolishing at least two buildings; and all this, according to the same despatch, while the wind was "blowing with a velocity of 20 miles an hour." Similar reports came from surrounding towns. The production of all this damage by a 20-mile wind seemed so absurd that I wrote to the signal officer at Chicago for the observed wind velocities on Oct. 14, and received the following: "Oct. 14, 1886, max. vel. of wind, S.W., 27 at 12.58 P.M.; vel. at 7 A.M., S.E., 11; at 3 P.M., S.W., 28; at 11 P.M., S.W., 11." Wind velocities of 40 miles per hour are not unfrequently recorded in Boston. On Oct. 31 the anemograph at the Boston signal office showed a maximum velocity of 40 miles, and on April 6 a maximum velocity of 51 miles; yet in neither case was there any record of broken or overturned trees and injured or wrecked buildings. This seems to show that wind velocities reported from Boston cannot be compared with wind velocities reported from Chicago. Not only can we not compare two stations of the signal office together, but we cannot compare wind velocities obtained during different years at the same station. During recent years high wind velocities have been much more frequently recorded at the Boston signal office than previously, and we find that while the average monthly wind movement at Boston from 1870 to 1881 was 6,630 miles (see Report chief signal office. 1883), the mean monthly movement during the last two years has been 8,120. Are we hence to conclude that Boston is becoming a windier place? I think not. The signal office at Boston was moved from one building to another building in 1884, and since then the velocities have been higher than previously, and are no doubt due to the changed position of the anemometer. But even with a continuous exposure of an anemometer at the same place, it is doubtful, as anemometers are now exposed, whether wind velocities from different directions can be compared with one another. There are two anemometers — a Draper and a Hahl — on the tower of the observatory at Blue Hill. These rise about eleven feet above the roof of the tower and about eight feet above the parapet. The Hahl anemometer is situated on the south side of the tower, and the Draper on the east side of the tower, which is sixteen feet in diameter. During the last three months there have been seventeen days on which the prevailing wind was from the west; and on all of these except four the total daily movement shown by the Hahl was larger than that shown by the Draper. On these seventeen days the average daily movement shown by the Hahl was 438 miles, and by the Draper 426. During the last six months there has been ten days on which the prevailing wind was from the north, and on all but three the Draper recorded more than the Hahl. On these ten days the average daily movement shown by the Draper was 353 miles, and by the Hahl, 346. This seems to show that wind velocities from different directions recorded by either instrument cannot be compared with each other, though the differences in this case are not large. Yet I think the Blue Hill anemometers are better exposed than many of those of the signal service which are near the edge of tall buildings, and have an abrupt descent on one side of them, and a long roof or series of roofs on the other.

As a sequel to this, I might call attention to the large errors which may arise from the bad exposure of the signal service rain-gauges on roofs, but I think this is generally recognized.

H. HELM CLAYTON.

Blue Hill meteor. observ., Nov. 10.

SCIENCE.—SUPPLEMENT.

FRIDAY, NOVEMBER 19, 1886.

EXPERIMENTAL PSYCHOLOGY IN LEIPZIG.

THE period in the development of a science at which observation is supplemented by experimentation has long been recognized as one of critical importance. Moreover, if the nature of the science thus advanced seems to be such that the employment of the new instrument is followed by the positing of a more complete and scientific stand-point; if, in other words, the influence of the experimental stage is as valuable for theory as for practice, — the importance of this step is certainly increased. There are many men now living who could have witnessed the beginnings of this movement in psychology, and lived its life with their own. Notwithstanding the great enthusiasm with which this departure was hailed, — an enthusiasm which in its short career has experienced many ups and downs, — the study has been taken up more largely as an avocation than as a serious life-work. Many scientists, mostly physicists or physiologists or alienists (Helmholtz, Mach, Hennig, Preyer), have taken up the limited portion of the subject in which they were most interested, and devoted themselves to it. The greatest advances of any have undoubtedly resulted from the labors of such men. On the other hand, the propounders of psychological systems have not been slow in incorporating the results and conceptions of the new movement into their doctrines, not always, it may be added, with a very congruous result. But there are many indications that an essential condition of the flourishing of scientific psychology is the existence of specialists devoted to its cause, with all the advantages, both material and intellectual, that their position in a first-class university can bring. Psychology is ready to emerge from the nomadic state; and, having given assurance of its permanency, it asks for a home, or rather for homes. The University of Leipzig, owing to the efforts of Professor Wundt, has been, perhaps, the foremost in answering this call. Many young men have gained an impetus for such work under his direction; and a quarterly *Philosophische studien*, devoted mainly to the publication of results of research in the Leipzig laboratory, was founded some years ago. The articles relating to experimental topics in the last two numbers of this journal[1] will indicate the direction in which work is being done.

A very interesting study is that on the 'Memory for tone,' by Mr. H. K. Wolfe. The impetus to the research was given by the admirable study of the memory by Dr. Emminghaus, in which he counted the number of repetitions of a series of nonsense-syllables necessary to enable the hearer to repeat the series from memory at once or after a certain interval. He found, for example, that he could repeat seven such syllables when read to him but once; if there were twelve syllables, they would have to be repeated sixteen times, and if twenty-four syllables forty-four times before they were memorized. Mr. Wolfe very justly remarks that what is here understood by memory is the power to reproduce, and that there is a more simple and retentive form of memory, which consists in the power to recognize as familiar an object that has been presented to the senses before. A very common illustration of this is seen in the fact, that, on reading a book a second time, we recognize a great deal more of it than we could have told of it. So, too, we can recognize at least ten times as many shades of color as we can see in the imagination, can understand more words than are in our usual vocabulary; and so on. It is this simpler form of memory that Mr. Wolfe studies. A series of nearly 300 vibrating metal tongues, giving the tones through five octaves, from 32 to 1,024 vibrations, was at his disposal. These tongues gave tones differing by 2 vibrations only in the two lower octaves, and by 4 vibrations in the three higher octaves. In the first series of experiments a tone was selected, and, after sounding it for one second, a second tone was sounded, which was either the same as the first, or different from it by 4, 8, or 12 vibrations in different series. The person experimented upon was to answer whether the second tone was the same as the first, thus showing that he recognized it, or whether it was different, and, if so, whether it was higher or lower. Of course, the interval of time between the two tones was an important factor. The proportionate number of correct judgments, and the smallness of the difference of the vibration-rates of the two tones, would measure the accuracy of the tone memory. It appeared that one could tell more readily whether the two tones were alike than whether they were different,

[1] *Philosophische studien.* Herausgegeben von WILHELM WUNDT. Band iii. hefte 3, 4. Leipzig, *Engelmann*, 1886. 8°.

although in both cases the accuracy of the memory was remarkably good.[1] When the tones were really equal, they were recognized as such, on the average, in from seventy-five to eighty per cent of all cases. In using tones differing by only 4 or 8 vibrations, though the difference was very often clearly perceived, the direction of it, whether higher or lower, was not always clear, and even in differences of 12 vibrations there was little confidence in one's judgment. This seems to be a peculiarity of auditory sensations: for in sight you can almost as readily say that a shade is lighter or darker than another as that it is different; you can almost as soon detect the direction in which a point is moving along the skin as you can detect the motion itself. But the main point is the effect of the time-interval between the tone and its reproduction. This was varied from 1 second to 30 seconds, or even to 60 seconds, or 120 seconds in some experiments. The general result is, that the longer the interval, the smaller the chances that the tone will be recognized; and this process of forgetting takes place at first very rapidly, and then more slowly. It is made probable that the interval must increase in a geometrical ratio to produce an arithmetical series of (approximately) equal degrees of forgetting; i.e., the curve is logarithmic. This law is subject to considerable variations, one of which seems to be constant and is peculiar; namely, there seems to be a rhythm in the memory itself, and, after falling, it recovers slightly, and then fades out again. Among other results were that the accuracy of the memory decreases as the pitch of the tone is lowered (within limits); that relatively high tones tend to be judged too high, and low ones too low, by unmusical ears; that the effect of practice is at first marked, but soon diminishes as is its general law; and that the recovering power of the ear is so great that fatigue has little effect. To prove the last proposition, experiments were made for one day from 8 A.M. to 7 P.M. (with ten minutes intermission).

A subject that has always received great attention at the Leipzig laboratory is the measurement of the time of psychic processes. These have been conveniently divided into three kinds: 1°, the reaction time, which is simply the time after the application of the sense-stimulus necessary for an individual to record the fact that he has received the sensation; 2°, the distinction or perception time, which is the additional time necessary for him to appreciate the nature of the sensation, e.g., whether a light was red or blue: 3°, the choice or will time, which is the additional time necessary to react in a certain way on the reception of a certain sensation, e.g., to press a key with the right hand when the red light appears, with the left hand or not at all for the blue light. Dr. J. M. Cattell, in a recent re investigation of a large part of the field, has brought to notice several new facts, and has improved the method in many respects. To insure himself against any variations in the working of his apparatus, Dr. Cattell devised a means of controlling it, an essential part of the device being the determination of the most suitable strength of current for running the chronoscope. The time is recorded on a Hipp chronoscope, which, by the release of a magnet and the springing back of the same, records intervals of one one-thousandth of a second. A falling screen, at a point in its fall, suddenly reveals a card or color, if that is the sense-stimulus, or can convey a shock to the finger, etc., and at the same time releases the magnet of the chronoscope, and sets the hands of the clock in motion. The reaction of the observer is made either by closing a key connected with the chronoscope with his hand, or by speaking through a tube, which, like the hand-key, has the effect of instantly stopping the clock. One can then read on the chronoscope the interval of time between the two events. In this way it was found, as the result of 520 experiments on each of two observers extended over a period of six months, that the reaction time for daylight, reflected from a white surface, was quite constant, and was about .149 of a second (strictly, .151 of a second for one, .147 of a second for the other observer), it being immaterial whether the reaction was made with the right or the left hand. But it takes .030 of a second longer to record the reaction by moving the lips. It is usually considered that the state of the attention has most effect on the reaction time; but Dr. Cattell found that the disturbance caused by the ticking and ringing of metronomes with bell attachments affected the reaction very slightly indeed, and explains this divergence from the results of other experimenters, by the unusual amount of practice which he had in such experiments. In other words, the process was too automatic to be affected seriously by the attention. Again: if the attention be distracted by the mental operation of repeatedly adding 17 to a series of numbers, the time is more seriously lengthened; and, if the observer makes a great effort to attend, the time can be slightly shortened. He also shows that this extreme state of attention can be main-

[1] Very unfortunately, Mr. Wolfe, in tabulating his results, has worked upon a false mathematical process, and has thus made it impossible to draw conclusions regarding the recognition of the fine intervals of tone. From the original records such conclusions could be drawn. I am thus forced, on this account, to speak only of the recognition of equality of tone, and even to make allowances in stating these.

tained for only about one second. The two observers show some individual variations, all of which indicate that the processes were more thoroughly reflex in Dr. Cattell's case than in that of his associate. It is argued that the cortex is not concerned in the reaction, and that perception and willing also have no part in it.

Passing to perception times, the observer is asked to react only if the card which the falling of the screen reveals has a white surface, and simply do nothing at all if it has a black surface. The additional time necessary to recognize the whiteness of the surface, and to send out the voluntary impulse, was for the one observer .061 of a second; for the other, .095 of a second. This time Dr. Cattell thinks should be divided equally between the two operations, because in the simple reaction the closing of the key was entirely automatic. Of course, it no longer makes any difference how the reaction is made. It, however, takes a little longer, if, instead of a white surface, a colored surface is used, though the observer has simply to distinguish that it is not black. If the color is to be distinguished, and in each case can be one of two colors, then the perception-and-will time was .100 and .110 of a second respectively for the two observers; if the color can be one of ten colors, .105 and .117 of a second. In other words, it takes about .0058 of a second longer to distinguish one of ten colors than one of two, but .033 of a second longer to say what the color is than to say it was not black. In a similar way, if two letters are to be distinguished from one another, instead of two colors, the time is lengthened by about .038 of a second. If a letter is to be distinguished out of ten letters, it matters greatly what the letter is. E is the most difficult to read. The order of difficulty of five letters experimented upon was M, A, Z, B, E. The perception time for short English words is somewhere about .142 of a second; it is slightly longer for long words and for words in a foreign language. A very important point is, that the perception time for words is only slightly longer than for letters; thus showing that the former, not the latter, is the reading unit. Finally, if small pictures of such familiar objects as a tree, hand, etc., be used instead of words, the time is found to be shorter, and is about equal to that for seeing a color. A picture is thus a simpler, less abstract sign than a series of letters.

There remains the will or choice time. We have seen in the series of experiments just described that a will time has already entered. If we change the form of experiment so that if a red light appears the right hand is to react, and if a blue the left hand, the time is lengthened by .026 of a second. In the former case the same hand always reacted; now the motor impulse is to be sent in a certain direction.[1]

A very interesting form of the experiment consists in letting the different kinds of reaction be the names of the colors, letters, pictures, or words; in other words, to measure the time necessary to read, i.e., to see and name them. Four-tenths of a second was thus found as the time necessary for reading a letter. Similarly the time necessary for reading a one-place number was found to be about .360 of a second, it taking only .033 of a second longer to read two-place numbers, and only .025 of a second longer for a three-place than a two-place number. As regards words, it was found that it took longer to read (not including pronunciation) long than short, and foreign than vernacular words. To name a short word in one's native language requires .111 of a second, which is .050 of a second less time than it takes to name a letter; thus showing, that, as we constantly read words and seldom letters, the association between the concept and the name is much closer. An interesting result as regards color is this: that, while it takes less time to perceive a color than a letter or word, it takes quite a long time (.343 of a second) to find the name of the color. The association between a color and its name is a loose one. The names of the more familiar colors were found in considerably less time. The average time for naming a picture is about equal to that for naming a familiar color. Familiarity is again an important factor: it took least time to name a 'hat,' longest to name a 'teapot.' By way of summary, the following table will be found convenient.[2]

Reaction time for	light	= .150 sec.
Perception time for	light	= .040 "
" " " a	color	= .095 "
" " " a	picture	= .105 "
" " " a	letter	= .120 "
" " " a (short)	word	= .125 "
Will time for colors		= .340 "
" " " pictures		= .365 "
" " " letters		= .155 "
" " " words		= .105 "

There have thus been recorded the times of some of the simpler mental activities, and the understanding of the higher psychic processes has thus been made more easy. The times of these processes Dr. Cattell supposes will become shorter in the course of evolution "and we will live so much the longer in the same number of years."

Finally, a very painstaking research by Dr. Alfred Lehmann deserves mention. His object

[1] The perception process is also slightly but not materially different.

[2] The final section of the paper is devoted to showing that extreme attention can shorten central operations; that the effect of practice is first marked, but soon reaches its limit (as automatism sets in); that fatigue is not as readily brought on, and is not as disturbing a cause as is usually supposed.

was to decide whether the method of the 'mean gradations,' is applicable to the sensations of brightness. This method consists in presenting two disks composed of different proportions of black and white (and thus, when rapidly revolved, showing different shades of gray), and asking the observer to regulate the amount of black and white in a third disk until it was just as much darker than the one as it was lighter than the other: i.e., to find a gray of a mean intensity. Call the intensity of the darker one x and of the lighter one y, then the arithmetical mean would be $\frac{x+y}{2}$. But if Weber's law (which says, that to produce equal differences of sensation, the difference in the stimuli vary proportionately to the stimulus already present) is true, then $\sqrt{xy}$ would be the intensity that appears to be mean; i.e., $x : \sqrt{xy} :: \sqrt{xy} : y$. Dr. Lehmann's study is devoted to discovering all the sources of error in such an experiment. The order of the disks, whether the variable disk should be between the two or not; the direction and kind of illumination; the order of experimenting; and, beyond all, the effect of contrast with the back-ground against which the disks were seen, — were all taken into account. Dr. Lehmann succeeded in measuring quantitatively the effect of contrast (a very valuable result), applied a method of eliminating its effect, but finally comes to the purely negative conclusion that the question of the validity of Weber's law is not favored or refuted by his experiments. A real test still remains to be made. His most valuable result is the study of the great effect of contrast in all such work.

JOSEPH JASTROW.

PROCEEDINGS OF THE ENGLISH SOCIETY FOR PSYCHICAL RESEARCH.

To allay at once any feelings of expectancy (which some readers may share with the writer whenever the green cover of a new number of these 'Proceedings' is caught sight of) it may be well to say that nothing unusually wonderful is therein revealed. A considerable portion of the number is devoted to the 'physical phenomena' connected with spiritualism. Fortunately, throughout most of the discussion the subject is strictly adhered to, and any theory of explanation involving assumptions contradictory to the principles of physical science is considered irrevelant. The issue is, in the main, considered to be whether certain strange phenomena are explicable by what we know of conjuring, mal-observation, and the psychology of belief, or whether they must be transferred to the category of the unexplained, to be reserved for future study. Can we say 'yes' or 'no' to this alternative, and if not, which of these answers is pointed out as the more probable?

Professor Barrett opens the discussion, and at once records his conviction, "that, at any rate, some of the simpler phenomena of spiritualism are inexplicable by any causes at present recognized by science." This conviction is not due to experience gained in the ordinary public seances; that is considered as largely fraudulent, and evidently worthless. But attention is called to a few cases of private mediumship, in which all the conditions necessary for a scientific test were granted. In the first of these cases, a girl of ten years had the peculiar gift of causing raps to be heard, even when her hands and feet were firmly held; the raps occurred at certain letters of the alphabet, and displayed a childish intelligence. A word "was misspelled by raps, exactly as the child would have misspelled that word." Professor Barrett concludes that he is 'morally certain' that hallucination, trickery, or known causes had nothing to do with it, but that it belongs to a 'class of phenomena wholly new to science.' A case is then cited in which a clever boy deceived his father (a distinguished surgeon) and all his family, by pretended spiritualistic manifestations, for a whole year; but the 'radical' difference is pointed out that in this case the trick was discovered, in the former case it was not. Professor Barrett, with another private medium, saw tables move, and raps spell out 'pious platitudes,' "such as the medium herself (a Methodist) would be likely to concoct," and again considers the phenomena as inexplicable. A seance with a paid medium, Mr. Englinton, added to the mystery. Whether further study will support this conviction or not, at any rate, says Professor Barrett, more light can be shed on these phenomena by occasionally assuming the possibility of the spiritualistic stand-point; theorizing is needed as well as observation.

The paper of Mrs. Henry Sidgwick reports an unusually able investigation of the so-called spiritualistic phenomena. It is the account of an observer who knows how enormous the possibilities of deception, of mal-observation, and how insidiously inference usurps the place of perception. Every one interested in the psychology of illusions should read this admirable exposition of an interesting chapter on that subject.

The phenomena to be explained include raps, levitation of objects, playing on musical instruments, psycography and so on. Mrs. Sidgwick speaks from a twelve years' experience with mediums, including several of considerable fame. As

Proceedings of the English society for psychical research. Part x, Oct., 1886. London, *Trübner*.

regards raps, one must remember that as early as 1851 it was shown that these could be and were produced by voluntarily dislocating the knee-joint. Holding the knees of one of the original Fox sisters was sufficient to prevent the appearance of the raps. It will be impossible to detail the many devices to prevent fraud of which Mrs. Sidgwick availed herself; but the reading of these extends one's appreciation of the conjuring art. Perhaps the most ingenious device was that of placing the medium in a hammock connected with a spring-balance which recorded the weight of the hammock and its contents. If the medium herself personated the 'materializations,' her stepping out of the hammock would be recorded. "The seances were nearly unsuccessful until the last." In the apparently successful ones an associate was in the cabinet for a time, and broke her promise by refusing to be searched when leaving it. In short, remembering that nearly every medium who pretends to any very remarkable manifestation, has been exposed at some time of his or her career; that the conditions which they prefer are those most available for trickery; that when the conditions are rigid and unexpected, success is rare (if it ever occurs); that the kind of feats by which the spiritualists choose to prove their theories are exactly the kind which a conjurer chooses, — in view of all this, the aversion of scientific men to investigate such phenomena is largely justified. The most (perhaps the only) valuable result of this research is, as was said above, the light it throws on the psychology of belief, and, from a natural-history point of view, the willingness of a certain class of humanity to be deceived and to long and search for the philosopher's stone.

Mr. C. C. Massey contributes a paper on the possibilities of mal-observation in the evidences of spiritualism, in which he maintains that these possibilities have been greatly exaggerated, and that, if we simply take the precaution of recording one simple observation at a time, human testimony is reliable enough. Mr. Massey (who is the translator of Zöllner's 'Transcendental physics') then attempts to show, by recounting seances with notorious mediums, that reliable evidence for the existence of obscure forces exists in abundance. The former president, Mr. Sidgwick, very properly adds a note that the policy of a psychic research society, far from encouraging this not over-moral trade, should distinctly be averse to having more to do with it than is necessary.

Two papers by Mr. Frederic W. H. Myers deserve some notice. The first treats of "Human personality in the light of hypnotic suggestion," and is a very exaggerated estimate of the evidence which this condition can furnish with regard to the nature of the eye. The main idea is, that the subject almost always resists the notion that anything but his own free choice determined the suggested action, and will invent the most fanciful explanations to make an absurd action appear rational. In other words, one may even have the feeling of acting as a free agent, and yet be constrained by a foreign agent, — a fact, by the way, well known to Spinoza. The object of the second paper is to suggest that telepathy may be operative hypnotism; that a subject may be put into this condition by the will of the operator himself a quarter of a mile or more away. The evidence produced is far from satisfactory, owing, in part, to the fact that the observers who were sent to find out whether the sleep followed would themselves unconsciously furnish the suggestion. Mr. Myers then proposes a serial classification of the methods of 'hypnogeny,' beginning with such massive disturbances as cause cataplexy in animals, and gradually leading up to this new 'telepathic' hypnotism. The scheme is in part suggestive, but is premature, and adopts as proved, facts extremely uncertain and improbable. The theoretical portion of the paper is extremely disheartening; such a sentence as "that perhaps when I *attend* to a thing, or *will* a thing, I am directing upon my own nervous system actually that same force which, when I direct it on another man's nervous system, is the 'vital influence' of mesmerists, or the 'telepathic impact' of which Mr. Gurney and I have said so much," certainly smacks of anything but a scientific spirit.

Mr. Myers, Mr. Gurney, and Mr. Podmore will very shortly give a detailed statement of their psychical researches, in a two-volume book, 'Phantasms of the living,' and to this work Mr. Myers refers readers for further information.

The present writer can not refrain from asking, if all the brains, the labor, the money, and the time devoted to these investigations by our English cousins have yielded such meagre results, and have led the way to so much useless and markedly perverted thinking, whether, as long as the world has so many important questions waiting for a decision, so much good cogitative energy should be allowed to go waste.

RECENT WORKS ON TOPOGRAPHICAL SURVEYING.

THE field work of the topographer consists of two parts, which are entirely distinct in character. These are, first, the work of location, which may be done entirely by angulation, or by angulation and distance measurements. It is geometrical work. This work of location serves only to correct the map ; it forms no part of the map itself. The matter of the map is obtained by the second part of the topographer's work, that of sketching. This is artistic work. Here we come to a definition of a map from the constructive point of view. It is a sketch, corrected by locations. The more locations per square inch of the map, other things being equal, the better the map ; but however numerous the locations may be, the map itself is none the less a sketch.

Locations are effected in two ways, as noted above. First, by angular measurement, starting from a carefully measured base. These measurements may be made with the theodolite or plane-table. Second, by direction and distance measurements ; the former by compass, theodolite, or plane-table, the latter by chain, steel tape, odometer, or stadia. These two methods are frequently used in combination, as in the ordinary work of the U. S. coast and geodetic survey, where the plane-table stations and many unoccupied points are located by angular work, while other points are fixed in position by direction and distance, from the stations, using the plane-table and stadia for this purpose.

Among topographers of wide experience in the use of instruments and methods of work, there is no question, where the conditions are favorable, as to the advisability of using the method of location by angulation, rather than that by direction and distance measurements. It is without doubt the most rapid and the most accurate method of controlling the sketches for a topographic map. Its employment requires, however, that the country shall present some relief, that it contain an adequate number of points, natural or artificial, suitable for being 'cut in,' and that it be not too generally covered with forests, in order that a sufficient number of cleared summits, well distributed for stations, may be obtained. The primary advantage in the use of the plane-table with this method, as with all other methods, is, that the work is plotted directly upon the station, and the sketch is then made upon a correct framework, — in other words, the map is made upon the station, with the country in view. The principal disadvantage, if it be a disadvantage, is that the angles, being recorded graphically, cannot be used subsequently for a map upon a larger scale. Objections to this instrument on account of its weight and cumbrousness have no force, as the plane-table may be made very light and simple without reducing its accuracy.

The theodolite may be used, the angles recorded, and the map plotted upon the station. This combines the advantages of the plane-table and the theodolite. It requires, however, more men, more instruments, and more time devoted to work upon the station, where time is of especial value. Another method of combining the advantages of both instruments is in extensive use in the western work of the U. S. geological survey. Here a light and simple plane-table is used, in conjunction with a theodolite. The map is made upon the former instrument, while with the latter, angles for location are read upon all important points. These are subsequently plotted in the office, and the plane-table sheets corrected accordingly.

The methods of continuous location by direction and distance measurements are known generally as traverse or meander methods. They are primarily applicable to the survey of lines and not of areas. The essential feature of these methods is, that one station is located from another in continuous series. There is necessarily an accumulation of error in such a series, which may be corrected by connecting the line with points in a triangulation. All these methods are imperfect in several respects. First, they are inaccurate, because of the liability to an accumulation of error. Second, they are ill adapted to the survey of areas, inasmuch as while the line (usually a road) and its immediate neighborhood are surveyed in the greatest detail, the areas between lines of survey are, in practice, comparatively poorly surveyed, and the resulting map is unequal in quality in different parts. Third, the traverse is necessarily made upon a much larger scale than is required by the scale of the map, and so the work is more expensive than it need be. The more hilly the country, the more force there is in the second of these objections, as the lines of survey, following the roads and trails, necessarily pass through the lowest parts of the country, and, therefore, the topographer, instead of being free to select the best points for overlooking his area, is obliged to content himself with the poorest outlooks. The result is seen in meaningless hill-forms, which were evidently sketched from below in the valleys. By experienced topographers, traverse methods are avoided whenever practicable, but in flat or timbered regions it often becomes necessary to adopt them.

Of the instruments used, the plane-table is ill adapted to this work, being difficult to manipulate quickly. The chain and tape are generally discarded in the survey of areas, as being more accurate than the requirements, and proportionately slower. The odometer attached to a revolving wheel measures distances with ample accuracy for almost any scale, and, in connection with the compass, allows the most rapid work of any of these methods. Measurements of height, however, must be made by a separate instrument, — by the barometer, if great accuracy is not required, or by spirit-level, if the barometer does not meet the requirements. The stadia instrument measures distance, direction, and relative height. In this combination lies its superiority to other instruments for traverse surveying. It is not, however, as rapid, as cheap, or as accurate in its measurements as the odometer. The method is new to many surveyors, and is attractive from its novelty. Extraordinary claims are made for it in regard to accuracy, which are scarcely to be realized in practice.

Until recent years, the vertical element of topography has received little attention. If recognized at all, it has been represented qualitatively only, by means of shading, either by hachures, crayon, or brush work. The U. S. coast and geodetic survey, however, from its inception, has mapped the relief quantitatively, by means of contours, but, strange to say, has in nearly all its published maps failed to reproduce this material, but has represented relief by hachures. At present the importance of showing the relief quantitatively is becoming recognized, and most modern maps have a vertical as well as a horizontal scale, the relief being represented by contours. Although this reform is now well advanced, and although the methods of surveying the vertical element are well matured, there is still much misconception among engineers in regard to these methods. Many engineers can imagine no other way of mapping the contours of an area except that of taking up each contour and tracing it in all its convolutions. That contours can be sketched with sensible accuracy over a wide area, providing the sketch be corrected by the measurement of the heights of a dozen or more key points, they are slow to believe, and the fact that the U. S. coast and geodetic survey uses this means of locating contours, only lessens their faith in the infallibility of that organization.

Among all the treatises and text-books upon topographic surveying recently published there is not one which treats the subject in a comprehensive manner. These books, in so far as they relate to field work, discuss little besides the geometrical part of the topographer's work, — the simplest and in many respects the least important, and always the most easily learned part of his profession. The artistic part of the field work is either ignored entirely or is treated as of very little importance. This is perhaps due to the difficulty of describing the almost infinite variety of the work, as it changes with each day and with every square mile. Moreover, it is a subject which can be treated with much greater facility by means of object lessons in the field than by books. The aphorism that 'topographers are born but not made,' may have something to do with this lack of facilities for making them. Another general criticism upon these books is, that, of the various methods of location, they treat only of location by traverse, and the impression constantly conveyed to the student is, that topographic work is universally done by means of traverses. A misconception regarding the use of the plane-table appears to exist in the minds of most engineers who have written upon topographic surveying. They appear to regard the plane-table solely as a stadia instrument, and criticise it from that point of view alone. There is no method of surveying to which this instrument is not applicable, and, for most kinds of work, it is the simplest, most convenient, and most accurate instrument in use. Again, these books are very unsatisfactory regarding the construction of the vertical element of maps. The impression conveyed by the treatment of this subject is, that contours should be traced upon the ground, a method never employed upon geographical surveys, as stated above.

Another generic feature of these books which is worthy of attention is, the great number and complexity of the conventional signs which they describe. In general topographic maps it is desirable to keep the number of such symbols down to the smallest possible, consistent with the amount of information which the map should contain: first, in order that the maps may be easily read; and second, that they may be easily kept up to date. Another notable omission is, the want of consideration of the scale of maps as affecting the character of the work, — a matter which involves the degree of accuracy and of detail necessary to be obtained in the survey, and, consequently, the cost of the work. It appears to be assumed that *a survey is a survey*, which may be plotted upon a larger or a smaller scale, without any regard to the quality of the material obtained. In point of fact, there is no more important question in the economics of map-making than that of scale, and the right proportionment of the work to the adopted scale. It is in this direction, more than any other, that improvement is to be expected in the conduct of work.

Professor Haupt's 'The topographer'[1] is the most comprehensive and satisfactory of the recent manuals on topographic surveying. Still, while treating with great fulness of traverse surveying, it ignores other methods of location. It makes an attempt to treat of sketching, but without much success. The chapter upon relief, drainage systems,

[1] *The topographer, his instruments and methods.* By Lewis M. Haupt, A.M., C.E., Philadelphia, *Stoddart*, 1886. 8°.

etc., contains numerous erroneous statements regarding geographical laws. The book is fully illustrated with cuts and maps. Most of the latter are fairly good specimens of work, but a better example of hachure work might have been selected than the map of the Yellowstone national park, while that of the Neversink mountains near Reading, Pa., is by no means a good specimen of contour work.

Mr. Carpenter's little book[1] is essentially a description of the methods of work in use upon the U. S. geographical surveys west of the 100th meridian, in which organization his experience was obtained. It is almost unnecessary to say that it deals almost entirely with traverse methods of location.

A number of text-books have been written upon stadia surveying, and many tables for the reduction of stadia measurements have been made, most of which are theoretically faulty, but all good enough for the material to be treated. Among these are Winslow's 'Stadia surveying'[2] and Johnson's 'Topographical surveying.'[3] The former contains only the theory of the instrument, with tables for its use. It is a convenient little volume. The latter goes into the subject more fully, giving the theory, describing the instruments in ordinary use, and the routine of field and office work, together with the applications of the method to railroad, canal, ditch, and pipe-line surveys, surveys of drainage basins, and city and town sites, etc. In discussing the cost per square mile by this method it will be noticed that no reference is made to scale, a fact which necessarily makes the figures of no value. Mr. Johnson discusses the relative advantages of the use of the plane-table and the stadia instrument at some length, to the disadvantage of the former, but it will be seen that he assumes that the plane-table is used simply as a stadia instrument. His concluding objection to the plane-table, viz., that it is a very difficult instrument to learn, suggests a want of familiarity with it.

Lieutenant Reed's 'Topographical drawing and sketching'[4] relates principally to the office work upon maps. A few pages are, however, devoted to field sketching and the use of instruments, but these treat of that ruder class of surveying known as reconnoissance. A chapter is devoted to the use of photography as an aid to topographic work, an idea which is very popular with amateur topographers. That portion of the work which treats of the office preparation of maps is very full, and is excellent. The book is beautifully illustrated with plates of conventional signs and examples of existing maps.

[1] *Geographical surveying.* F. DEY. CARPENTER. New York, *Van Nostrand*, 1878. 12°.

[2] *Stadia surveying.* By ARTHUR WINSLOW. New York, *Van Nostrand*, 1884. 12°.

[3] *A manual of the theory and practice of topographical surveying by means of the transit and stadia.* By J. B. JOHNSON, C.E. New York, *Wiley*, 1885. 8°.

[4] *Topographical drawing and sketching, including applications of photography.* By Lieut. HENRY A. REED, U.S.A. New York, *Wiley*, 1886. 4°.

M. VULPIAN recently communicated to the French academy the interesting results of an experiment on brain-mutilation in a fish. The cerebral lobes were removed from a carp on March 18 last, and the fish was under daily observation up to the 29th of September, when it died from causes believed by the author to be wholly unconnected with the brain injury. During all this time its movements and respirations were normal, not differing from those of its uninjured fellows. In fact, two months after the operation, M. Vulpian could not perceive any difference in its movements and behavior from those of healthy fishes. Its sight was in no wise impaired. It saw and avoided obstacles, and readily recognized the yellow and white fragments of boiled egg on the bottom of the aquarium. It struggled actively with its fellows to obtain the small particles of food thrown into the water, seeing them from a distance, and following them as they fell. At the approach of the one feeding the fishes, it would swim from the opposite side of the aquarium, manifesting no impairment of intelligence. Its sense of taste was preserved, as shown by its rejecting non-alimentary substances accidentally taken into its mouth. The sense of smell only, was destroyed, owing to the section of the olfactory processes; otherwise it seemed to retain all the senses, and the intellectual and instinctive faculties of the normal healthy fish. Upon examination, the cerebral lobes and pineal gland were found to be entirely wanting, but the rest of the brain was intact. Although nearly six months had elapsed since the operation, there was no indication of the regeneration of the lobes. The opening in the cranium closed up in about two months, and, had the fish lived a month or two longer, the author was certain that the walls would have been wholly ossified. The experiment shows that the instinct and the will — faculties which in all higher animals seem to be located in the cerebrum — are capable of their full manifestation in the fish after its complete ablation.

— Dr. Beaulieu, in the *Economiste français*, gives the following as the quantity of tobacco consumed by each 1,000 people in Europe; in Spain, 110 pounds; Italy, 128; Great Britain, 138; Prussia, 182; Hungary, 207; France, 210; Denmark, 284; Norway, 229; Austria, 273; Germany, 336; Holland, 448; Belgium, 560.

SCIENCE.

FRIDAY, NOVEMBER 26, 1886.

COMMENT AND CRITICISM.

WITH THIS ISSUE, *Science* offers to its readers an educational supplement, and a portion of the body of the paper is also given over to matters of educational interest. Hereafter this will be the case with every fourth number of the paper. These educational numbers will also be reprinted separately, and bound as an educational journal complete in itself, entitled *Science and education.* This will be furnished separately to teachers and others who may desire it and yet not feel able to subscribe for *Science* as a whole. The object in taking this step is to emphasize and elucidate the truth that education is a science, and teaching a profession. While adhering to no particular school of pedagogics, we believe that the present movement in favor of the scientific treatment of education is eminently proper, and we mean to aid it by all means in our power. As education, like civilization, is international, we shall endeavor to present to our readers from time to time an account of what is doing in Europe, and to inform them concerning current pedagogical literature, both American and foreign. We shall include articles on the history of education, the art of instruction, the science of education, classical study, industrial education, science-teaching, normal-school methods, school discipline, common-school questions, and cognate subjects. We hope to make our book-reviews especially useful to teachers and general readers, and to tell them what new books we consider useful to educational science, and what harmful. We propose to make this educational journal essential to teachers, and to educators generally, and to lend an efficient hand in aiding true educational progress.

THE VICE-CHANCELLORSHIP of the University of Oxford is the most influential office of the university, and the election to the position a great honor. Inasmuch as the vice-chancellor is the virtual executive officer, and enjoys many special prerogatives and privileges, his is a position of great influence and responsibility. Nominally the vice-chancellor is elected for a year; but if he is willing, and his health permits, he is re-elected annually for three years: so the full term is practically four years. A new vice-cancellarean term has just begun at Oxford, Prof. Benjamin Jowett, master of Balliol college, having completed his four-years' tenure. His successor is Dr. Bellamy, president of St. John's college, a man of conservative tendencies, and of whom nothing but good is spoken. Professor Jowett has been called the most learned man in England, and his vice-chancellorship, quite in keeping with his reputation, has been notable. He may be called a radical, so far as that term will apply in the field of scholarship, and he has been instrumental in breaking down many of the old traditions that have trammelled his university and limited its usefulness. Under his active direction, the Indian institute was opened, the new physiological laboratory built and endowed, — a tremendous blow to the conservative element, — a new theatre built for academic uses, an actor invited to lecture before the university, the examination schools used as ball-rooms, and a non-conformist college actually founded. Corresponding to these external evidences, Professor Jowett has infused into the university a spirit of catholicity and tolerance utterly new to it. It is safe to say that among his greatest works will always be reckoned his liberalizing of the ancient university. His services to the cause of education are of inestimable value, and we trust he may long be spared to enjoy the honors he has so richly deserved.

ARTICULATENESS IN ANY SCHEME of education is essential to its perfection. In state-controlled education this articulateness is obtained by law, but in countries like our own it is left to circumstances and the discretion of the authorities of the separate grades of educational institutions. All honorable endeavor should be made, therefore, to bring these authorities frequently together, that they may learn each other's wants and necessities, and work together for their common end. An attempt to do this is being made to-day in Philadelphia, where a convention of teachers interested in preparing boys for college is being held. Papers are to be read, — those announced in the programme are by Professor James of the University of Pennsylvania, and Professor West of Princeton, — and followed by general discussion. The meeting should be a valuable one, and we trust it will be. It would be especially notable should it prove to be the first step in bringing our colleges and preparatory schools into frequent and close conference in some official manner.

A CIRCULAR FROM PROFESSOR LESLEY, state geologist of Pennsylvania, announces that Mr. C. A. Ashburner, who has in recent years acted as geologist in charge, has resigned this position for the purpose of associating himself with a company in Pittsburgh, that, among other projects, proposes to undertake a systematic search for and development of natural-gas fields for economic uses. Mr. Ashburner's services on the state survey, especially in the anthracite region, are well known and highly appreciated by American geologists, and it is fortunate that part of his time may still be given to the completion of work at present in hand. It is gratifying also to see that Mr. Ashburner's geological studies have led him to so practical and valuable a knowledge of the occurrence of natural gas, that his guidance in the search for this new fuel is now needed by commercial men who measure their good opinion in high salaries, with which the pay for the more purely scientific work of a geological survey, as measured by legislative opinion, cannot compete.

PLEURO-PNEUMONIA, which has lately given the authorities so much trouble and anxiety in Illinois, is steadily advancing into other states. It is now attacking herds of cattle in the counties of Harvard, Clinton, Newton, Jasper, and Benton, in the state of Indiana, and it is reported that infected animals have been shipped to other counties. The U. S. authorities have, in our judgment, been very remiss in their duties in respect to contagious pleuro-pneumonia. The increased prevalence of this disease was brought to their attention some years ago, and they were urged by sanitarians and veterinarians alike to take the steps necessary to its control and extinction; but the appeals were in vain. It will be found, we predict, before many months have passed, that the government must take the most radical steps if it expects to cope with this disease, which has already cost the country millions of dollars, and will doubtless cost it as many more before its progress is stayed.

MR. ALFRED RUSSELL WALLACE, D.C.L., who read a paper before the National academy of sciences at Boston recently, and who is to deliver Lowell institute lectures this year, should need no introduction to American students and scientists. Mr. Wallace shares with Charles Darwin the honor of having discovered the laws of the modification of species and of natural selection. Mr. Darwin, in the introduction to his 'Origin of species,' refers to Mr. Wallace's work in the same fields as his own. Mr. Wallace, however, is more conservative than the more ardent Darwinians in his limitation of the scope of the laws of natural selection. Mr. Wallace's principal writings, aside from his numerous special contributions to the proceedings of learned societies, are, 'Travels on the Amazon and Rio Negro' (1853), 'Palm trees of the Amazon' (1853), 'The Malay Archipelago' (1869), 'Contributions to the theory of natural selection' (1870), 'Miracles and modern Spiritualists' (1875), 'Geographical distribution of animals' (1876), 'Tropical nature' (1878), 'Island life' (1880), 'Land nationalization' (1882), and a work edited by him on Australasia, to which he was also a large contributor. In 1885 Mr. Wallace published an essay on 'Bad times,' ascribing them to an excessive war expenditure, the increase of speculation and of millionnaires, and to the depopulation of the rural districts. Mr. Wallace's political and social opinions are not so authoritative as those on subjects in the domain of natural science. The socialists, anti-vaccinationists, and Spiritualists all claim Mr. Wallace as one of themselves, though with how much reason we do not know.

THE GREAT ATTENTION that the phenomena of hypnotism have attracted in France, owing doubtless to the prevalence of that nervously volatile temperament necessary for a good hypnotic subject, has culminated in the establishment of a monthly review, already referred to in *Science* (Sept. 3, p. 207), devoted exclusively to this subject (*Revue de l'hypnotisme expérimental et thérapeutique*). The editor is Dr. Edgar Bérillon, who has gathered together a goodly array of collaborators. 'Hypnotism is the order of the day:' thus says the opening editorial. Societies having for their object the investigation of this side of psychic life are flourishing; many physicians (in France) are employing it as a therapeutic agent, especially in nervous diseases; the question of responsibility in this condition must be discussed by medico-legal experts; the physiology and psychology of this attention-cramp, or whatever we call it, must be worked out. Hence a review. Judging from the contents of the first four numbers of the *Revue*, one must pronounce it a very convenient publication. It will enable one to follow the development of this interesting movement with least waste of time. It differs from the proceedings of our psychic research societies in that its aim is essentially practical, and the interest it represents largely medical. True, we are introduced to such novelties as hypnotizing through the telephone, and the action of medicaments at a distance; but these are brought forward to show the extent of the change in sensibility in hypnotics, not as evidences of 'supernormal' gifts. There is a large scientific field for this sort of study; and physicians, particularly specialists in nervous diseases, are the ones best qualified to take it up. On the whole, the movement represented by the staff of this review may be regarded as a very promising one.

THE REPORT of the British commissioners of customs for the last fiscal year contains some interesting statistics and observations. We learn, that, inclusive of warehouse charges and the revenue of the Isle of Man, the customs revenue for the year amounted to £19,916,995, a decrease of over £800,000 from the receipts of the preceding year. Some of this difference is attributable to the fact that the receipts for the last quarter of the preceding year were unusually increased by the general expectation that the duty on some articles, notably tea, was to be increased; and consequently unusually large imports were made in order to gain the advantage of an increase in the customs tax. The consumption of coffee, as measured by the customs returns, continues to decrease, the commissioners saying that not even the low duty of one and a half pence a pound is able to counteract the inconvenience which is inevitable in its preparation for consumption in comparison with tea. If the receipts from coffee, based on the returns of ten years ago, had kept pace with the growth of population, they should have yielded this year a revenue of £227,644; while as a matter of fact they yield only £207,977. The decrease in the receipts from rum and brandy together amounts to £195,610, which seems a proof of a real and large decrease in the consumption of them. Tobacco shows an increase of £12,351; but, as much of the quantity imported is still in storage, this sum does not fairly measure an increased consumption. As regards smuggling, the commissioners observe that it is in tobacco that nearly all the frauds on the revenue by importation are attempted, and they regret to have to report that their experience leads them to conclude that an organized system of smuggling is in operation at all the large ports trading regularly with countries where tobacco is to be bought at a slight increase on its cost of production, and that to effectually check this illegal practice great severity of the revenue laws and the utmost vigilance of the officers are necessary.

ACCORDING TO THE ANNUAL REPORT of the commissioner of internal revenue, the receipts of the U.S. treasury from that source for the last fiscal year were $116,902,869, an increase of about $4,500,000 over the receipts for 1885. The cost of collection was 3.6 per cent of the amount collected; last year it was 3.9 per cent. Violations of the internal revenue law seem almost wholly confined to the mountainous districts of Georgia, North Carolina, Tennessee, Kentucky, and Virginia, where considerable illicit distilling is carried on. Property to the value of $286,902 was seized during the year for violations of the law, 6,242 distilleries were registered, and 6,034 operated, during the year. In reference to the operation of the new oleomargarine tax law, the commissioner says that "it is impossible at this time to estimate the amount of internal revenue which will be derived from oleomargarine. If, however, the operation of the law should prove unsatisfactory in its present form, which is construed to levy a tax only upon the article manufactured and sold or removed for consumption or sale as supposititious butter, the law can be so amended as, while imposing a tax upon oleomargarine-oil, neutral, and such like substances, without which the supposititious butter cannot be extensively manufactured, to provide also for the use of such substances by subsequent compounders without the payment of a second tax, as rectifiers are allowed to compound distilled spirits on which the tax is paid without paying an additional gallon-tax, simply by delivering up the original tax-paid stamps, and receiving in exchange other stamps representing the same quantity; also for refunding the tax on so much as is used for lubricating purposes or otherwise in the arts and sciences. In my opinion, the advantage in securing the tax from the manufacturer who derives his material from the slaughtered animals cannot be overestimated. These manufacturers are comparatively few in number. By requiring them to stamp and brand all their productions, and to keep such books as will indicate the destination of their products, such products can be followed to the dealers, and through the dealers to the customers. At the same time, by the use of a system of exchanging stamps similar to that now in operation as to distilled spirits, the article may be readily identified by the consumer without necessitating the imposition of a second tax."

THE SKILL DISPLAYED by Mr. Edward Burgess in the application of scientific principles to the construction of yachts has again received a mark of appreciation from the Naturalists' club of Boston, to which he belongs, and which last year gave him a dinner to commemorate the victory of the Puritan. Last Friday, at a dinner given in his honor, at which some fifty members were present, the club presented him with a pair of silver salt-cellars modelled after 'nature's most graceful designs,'—one of them a miniature Nautilus inscribed 'Puritan;' the other an Argonaut-shell of similar size, marked 'Mayflower;' and both excellent copies of the originals; while the spoons have handles of twisted rope, and on the back of the bowls, delicately raised pictures of the famous yachts. No pains were spared in the workmanship.

WOMEN ON THE NEW YORK SCHOOL BOARD.

AS was foreshadowed in a recent number of *Science* (viii. No. 197), the movement in favor of the appointment of women to the board of education in New York City, has been successful. On Wednesday of last week, Mayor Grace filed his appointments, and the list was found to be made up of three new men, two of the old commissioners who were re-appointed, and two women. In taking this step, the mayor has put himself in line with advanced thought on this subject, and has, we feel certain, contributed in no small degree to the increased efficiency of the public-school system. For years women have sat on the school boards of London, Edinburgh, and other foreign cities, and many of our own towns and school districts choose one or more women among their managers. When we consider the character of education in general, the peculiar conditions of public instruction, the fact that a large proportion — not infrequently a majority — of public-school students are girls, and that fully nine-tenths of the public-school teachers are women, the reasons for the presence of women on the boards of education are apparent. Then, too, it is highly probable that the presence of women commissioners will raise the deliberations of a board of education to a higher plane, and lift them out of the political entanglements in which they are too often caught.

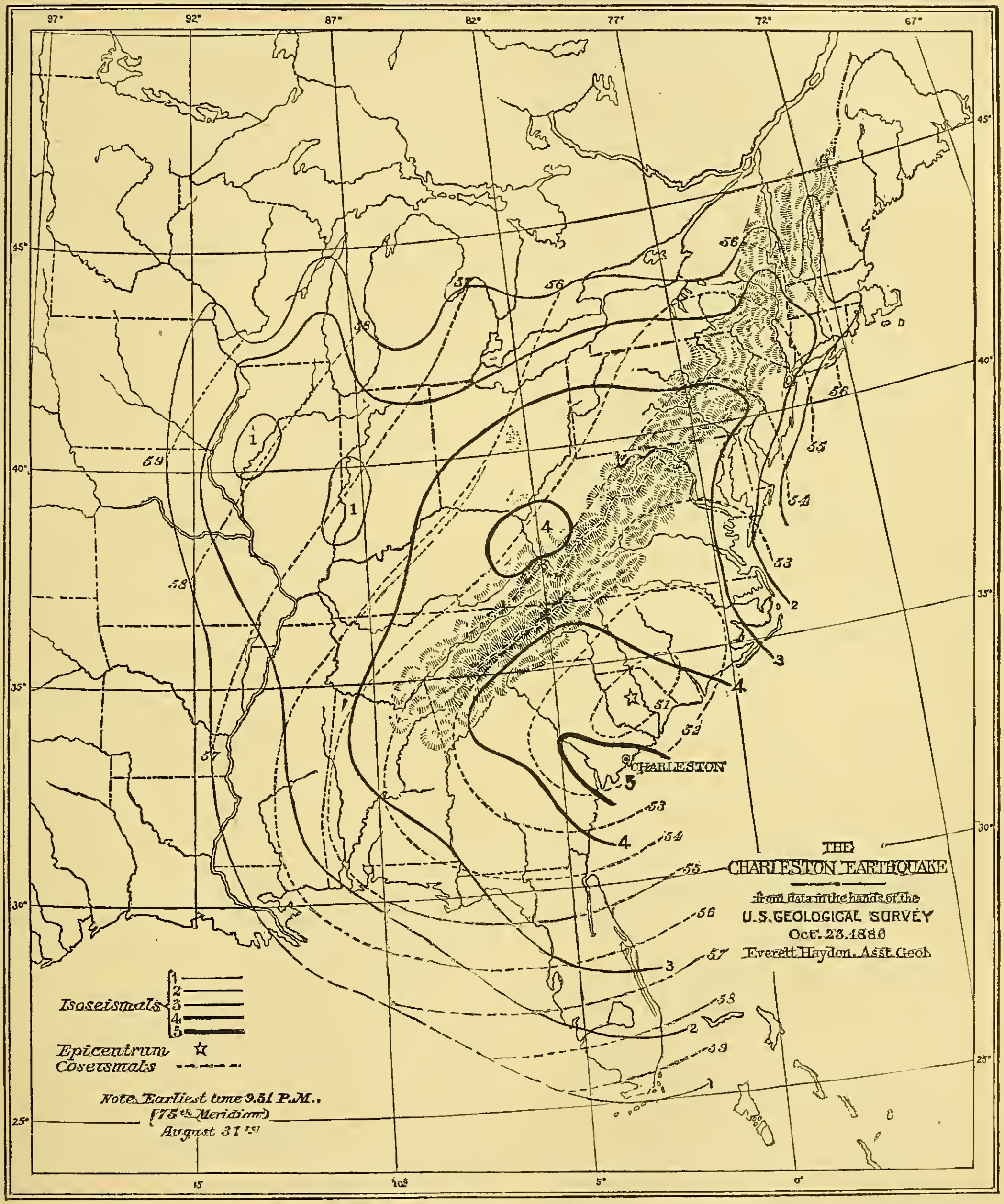
All these considerations apply with peculiar force to New York City; and, moreover, these commissioners of education enjoy a position of great influence and honor. The board of education has general supervision of the whole school system. It appoints the principals of schools, but not the teachers. these are appointed by the trustees of the various wards, who, in turn, are chosen by the board of education for a term of four years. All the money and supplies for the schools are voted by the board, and all repairs and new buildings and the purchase of sites are directed by it.

In making these particular appointments, Mayor Grace has avoided what would have been a great mistake. He has not appointed any 'cranks' or any professional agitators for 'woman's rights.' At such a time plenty of these persons come forward as candidates, but their appointment would have been turning the whole movement into ridicule. Both of the women chosen by the mayor are of the highest standing, morally, intellectually, and socially. They are neither agitators nor theorists, but women of pure Christian character, great ability, and, what is quite as essential to a commissioner of education, some common sense. They are both deeply interested in education, and close students of its theory and practice. Distinguished for years in connection with the prominent charities and philanthropic institutions of a great city, we have every reason to predict that the character and talents which they bring to their new and somewhat trying office will elevate and improve its public-school system.

THE CHARLESTON EARTHQUAKE.

WE are indebted to the Philosophical society of Washington for permission to use the accompanying map in advance of its regular publication in their Proceedings. It was presented by Mr. Hayden to illustrate his paper on the Charleston earthquake, read before the society on Oct. 23, and represents graphically the data which had reached the U. S. geological survey concerning the distribution of the earth-wave from the great shock of Aug. 31, as to area, intensity (isoseismals), and time (coseismals). It was compiled mostly from information sent in by private correspondents, and it will be interesting to compare it with results obtained later, when much additional data will be at hand from the signal service, lighthouse board, and other official sources.

Calls for information in the public press and by circular letters have been so generously responded to, however, that the lines may be regarded as fairly well established, although if our readers notice any inconsistency between the times and relative intensities, as plotted, with any facts which have come to their knowledge, the survey will no doubt be glad to hear of it. These lines, when drawn from reliable observations, form, perhaps, the most important of all records that can be made, and on such data the future progress of seismology must be largely based.



The outer isoseismal (where the shock was felt by only a few persons) encloses a land area of 774,000 square miles, and adding only half as much more for the ocean and gulf makes the disturbed area very nearly as large as that given by Reclus for the great Lisbon earthquake of 1755. Indeed, the state department has reported one reliable observation showing that it reached Bermuda. The irregularities of the isoseismals are, of course, due to the varying geologic and topographic structure of the country, and will well repay a more careful study than we have space for here. The rapid loss of energy in the sands and alluvial deposits of the north-east coast and lower Mississippi valley is especially noticeable. The isolated areas of different intensities, too, are typical of cases which would be very numerous were it possible to plot intensities in great detail, instead of only indicating the general features of their distribution.

The coseismals were determined by many very reliable and consistent but non-instrumental observations, the most accurate being from points in that part of the disturbed area north of a line from Jacksonville, Fla., to St. Louis. For the most part, high velocities of wave-transmission are indicated. Where the lines are somewhat crowded, it must be owing, at least in part, to the earlier tremors having failed to reach so far; so that a later phase of the wave was successively felt and recorded. The general use of standard time has added greatly to the reliability of these observations; and, on the whole, we may perhaps be justified in feeling a certain sense of self-satisfaction, in view of Mallet's remark, that "the accurate measurement of time is one of the surest indications of advancing civilization."

At the present age of this young and interesting science, probably the most valuable results will be obtained from observations made at numerous points in a selected district, with some simple instruments which will accurately record the time, number, and duration of every shock that occurs.

TECHNICAL AND MANUAL TRAINING CLASSES OF THE SOCIETY OF DECORATIVE ART.

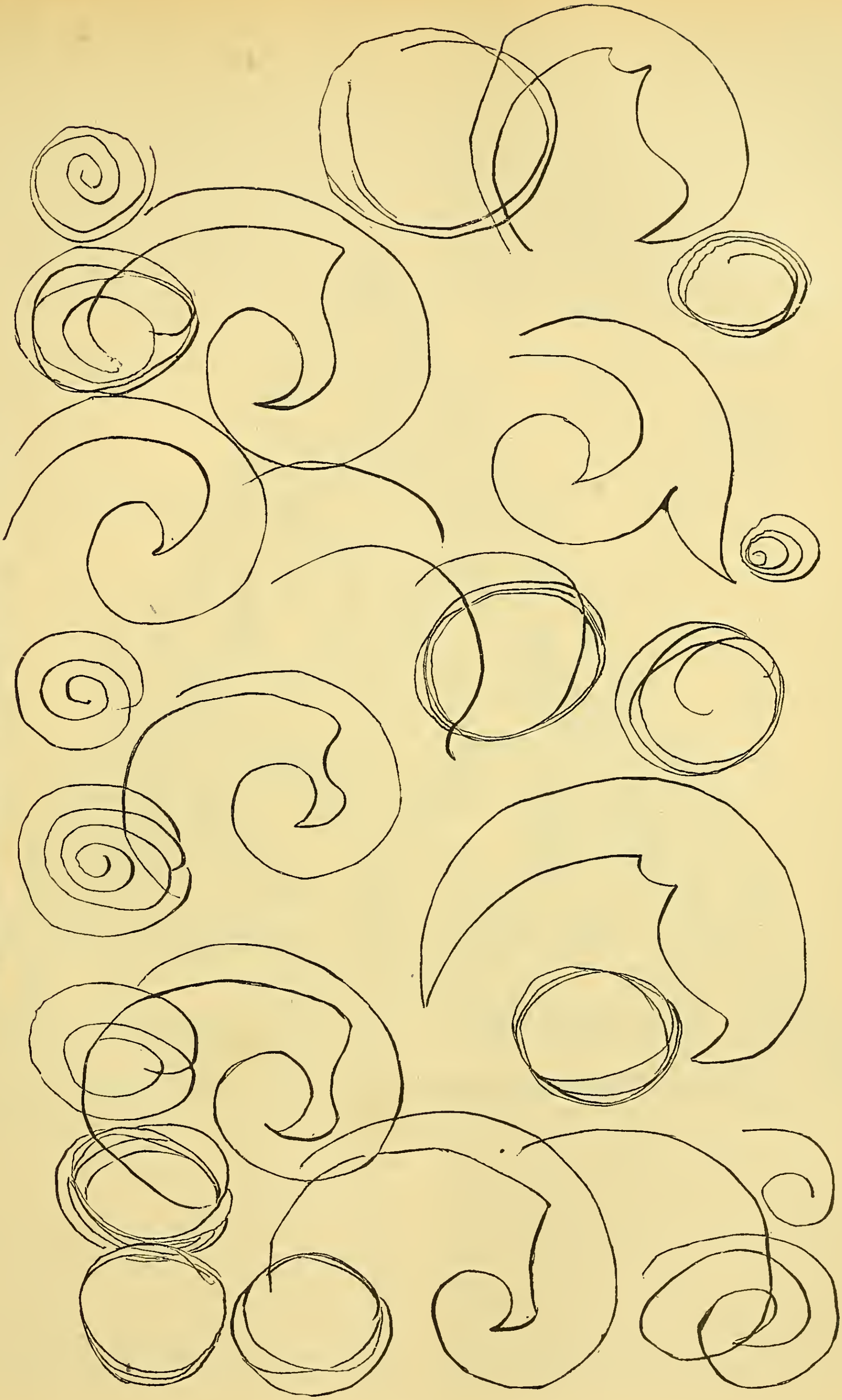
IN the autumn of 1885 the Society of decorative art of New York, desiring to extend its educational advantages, opened an art-school, where men and women, boys and girls, might be trained in the principles of art, and in the rudimentary steps of various art-industries. The first season was one of much usefulness and encouragement, and the second opens with promise. The school is centrally located in West 22d Street, Nos. 37 and 39. An important feature of the school, in addition to classes in drawing, painting, modelling from life, from still-life, and from the antique, is a special department in manual training, as applied to practical designing, modelling in clay, wood-carving, and metal-working.

In considering the plan of instruction of this new school, the fact must be borne in mind that the work of the Society of decorative art has, from its inception, been distinctively educational. The object of the society was to develop art-industry in America; to extend among women the knowledge of art-needlework, and its adaptation to household decoration; to provide instruction; to lend books; to give helpful criticism for the guidance of those at a distance; and, in addition, to furnish a salesroom where artistic work might be brought to the notice of purchasers.

In the brief period of its life, — less than ten years, — the society has faithfully striven to accomplish these purposes. A standard of color-design, workmanship, and adaptation, has been created through its influence,— an influence which is felt in every home throughout the country, and may be recognized in the wares of the humblest shop where decorative materials are sold. Needlework was almost a lost art, so entirely had the sewing-machine triumphed: it has already taken a place among art-industries. Hundreds of women have been trained by the society, and have gone forth to earn a living and provide homes for themselves and those dependent upon them.

The demand of the age is for workers — men or women — who can 'do.' The artisan who has command of head and hand alike is the one who is sure of success. Human machines can have no chance in competition with those who are intelligent in their work. Head-craft and hand-craft combined give to the worker a solid stone on which to stand. The society's department for technical and manual training provides just this education. Classes have been formed where boys and girls are taught to think and do; to use brain, eye, and hand together, that they may become intelligent and disciplined workers.

The school is fortunate in having secured the services of Mr. J. Liberty Tadd as director, who brings to his work an enthusiasm and confidence born of success. The keynote of his teaching is, that everybody has capacity in some direction. Training will develop the peculiar aptitude. The earlier in life this work of training begins, the better for the pupil. The child, restless and impatient, is eager to try its hand, and welcomes a suggestion to 'make something.' This desire is gratified and directed, interest is held, ambition stirred, and thought developed. The result is calm, quiet growth, an appreciation of labor, a

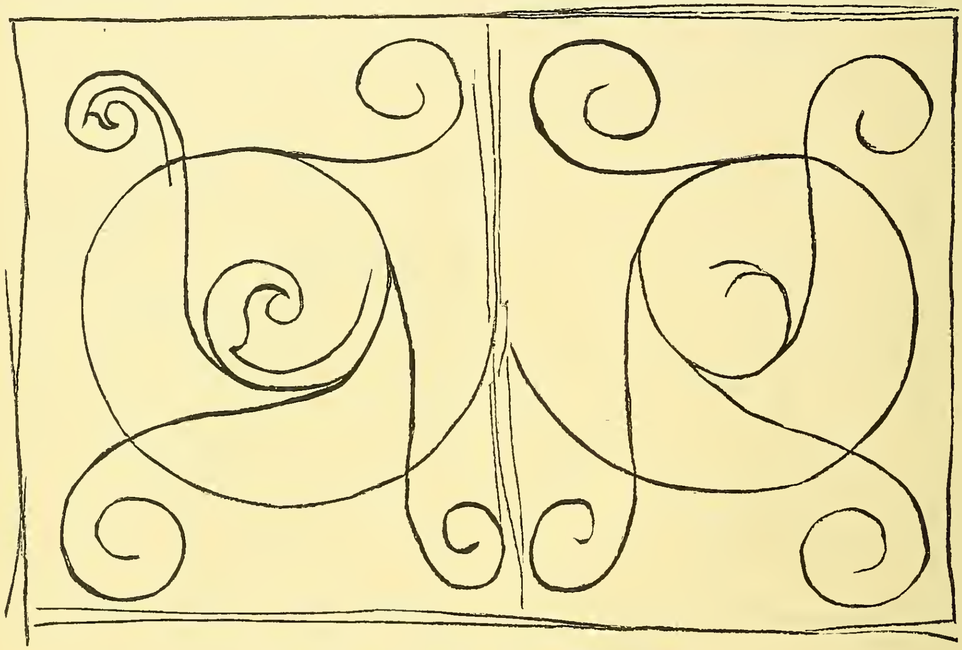


ELEMENTARY PRACTICE AT THE NEW YORK ART-SCHOOL (slightly reduced).

knowledge of material, and an ability to both plan and execute that is surprising. Children cannot be made interested and enthusiastic by abstract ideas. They must see, to know.

At the foundation of technical study lies practical designing. Some knowledge of its principles is necessary in almost every pursuit. The acquisition of this knowledge, and reasonable skill, may be easily obtained without special gift or artistic talent. Let us take, for example, one of the free classes. These meet three evenings of the week. The students are ranged on either side of long tables, each of which commands a view of the large blackboard. In front of each pupil is a sheet of clean brown paper, a piece of rubber, and a pencil.

The instructor draws upon the blackboard with a piece of chalk the elements of all drawing or design, — three lines, straight, diagonal, and curved. He explains that the first step in drawing is to learn to put these down with free sweep of the hand,— no piecing out or adding to a broken, given-out line. Many attempts are made, and many sheets of paper covered with crude efforts, to catch the proper knack or to acquire steadiness of hand. But paper is cheap, and the struggler is not limited by material. The hand has naturally more facility in some directions than in others: this tendency must be controlled, and evenness of action developed. It cannot be done all at once. Then comes the second step. The elementary lines are to be combined into certain forms,— motives of the Persian, Egyptian, Greek, Roman, Moorish, modern French, or any other school of design chosen by the instructor. These forms are drawn upon the board : the pupil repeats them on the side of his paper. He has now a leaf as his dictionary, and will in time learn the peculiar characteristics of each school of ornament. He is asked to take the forms given, to enlarge, combine, and repeat them in a pattern which shall be suitable for something, — sofa-cushion, frieze, mantel-tile, church-panel, or locomotive plate. The pupil is called upon for a mental creation. He draws a square or rectangle and locates the central point, from which and around which the intervolutions of his pattern are to be arranged. At this stage he is apt to find himself rather dazed and helpless. He is obliged to think definitely.



A BOY'S (AGE 11 YEARS) FIRST DESIGN (same size).

He is assisted a little, and his ideas brought into shape by the question, 'For what do you propose to make a design?' Usual answer, 'A panel.' 'That is too indefinite : a panel for a door, wainscot, ceiling, sideboard, desk, or chair-back?' Suppose the decision to be a sideboard. Then follow the questions, 'How many panels are there to be?' 'Are all to be the same shape and size?'

'Is the design to be carved in relief, or outlined on the wood?' etc. When the thing has been so variously and closely considered, the pupil has quite distinctly a mind-picture of his sideboard, and he sees his design, or the one he means to make, in its place, reproduced in material. He knows exactly what he wants to do, the leading thought being the adaptation of his design to the place and material in which it is to be given permanent shape. The first result is crude, and unworthy of his own thought, but day after day the improvement is marked. With deftness of hand comes strength and vigor of conception. The same motives will weave themselves into a hundred different combinations; and yet, through all the deviations and intricacies of a geometrical figure or Arabesque scroll-work, may be seen the original elements.

The designs are drawn in narrow ribbons or spaces about half an inch wide. When the pattern is finished, to make it more vigorous, it is thrown into relief by blackening the background. This is done with India ink and a brush. This is a lesson in accuracy. To follow the curves neatly, preserving a strong, clean outline, is no easy matter. A free, steady, and true hand is needed. The best work is marked for inspection, and placed against the wall. In three months' time there is usually a display of much artistic value.

THE BOY'S SECOND DESIGN (one-third size).

As yet, the work has been only on the flat surface. The pupil must go further. When a good design has been made, the important requisite is to give it form, to 'put it into the round' by repeating it in clay. Here the work is tested in the cheapest possible material, and here the pupil learns to use his hands in earnest. Artist and artisan meet in the modelling-room, for in this reproduction the truth of art is found. In the dividing, handling, and manipulation of material their use is learned, and with this knowledge comes power. Fidelity, experience, and skill acquired in the use of clay give double value to the later work in wood, iron, brass, copper, stone, or marble.

When the student repeats his conception in the clay with his own hand, when, instead of a flat surface, his work takes form, he learns its minute details, and sees what lack of fitness there may be in the design. He is trained also to a system of

MODELLING FROM LIFE.

'values,'— the value of material and of labor. He learns that it is the skill of the artisan which gives value to material. The modelling-room makes flexible and develops every muscle of his hand and wrist.

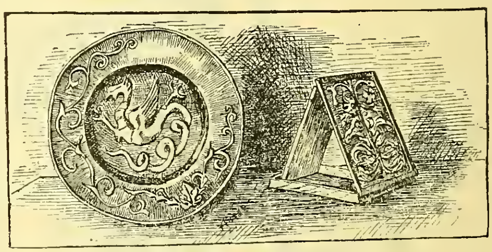
The school attempts no graded course at present. The pupil, however, who undertakes wood-carving or metal-work without some knowledge of design, can never be an independent worker. The first need when he takes up his panel or his sheet of copper or brass, before a tool is handled, is ability to draw thereon a pattern.

Many specimens of wood-carving and metal-work done by students can be seen at the schools, as well as the actual processes themselves. The woman who takes fifty cents' worth of oak, or eighty cents' worth of mahogany, and can add to it as it passes through her hand such beauty of carving that its value is increased a hundred-fold, has a power that is worth something. The range of wood-work is unlimited. Panels, mirror-frames, a substantial wood-box, a massive hall settee with antique scroll-work, are made, all with ornamental carving. In the metals, among the many articles made, are brass finger-plates for doors, silver napkin-rings beautifully chased, copper plaques, Arabesque corners and hinges for boxes, tables, and so on.

It is a painful truth that not all the men and women who set before themselves an artist's career can or do succeed. But talent and industry may raise a man or woman from the rank and file into distinguished standing, both in the minor or industrial arts and in the higher fields of sculpture and painting. The two departments stand in a helpful relation to each other, and should be so considered.

This is the stand-point from which the art-school of the Society of decorative art is working. The classes of the industrial and technical department are free three evenings in the week. One of these evenings is to be given particularly to the instruction of those who wish to become teachers. The day classes, held morning and afternoon, have a moderate charge. The studios are open, and free to students for practice, every day.

A small but carefully chosen library has been opened this season, where, in a bright room, the



SOME OF THE RESULTS.

pupils may have access to books and current art-literature, foreign and American, with opportunity for quiet thought and study.

The motive of the whole system is true education, and intelligent work on the simplest, most practical principles. No attempt is made in the technical and manual training classes to specialize. A boy or girl is simply prepared for life, ready for any trade to which they may be called, in command of self, with a knowledge of what can be done, and a power to do it accurately, intelligently, and skilfully. But leaving out all question of artist or artisan, there is a discipline, a culture, and a training of the powers of observation, that are of inestimable value in after-life.

From time to time during the winter, lectures are given at the school upon subjects connected with the studies. Visitors who wish to see the work of the school will find the studios open each day from nine until twelve in the morning, and from one until four in the afternoon. The free classes are taught from half-past seven to half-past nine, Monday, Tuesday, and Wednesday evenings of each week. EMMA MOFFETT TYNG.

RIO DE JANEIRO LETTER.

THE scientific movement of Brazil can afford but little matter of interest to the outside world. Within the last few years a few isolated workers have succeeded in making their names known beyond the limits of the country, but for the present they are too few to have established any noteworthy centres of scientific thought, either in the way of societies or periodicals. Outside of the medical profession, which maintains a very creditable society and one or two special journals, the spirit of association has taken the direction mainly of organizing geographical societies, of which Rio de Janeiro boasts of three,— the old and highly reputable though decidedly fossilized Historical, geographical, and ethnological institute, the more recent Rio de Janeiro section of the Lisbon geographical society, and the Rio de Janeiro geographical society. Each publishes its review, mainly valuable cn account of the insertion and discussion of old and little-known documents, recent contributions of importance rarely appearing. This abundance of geographical societies is not due to a superabundance of active workers, but to a sudden outburst of enthusiasm and fraternal good feeling, awakened by a visit from the Portuguese explorer of Africa, Major Serpa Pinto. On this occasion Brazilians and Portuguese united in founding a section of the Lisbon society to commemorate his visit. National rivalries soon appeared, however, and led to the withdrawal of a portion of the Brazilian element to found the Rio de Janeiro society, which, of the three, appears at present to possess the most vitality and promise of usefulness.

The other scientific publications are the *Archivos do museu nacional*, of which six volumes have been issued, containing articles on archeology, anthropology, zoölogy, and geology, contributed mainly by the officers of the museum; the *Annals da Escola de minas de Auro Preto*, of which the four volumes published are mainly devoted to metallurgy and mineralogy; and the recently established monthly *Revista do observatorio*, which is taking a very useful direction in the collection of meteorological observations from various points of the empire. Private enterprise in the publication of scientific journals has taken the direction of technical reviews for engineers and architects, of which three are published. In the absence of other organs, articles of general science are sometimes inserted in these, particularly in the oldest and best established of them, the *Revista de engenharia*. The last number of the *Archivos do museu*, issued near the end of last year, contained profusely illustrated articles on the extraordinary ornamented pottery of the mounds of Marajo. The next volume, to be issued shortly, will be devoted to a memoir by Dr. C. A. White of Washington, on the Brazilian cretaceous fossils, and will undoubtedly be the most important contribution ever made to South American invertebrate paleontology.

Since the beginning of the present year, three official commissions have been organized, from which results of some value may be expected, and of which notice has already been given in *Science*. The first in point of time is for a geographical and geological survey of the province of San Paulo, on the plan of the U. S. surveys of the territories, under the charge of Prof. O. A. Derby of the national museum. The first work undertaken was the exploration of the second largest river of the province, the Paranapanema, tributary of the Parana. The party, consisting of Dr. Theodoro Sampaio, geographer, with Dr. J. W. Aguiar as assistant, and Dr. Paula Oliveira geologist, embarked on the upper river May 22, and has only just returned, having traversed about 900 kilometres of difficult river in a sparsely populated, almost desert region, and about 500 kilometres by land, all in a region that had never before been scientifically examined. The river was found to be full of dangerous falls and rapids in its middle section, of the extension of about 120 kilometres, but comparatively free from obstruction in an upper section of 200 kilometres, and a lower section of 309 kilometres. The latter section promises to become an important link in the system of internal communications with the distant province of Matto Grosso. For over half its course, the river flows through a region of bedded traps, presumably of triassic age. The chief of the commission has been engaged in the examination of a remarkable development of nepheline sienites, occurring in several points of the province, and in such intimate association with typical volcanic rocks, tuffs, phonolites, trachites, nepheline, leucite, and olivine basalts, as to establish the volcanic character of the whole group. The passage of nepheline sienite to phonolite is clearly demonstrated, and leucite rocks are reported for the first time in South America.

A second commission, appointed by the minister of agriculture, is for a study of the disease of the coffee-plant, that during the past few years has destroyed a large number of plantations over a considerable area in the northern part of the province of Rio de Janeiro. This is intrusted to Dr. Emil Göldi, an able and energetic young Swiss naturalist, who has recently been appointed sub-director of the zoölogical section of the national museum. Dr. Göldi has been in the field for the last two months, studying the disease *in situ*, but as yet has not made public any of his results. A valuable biological contribution may be confidently expected from this commission.

A third commission, headed by Dr. J. B. Lacerda, well known through his researches on snake-poison and on beriberi, is about to proceed to the northern provinces of Pará and Maranham to study the disease beriberi, which is extending rapidly over the north of the empire, and is beginning to appear to an alarming extent in the south as well. The last steamer to New York takes the president of the chamber of deputies, who is making a sea-voyage in the hope of throwing off the disease ; and a prominent physician of Rio, who was appointed on the beriberi commission, has been obliged to resign on account of having become a sufferer from it. As has already been noticed in *Science*, Dr. Lacerda attributes the disease to a microbe, a conclusion which has been confirmed by Dr. Ogata Masanori of Tokio, in Japan. Up to the present time, elements for the study of beriberi have been rather difficult to obtain in Rio, and the present study in the principal centres of the disease will undoubtedly add greatly to our knowledge on the subject. Dr. Lacerda has also been investigating a very similar disease of horses, very prevalent in the provinces of Pará and Matto Grosso, known as *peste da Cadeiras*, or hip-evil, which at one time he was inclined to identify with the beriberi ; but he has recently discovered some well-marked differences in the micro-organisms characteristic of the two.

Considerable interest has been manifested among medical men in the proposed American commission to study Dr. Frere's yellow-fever investigations, and methods of inoculation. The work of Dr. Frere seems to have awakened a more lively interest abroad than here. The official support that he received as president of the board of health has been withdrawn since his retirement from that post, on account of his commendable, though perhaps not always judicious, efforts to suppress the powerful industry of manufactured wines, while the general attitude of the medical profession is that of extreme reserve. While he has a number of very fervent followers, a number of prominent physicians have vigorously combated his conclusions. As few, if any, of his critics, are practised microscopists, he has been able to meet their scientific arguments quite successfully, but has been less fortunate in the defence of his statistics regarding the immunity of inoculated persons. Like all Brazilian statistics, these are too loosely drawn to inspire confidence. A large proportion of the inoculated has been among the shifting population, whose subsequent history can only be followed with difficulty ; and Frere is accused of not admitting that the disease is yellow-fever, in the case of the death of an inoculated person, no matter what the opinion of the attending physician may be.

The National museum has recently received several interesting additions. The veteran paleontologist of Buenos Ayres, Dr. Hermann Burmeister, made it a present of a very perfect skeleton of Scelidotherium, and added greatly to the value of his gift by coming in person to superintend the mounting of it. Although in his eightieth year, Dr. Burmeister is still vigorous, and looks able to continue his work for several years yet. While in Rio, he received many attentions from the emperor and imperial family, and found himself obliged rather reluctantly to accept from the emperor the decoration of dignitary of the order of the rose, which is next to the highest rank of the order, and one seldom conferred. The museum has also received a fragment, weighing nearly two kilograms, of the famous Bendigo or Bahia meteorite, the second largest mass of native iron known ; and hopes are entertained of obtaining the entire mass, which is estimated to weigh about nine tons, and lies about sixty miles away from a recently constructed line of railroad. A wealthy gentleman of Bahia is inquiring into the feasibility of transporting it with the intention of placing it in the museum if it be found practicable. The latest addition is a perfect skeleton of a whale, apparently Balaena australis, measuring about fifteen metres in length, which was stranded a few weeks ago in a little bay to the south of Rio.

Dr. Barbosa Rodriguez, director of the museum of Manaos, province of Amazonas, has just announced the rediscovery of Lepidosiren, of which no specimens have been found since the time of Natterer and Castelnau, and whose existence in South America has recently been put in doubt. It may now be confidently expected that specimens of this rare and interesting animal can be obtained in large numbers. Y. A.

Rio de Janeiro, Oct. 15.

M. C. GUYOT, professor in the School of forestry at Nancy, is preparing an important work on 'Les forêts lorraines jusqu'en 1789.'

NOTES AND NEWS.

THE knowledge and appreciation of our educational institutions by European scholars are largely on the increase. M. Buisson, who came to this country as a French commissioner to the New Orleans exposition, made a special study of our advanced educational institutions, and is now contributing a series of articles on the subject to the *Revue internationale de l'enseignement.* The first of these has already appeared, and, after some introductory paragraphs, describes Columbia and Harvard colleges. M. Buisson has grasped clearly the nature and functions of the board of regents in New York state, and makes plain the relation sustained by that body to the various colleges and academies of the state. He was particularly impressed with Columbia's great library, and frankly says that it seems to him 'the ideal of what a university library should be,' not because of the number of its volumes, but because of its scope and organization. M. Buisson describes with great minuteness of detail the working of the library, and recommends it to the consideration of those having in charge the re-organization of the library of the University of Paris.

— Below is given the standard time-table for high schools for girls in Germany, drawn up by the commission appointed by the minister of instruction. It will shortly be adopted throughout Germany. The figures in the various columns represent hours per week.

Subjects.	Grade IX.	Grade VIII.	Grade VII.	Grade VI.	Grade V.	Grade IV.	Grade III.	Grade II.	Grade I.
Religious instruction	2	3	3	2	2	2	2	2	2
German	9	9	9	5	5	5	4	4	4
French	—	—	—	5	5	5	4	4	4
English	—	—	—	—	—	—	4	4	4
Arithmetic	3	4	4	4	4	4	2	2	2
History	—	—	—	—	—	2	2	4	4
Geography	—	—	2	2	2	2	2		
Physics and physiography	—	—	—	—	2	2	2	2	2
Singing	—	—	—	2	2	2	2	2	2
Writing	—	—	—	2	2	—	—	—	—
Drawing	—	—	2	2	2	2	2	2	2
Gymnastics	2	2	2	2	2	2	2	2	2
Needlework	2	2	2	2	2	2	2	2	2

— Dr. Schliemann, after a fruitless journey to Crete, has returned to Athens. Before leaving Constantinople, he was informed by the Turkish authorities that he must make such terms with the Cretans as he found possible, but that he must in any case pay down £1,000 as a guaranty that he would take nothing away from such excavations as he might make. The conditions under which he had formerly excavated in the Troad, namely, that he should have all the duplicate objects exhumed, were considered far from lenient, inasmuch as real duplicates very rarely occur. Taking advantage of the situation, the owners of the ground that he desired in Crete demanded £4,000 for it, and insisted upon his including in the purchase more land than he really wanted. So Dr. Schliemann came away without having dug his spade into the ground, though he saw, peeping out from the hill he desired to excavate, a huge building; but whether it was a megarm or a temple he could not tell.

— The professor of archeology at the University of Berlin, Dr. Furtwängler, has arrived at Olympia to arrange the objects which have been claimed by Greece from the excavations now concluded, in a large museum built on the spot by a patriotic Greek for their reception. He is also examining the various objects anew for the large work that is being prepared on Olympia, the German professor having been himself formerly one of the directors of the excavations.

— The first meeting of "the international congress having for its object technical, commercial, and industrial training," met at Bordeaux a few weeks since. We see no notice of any delegate from the United States being present. The conference brought clearly into view two points: 1°, the encouragement there is in the recognition of the fact that England, France, Germany, Spain, Italy, and Belgium, as well as other countries and dependencies, have common ends in view in commercial and industrial education; and, 2°, that while this first international congress was merely tentative, yet it has paved the way for future congresses to come to a surer agreement regarding principles, and to develop substantial unanimity in details. In addition to the valuable papers that were read, debates and discussions were held daily during the session of the congress, and it is believed that they contributed to give the nations of Europe a clearer and sounder knowledge of the aims and methods of technical education.

— The lord-almoner's professorship of Arabic at Cambridge university, made vacant by the resignation of Dr. Robertson Smith, the newly elected university librarian, who has held the post since Prof. Edward H. Palmer was murdered by the Arabs, has been conferred on Hon. Ion Grant Neville Keith-Falconer, M.A., of Trinity college. The new professor is the second son of the late Earl of Kintore, and, though but thirty years of age, he is very learned in the oriental languages and literature.

— It is remarked in England that the American historians are very popular there. Almost simultaneously, new editions of Prescott and of Parkman have been issued by London publishers. "Prescott has a well-established reputation, and the brilliancy of Mr. Parkman's narratives will assuredly make him a classical historian in England as well as in America."

— James M. Cattell, Ph.D., son of ex-President Cattell of Lafayette college, has recently been elected lecturer on psycho-physics at the University of Pennsylvania. Dr. Cattell has been pursuing his researches for some time past in Professor Wundt's laboratory at Leipzig, and has formulated his results in articles which have been published in *Philosophische studien* and in *Mind.*

— The new volume of Trübner's 'English and foreign philosophical library' is 'Life and works of Giordano Bruno.' It is now ready.

— Students of psychology and of philosophy generally, will be glad to know that Dr. Ferrier's work on 'The functions of the brain' has been issued in a new edition. This new edition is essentially a new book, since it has been almost entirely rewritten, and now embraces the results of the author's latest investigations, as well as a critical survey of the more important physiological and pathological researches on the functions of the brain that have been published during the last decade. The chapters on the structures of the nerve-centres and the functions of the spinal cord have been enlarged to such an extent that the book is now virtually a complete treatise on the central nervous system.

— Volume viii. of Leslie Stephen's 'Dictionary of national biography,' including names from Burton to Cantwell, has been published. The Bruces, Butlers, Campbells, Burns, Burke, Byron, Mrs. Browning, Buckle, Caedmon, Cairns, and Cairnes are among the most prominent subjects treated. Volume ix. may be expected in January.

— Investigations made by the editor of the *Academy* in several hundred schools in every state in the union give the following result as to the methods of Latin pronunciation in use. Of the institutions, 6 per cent use the continental system, 46½ per cent the Roman, and 47½ per cent the English. Some of these schools, however, are very large, others quite small; so that a comparison of the number of students trained in each method seems preferable. Such comparison shows 2 per cent using the continental, 46½ the English, and 51½ the Roman.

— A recent presidential decree in France regulates the instruction in gymnastics in the *lycées* and colleges for girls. The instruction must be given by female teachers, who must have received a certificate of aptitude from the proper authorities. Such teachers are to receive from 1,200 to 2,000 francs per year each, and may be required to teach sixteen hours a week. They must teach at least twelve hours a week.

— The English association for the improvement of geometrical teaching, says *Nature* of Sept. 30, has revised its 'Syllabus of elementary geometrical conics,' and is about to publish the same, with three figures lettered in accordance with the enunciations of the Syllabus. The work will be interleaved to allow of teachers and students supplying their own proofs, and will, it is hoped, appear in November. Messrs. Swan Sonnenschein are the publishers.

— The Bombay government, according to *Nature* of Sept. 30, has issued a long resolution on the subject of technical education, which is one of special importance to India. The resolution lays down the outlines of the scheme which it favors under three heads,— agriculture, art, and mechanical industries. It proposes that the College of science at Poonah shall be a central institution for the teaching of higher agriculture, and that local classes and schools shall be established throughout the province under the supervision of district officers and of the educational department. The Jamsetjee Jeejeebhoy school of art in Bombay is to be the centre of government efforts for the purpose of art-teaching, and a report is called for as to the propriety of obtaining additional teaching. The question whether a technological institute for mechanical industries shonld be established is discussed at some length, and the government expresses the opinion that the time for doing so has not yet come. Meanwhile it is suggested that the committee of the Ripon memorial fund should form itself into an association for promoting technical education in Bombay City, the government promising to give it the utmost possible aid. The main dependence of other parts of the province must be upon the high schools for elementary science, and upon such institutions as may be started by means of local efforts. The resolution concludes by saying that the scheme is not academic, but that it is meant to enhance the well-being of the people at large by giving increased employment to labor and capital, and by cementing harmonious relations between them.

— Dr. R. G. Eccles read a paper before the pathological society of Brooklyn recently, in which he gave the results of a long series of experiments, extending over nine months, on the value of the different pepsines in the market, and in which he showed that some of the pepsine furnished by reputable manufacturers was almost valueless, and yet sold for a price considerably above that of other dealers whose product was very active in the conversion of albuminoids into peptone. His experiments also included the retarding effect on digestion of many of the remedies which physicians prescribe to be taken at meal-time.

— Colonel Majendie, the English inspector of explosives, is now in this country, studying the methods here adopted for the regulation of the storage and sale of inflammable materials. During his stay he will visit the oil-regions of Pennsylvania and examine the oil-wells.

— As a supplement to the last number of the *Rivista di filosofia scientifica*, is issued an interesting prospectus of a new *Rivista pedagogica Italiana*, to be issued Nov. 1, under the direction of Prof. Francesco Veniali, general inspector for the minister of public instruction. Each issue will contain several articles on theoretical and applied pedagogics, a *résumé* of the progress of educational thought and activity in Italy and throughout the world, correspondence, and the full text of all official documents on education. Professor Veniali has secured as co-operators the principal professor of pedagogics in Italy, the chief government inspectors of schools, and the directors and professors of the larger normal schools. There is every reason to suppose that the new *Rivista* will be a most valuable acquisition to educational literature.

— The new rules promulgated by the educational department in France present several changes. Women are admitted as teachers at the age of seventeen, but men not until eighteen. A very important clause provides that in public schools of every description all instruction is to be given exclusively by laymen. This takes from the clergy their last hold on elementary education, for hitherto they have had the right to nominate in the schools a certain number of teachers who were not subject to the regulations under which the government teachers worked. These teachers were under the direct control, not of the minister of education, but of the superior of the religious society by whom they were appointed. In the new rules, too, the regulations respecting the qualifications of teachers, both public and private, have been made more stringent.

— The committee of the school museum at Berlin proposes to celebrate in 1890 the centenary of the birth of Diesterweg by founding a Diesterweg pedagogical museum.

— The first volume of the *Deutsche encyclopädie, ein neues universal-lexicon für alle gebiete des wissens*, has been published by Grunow of Leipzig. It comprises ten hundred and seventy pages devoted to topics whose names begin with the letter A.

— The *English historical review* for October contains an erudite and valuable article on the 'Origines of the University of Paris,' by Rev. H. Rashdall.

— The London *Journal of education* draws the following lessons from Mr. Matthew Arnold's recent report on education on the continent of Europe: 1. *All* teachers must be trained, no more acting certificates must be granted, and the college course must be extended to at least four years. 2. The demoralizing system of annual grants, dependent mainly on individual papers in the three R's, must be abolished. If the fixed capitation grant were doubled, and the remainder assigned by general merit, we should have a workable but not a perfect system. 3. The school-years must be extended. At present, in England, school-life ends, on an average, at eleven years of age: on the continent it ends at fourteen. 4. Schools must be graded.

— The first report of the Royal commission (English) to inquire into the working of the elementary education act is a large folio of 543 pages, and contains 13,684 questions and answers, in addition to voluminous appendices.

— The law by which it is forbidden in Germany to give instruction in any subject without a proper certificate or other qualification, has lately been extended to cover the case of private teachers.

— Mr. Albert V. Dicey and Mr. Harold B. Dixon have been elected fellows of Balliol college, Oxford. Mr. Dicey is Vinerian professor of English law and a well-known writer, and Mr. Dixon is lecturer on physics.

— The recent election for rector of Edinburgh university resulted in the choice of Lord Iddesleigh over Sir Lyon Playfair.

— Rev. Dr. Montagu Butler, lately head master of Harrow school, has been appointed master of Trinity college, Cambridge, in succession to the late Dr. Thompson. This position is one of the most eminent in England, and is in the immediate gift of the crown. The income is £2,670 per year.

— The *Deutsche geographische blätter* of Bremen publishes several original papers on the natives of North America. Mr. Henry T. Allen reports on the Atnatánas, or Indians of the Copper River, who, to the number of 366, occupy a territory of 25,000 square miles; Mr. Charles N. Bell of Winnipeg deals with the Ojibeways in north-western Canada; and Dr. H. Rink summarizes the information recently collected by Danish travellers respecting the Eskimo of eastern Greenland.

— Volume xxi. of the 'Encylopaedia Britannica,' which has just been issued, contains several distinctively philosophical articles. They are 'Rousseau,' by George Saintsbury; 'Scepticism,' by Andrew Seth; 'Schelling,' by Professor Adamson; 'Schleiermacher,' by Rev. J. F. Smith; 'Scholasticism,' by Andrew Seth; and 'Schopenhauer,' by Prof. William Wallace.

— Every once in a while some new hint is dropped concerning the forthcoming biography of Darwin by his son. The last is that Professor Huxley will contribute a chapter, and that the book will bear strong testimony to the influence exercised by Sir Charles Lyell over Darwin.

— Professor Tyndall's stay in Switzerland has greatly benefited his health, and he now intends to deliver the Christmas lectures at the Royal institution in London himself.

— Dr. Köhler has been succeeded as director of the German school at Athens by Dr. Peters, late professor of archeology at the University of Prague.

— The programme of the Aristotelian society of London for the winter is unusually interesting. Mr. Shadworth Hodgson opened the year's work with an address on the re-organization of philosophy. Other papers will treat of Malebranche, Leibnitz, Lotze, T. H. Green, Hegel's 'Philosophie des rechts,' and the Augustinian philosophy. Dr. Cattell of Leipzig will give an account of some recent psycho-physical researches. The ancient distinction of logic, physic, and ethic, the relation of language to thought, the distinction of fact and right, and the theory of motion, will be treated by other members of the society; and the session will be closed by Dr. Bain, 'On the ultimate questions of philosophy.'

— A new encyclopaedia of education is being prepared in England under the editorship of Mr. A. Sonnenschein and Rev. E. D. Price.

— Capt. R. L. Pythian, U.S.N., was ordered to duty on Nov. 14, as superintendent of the naval observatory at Washington. Commander A. D. Brown, who has been acting as superintendent, will continue on duty at the observatory as assistant superintendent.

— Herbert H. Smith, who has been collecting natural history specimens in South America for several years, left Rio de Janeiro for this country over a month ago upon a sailing-vessel. He brings with him enormous collections.

— The number of those who are now invalids as the result of the war is said to be 265,854, the total number of soldiers having been about one million and a quarter.

LETTERS TO THE EDITOR.

The swindler at work again.

I ENCLOSE for the benefit of others a letter from a swindler in the west, addressed to me, over the very well forged signature of Charles D. Walcott, U. S. N. M. (national museum at Washington), dated simply 'Cook co. Normal, Nov. 7, 1886.' Chicago is in Cook county, Ill. It requested the immediate despatch of a set of geological reports to Prof. George Wells Litz, of the Cook county (Ill.) normal school, and his colleague, Professor Parker.

Cook co. Normal, Nov. 7, 1886.

Prof. JOHN P. LESLEY.

Dear Sir,— Will you kindly send to Prof. George Wells Litz, of the Cook county (Ill.) normal school, a complete set of the reports of the second geological survey of Pennsylvania. I am indebted to him, and to his colleague Professor Parker, for a most delightful Sunday, and wish to place him and his friend in the way of getting literature at present inaccessible to them.

An early compliance with this request will be considered a great favor, and one to be soon repaid by your friend, CHARLES D. WALCOTT, U.S.N.M.

Mr. Walcott informs me by letter, after seeing the above letter, that he had tried to trace the rascal, but thus far without success. The fellow has obtained, under various false pretences, quantities of specimens, books, and sometimes money, from eastern geologists.

J. P. LESLEY.

Effect of electric light on plant-growth.

"The light from an electric-lamp tower in Davenport, Io., falls full upon a flower-garden about one hundred feet away; and during the past summer the owner has observed that lilies which have usually bloomed only in the day have opened in the night, and that morning-glories have unclosed their blossoms as soon as the electric light fell on them."

The above item, which originally appeared in the *Democrat* of this city, and has gone the rounds of the press, has a substantial basis of fact. The 'Jenney' system of electric lighting was introduced into this city early this past spring, and across the street from the residence of Mr. Henry W. Kerker is situated one of its towers. This tower is 125 feet high, and contains five arc lights, each of 2,000 candle-power. During the past summer, Mr. Kerker's attention was attracted to the singular effect these lights produced upon some day-lilies blooming in his garden. These flowers closed as night came on, but, as soon as the electric lamps were started up, they re-opened, and while the lights were in operation continued in full bloom. As the street is about 80 feet wide, the lights were distant some 200 feet from the flowers. Other similar observations here are reported, but, as they are less accurately verified, I pass them for the present without special mention.

CHAS. E. PUTNAM.

Davenport, Io., Nov. 19.

Milk-sickness.

This disease seems to have received but little attention from the medical fraternity, probably on account of the supposition that its ravages are circumscribed to the area within the confines of its origination; yet it is presumed that such is not the fact, and that hundreds die annually, in places far distant from the localities of its origination, by the use of meat and butter shipped from such places, as the dairy products of localities infected with this scourge have to seek a market from home; and as a natural sequence they find their way into the large cities, thus placing the fatal poison into the mouths of many.

Physicians unacquainted with it are apt, after diagnosing it, to give it fever treatment; and the resultant sequence is, that the patient dies. So the physician soon finds that he has a disease that in its special pathology, from the closest observation, he has given a febrile nosology; yet the febrile therapeutics only hasten dissolution. From its febrile semeiology, it is likely to mislead those not familiar with it in its diagnosis.

The effect of milk-sickness upon 'dry cattle,' males and sucklings, is death; but the milk-giving cow excretes the poison in the lacteal fluid, and receives but little, if any, perceptible injury from it. The buttermilk is said to be as harmless as that from well cattle, while the sweet milk and butter hold the poison; yet, from the statement of many, it does not seem to be held in solution after the milk is drawn from the cow, but seems to have a magnetic attraction for itself, thus segregating all its minute particles from the milk or butter, conglomerating and conglutinating into one imperceptible particle until swallowed by some one, when the virus at once becomes active. It is stated, upon seemingly good authority, that of a milking, if drank while sweet, although a dozen persons may partake of it, yet only one will contract the disease; and the same statement is made as regards the use of the butter made at one churning.

This disease occurs among cattle that browse on the north side of the Blue Ridge and foothills, and in dark rich coves where there is but very little sunshine. It is positively stated, that, if the cattle in the localities where the disease prevails are not allowed to graze until after the dew evaporates, the disease will not appear, provided they are driven from the place before the dew begins to accumulate in the evening; but, when a cow eats any of the herbage with the dew on it, milk-sickness is the sequence. This is the unanimous statement of native residents in localities where it originates.

The following experiments have been made with it in Macon county, N.C.: One man placed a couple of bundles of corn-fodder out in the evening, and took them the next morning before sunrise, with the dew on them, and gave them to a yearling. It died in about three days with the disease. Another person placed a piece of good, fresh beef on a rock near a brook after sunset, and the next morning early he gave it to a healthy dog, which ate it, and died in four days of the disease. This evidence would tend to show that it was not induced in cattle from poisonous plants, but from a poison held in solution in the dew, and that it evaporates with the dew.

One Dr. Cauler, last year, in the Blue Ridge *Enterprise*, published at Webster, N.C., in writing of the etiology of the disease, stated that it was caused by arsenical poisoning. He said that there were cupreous deposits in the localities where it occurred, and that the "solar heat freed the arsenic from the copper, which the dew held in solution on the herbage;" yet it occurs in localities where no copper has been found. And then, a gentleman who has manufactured arsenic says that it would be unnatural for copper to give off arsenic so easily and so freely.

Another opinion is, that it is caused by the cattle's eating a poisonous fungus, as it has been found in the stomach of a cow that died with the disease. Webster, in defining milk-sickness, concludes by saying, 'Its cause is unknown.'

There are localities in Macon county, N.C., that offer excellent opportunities for studying and investigating fully that disease; and in the same county, at Smith's Bridge post-office, lives Dr. Brabson, who, it is claimed, is the only physician in the county that fully understands the treatment of the disease. This is a matter worthy of investigation, and is really of more interest to the public than they are aware, as reasons given in the beginning of this letter show.

J. W. Walker.

Pine Mountain, Ga., Nov. 6.

[The disease to which our correspondent alludes in the foregoing letter was known in North Carolina during the past century, but was first brought to the attention of the medical profession about the year 1812. It subsequently appeared in Tennessee, Kentucky, Ohio, Indiana, Illinois, and other portions of the country. A very interesting account of this disease, and references to numerous writers, will be found in Wood's 'Practice of medicine.' As to the causation of the disease, very many theories have been held, although it seems to be generally conceded that the disease disappears as soon as the region where it exists becomes cleared up and cultivated. Some authorities have attributed to it, both in cattle and in man, a malarial origin; others have thought it to be caused by the poison vine, Rhus radicans. On this subject Dr. Wood many years ago said, "It appears to me that there is but one mode of approaching an explanation of these various phenomena. Providence may have planted in the rotten soil of our new lands certain germs, etc. Of the nature of these germs we are quite ignorant. They may be microscopic animalcules or mushrooms." Dr. Phillips observed cases on the upper water of Scioto, Ohio, and found in the blood "a great number of living, moving, spiral bacteria, similar, in their general appearance, to those spiral bacteria described by Professor Lebert as abounding in the blood of relapsing-fever patients. I also found in the urine of that patient those same spiral bacteria, and, co-existing with them, the sphero-bacteria, in segments of two to six or eight." Dr. Schmitt, who observed cases in the same region, found no bacteria in their blood. Professor Law, in the National board of health bulletin, vol. ii., No. 4, p. 456, says that "in its source, in unimproved marshy localities, it closely resembles the malignant anthrax, also in its communicability to all animals; but it differs essentially in that it fails to show anthrax lesions, in place of which it expends its energy on the nerve-centres, producing great hebetude and loss of muscular power. The germ is probably derived from drinking-water, or the surfaces of vegetables, as certain wells are found to infect with certainty, and the disease has been repeatedly produced by feeding upon particular plants (Rhus toxicodendron, etc.). That these plants, in themselves, are not the pathogenic elements, is shown by their innocuous properties when grown in places out of the region of milk-sickness infection. The great danger of this affection consists in the conveyance of the germ with unimpaired potency through the flesh and milk, and through butter and cheese. The disorder proves fatal in man as in animals." As our correspondent says, this subject is one of great interest as a disease affecting both man and animals, and we should be glad to receive any information which will indicate its present home and prevalence. — ED.]

The teaching of natural history.

I have been much interested in reading the rather unjust review of French's 'Butterflies' in a recent issue of *Science*, 'A teacher's' letter in a succeeding number, and Mr. S. H. Scudder's reply in the last. Unlike Mr. Scudder, I have been a teacher, although I have never had but one pupil, — myself; and, as I have him yet, I want to ask Mr. Scudder what I shall do with him. What education I possess was, with one exception, directed by the faculties of certain institutions, where nothing was known but Latin, Greek, and mathematics. The exception was in a high school where Gray's 'How plants grow' was used as a reading-book. The class never had a plant, a flower, or a leaf. The readers simply stood up and read the first one hundred pages of that book. The pupils asked no questions, they could not for evident reasons; neither did the teacher; and the latter volunteered no remarks; yet that botanical instructor was, it seems to me, adopting the plan advocated by Mr. Scudder, for he was not using Gray's book in 'finding out the mere names of objects:' he was allowing the book to discuss "the nature, meaning, and causes of the relative affinities of organized beings," so far as that little book could do. I did not learn the name of a single plant. I am more than sure that I learned none of the relative affinities of which Mr. Scudder speaks. How could I? Without the specimen, what meaning is conveyed to the beginner by, "A flower, with all its parts complete, consists of calyx, corolla, stamens, and pistils; one from the morning-glory will serve as an example"? The morning-glory, indeed! Why, this will never do. Morning-glory is the *name* of a plant, and Mr. Scudder says, 'The name may be called a necessary evil; and unless, with it, is more emphatically acquired a knowledge of the structural and biological relations of the object which it bears to other objects, it is worse than useless knowledge." In my case the name was not even a necessary evil, for it did not exist. I was supposed to be acquiring knowledge of structural relations in an elementary way, and the book was supposed to be teaching the class the affinities and relations of things botanical; but, so far as I am concerned, I am free to admit that the result was an abominable failure. How could I have obtained the flower called for, since I did not know the plant producing that flower?

When Mr. Scudder goes to a flower-show and sees a strange plant, does he engage the florist in a discussion about biological relations or structural affinities? No, I think Mr. Scudder says, 'What *is* that?' When Mr. Scudder finds a fossil insect, he doubtless studies its biological relations, since he is an advanced and accomplished naturalist; but, if he were an ignorant beginner, he would run to his teacher with the question, 'What *is* that?' And if he had himself for a pupil, who had not learned the structural affinities of 'the find,' he would ransack the books for the name; and, having found it, he would en have not only the key that opens the door to further knowledge of the work of other investigators, but he would have a peg as well, on which to hang his information and the result of his own investigations. If he would not do this, what would he do? In all kindness, with the heartiest feelings of esteem for Mr. Scudder, and with a burning desire to increase my own knowledge, let me beg Mr. Scudder to tell me what I shall do with my single ignorant pupil. How can I teach myself the biological relations and structural affinities of the butterflies, since I am not supposed to know the name of even the commonest butterfly? Without the name, what foundation have I on which to erect my future learning? I got the structural affinities without the names in my earliest botanical instruction. The result I do not approve. But if Mr. Scudder will tell me how to teach myself according to his plan, he will also be telling 'A teacher' how to teach his pupils, although I am *not* the author of the letter in the last *Science*. If I am not to begin by finding out the name, where shall I begin? If I dissect the butterfly, study its histology, and write a monograph on its ontogeny, and know not its name, what shall I call the book, and what will its readers say? Shall it be 'The structure and life history of *a* butterfly?' Of what butterfly? To my uninstructed eyes there seems to be more than one butterfly. If there are more than one, do they all have the same structure and life-history? Were I allowed to pursue what seems to be a natural and proper course, I would take French's excellent book, and having found the name of the specimen by French's excellent key, and having learned what French has to say in his text, I would, as I do, await the issue of Mr. Scudder's expected work on the butterflies with pleasant thoughts of anticipations about to be agreeably realized. But since this would be the wrong method, will Mr. Scudder kindly tell me what would be the right one?

A. READER.

The classics versus science.

An editorial paragraph in *Science* for Nov. 19 suggests some curious reflections. If, as you say, Mr. Lowell's oration at Harvard "is itself a justification of a classical and literary education, and a living argument for a culture loftier and deeper than that which strictly utilitarian theories would provide," does it not logically follow that science deserves no place in the curriculum, and that your own journal has little excuse for being?

Science has been added to the course of studies largely because of the demands of the utilitarians; and only in recent days, and faintly, has its disciplinary value been urged.

Certainly, when one sees what is oftentimes taught as science, and is obliged to read the wretched English in which some scientific books are written, — which books, by the way, are highly lauded in scientific journals, — and, moreover, when one witnesses the temper of scientific men in treating those who differ with them concerning the latest ephemeral classification or other equally important point, one is inclined to side with the classicists in the belief that the study of science has little value either for purposes of discipline or culture; that it scarcely forms 'open-minded' men in the poet's sense; and that perhaps it would be better for all concerned that they should be 'digging Sanscrit roots.' F. W. STAEBNER.

Westfield, Mass., Nov. 21.

SCIENCE.—SUPPLEMENT.

FRIDAY, NOVEMBER 26, 1886.

PRIMARY EDUCATION IN ENGLAND.

Two of the functions which almost every modern state has been obliged to assume, whether in other respects its policy is *laissez faire* or state interference, are the support of its helpless poor and the education of its ignorant youth. Both of these matters were attended to in the Europe of the middle ages by the church, which, on account of its large endowments and its literary stores, was perhaps better fitted to relieve misery and spread the light of education than the state as then organized. England formed no exception to this rule. The early English monasteries could find almost the only reasons for their being, in the fact that the poor and helpless found, under their hospitable roofs, shelter and support, and that the children of the neighboring districts obtained the instruction they so sadly needed in the schools connected with them. These schools were established at about the same time that Christianity was adopted by the English people. Such a one was the school established in 680 by Theodore, archbishop of Canterbury. Later, schools were likewise provided in almost all the cathedral towns. These schools were employed by the clergy to keep their hold on the people; and with the reformation there naturally came a change in the educational system, which reflected that which had taken place in the relations between church and state. The laity were to have a share in the management of the schools, which were, however, to be supported in somewhat the same way as before.

The intention of the leaders of the reformation was to appropriate for school maintenance a large share of the property of the monasteries; but the king's friends were able to secure most of this property for themselves. Such schools as lived through this stormy period at all, or such as were founded soon after, had to subsist on private charity. A great many schools were founded as the immediate result of the reformation, but they were mostly grammar or higher schools, whose influence was necessarily limited; and it was not until considerably later that any attention was paid to primary education, — the only kind of education that can interest the masses of the people. Attempts had indeed been made to make some provision for the education of the children of the poor. Statutes had been passed in the sixteenth century under which schools for poor children were to be maintained by the clergy in each parish. But the great inequality in the distribution of the income of the state church — an inequality which all the expedients that have been devised have not done away with — gave the great majority of parishes barely enough for ecclesiastical needs: little, therefore, could be spared for the establishment of an efficient system of primary education. Parochial schools did exist in the richer parishes, it is true, but they were of a very poor character, and were supported by means of school-fees, or by the revenue of foundations; but in the larger number of the rural districts no schools at all were to be found.

But what the church had neglected to do was taken up by private associations, beginning with the latter part of the last century. In 1781 Robert Raikes founded the first Sunday schools; in 1803 was founded the British and foreign school society, managed by the dissenters; in 1811, the National society, the organ of the state church; in 1837 the Ragged-school society had its origin; and in 1850 there was formed by the large factory-owners the Lancashire public-school association. The two great names in this period are those of Andrew Bell and Joseph Lancaster, — the one a churchman, the other a non-conformist, and each the founder of the school society recognized as the agency of the religious body to which he belonged. To these two men, it has been said, England must "allow the credit of conceiving some sort of scheme for popular education, and of submitting proposals by which it might be carried out;" and it was through the societies founded by them or their followers that state aid, when it was finally given, was distributed. This began in 1832, with an appropriation of twenty thousand pounds. For several years before that, attempts had been made to secure state aid, but they were frustrated by the jealousies of the church and non-conformists. The "church was alarmed at any thing which seemed to trench upon what she naturally thought to be her appointed task. The dissenters dreaded what might add to the impregnability of the church's strongholds."

With this appropriation in 1832 begins, then, the assumption by the English state, of the duty, which is now universally recognized, of educating its ignorant youth. The period between 1832 and the present time we may divide into three sub-periods.

First, the period of the pure subsidy system. Each year the appropriation was increased, until in 1860 it was thirty times as great as in 1832. It was originally intended that this appropriation should be distributed by the treasury department; but in 1839 this duty was transferred to the education committee of the privy council, which then began to take the form of an executive department for educational affairs. The principles which were to guide the committee in the distribution are found in a treasury minute of 1833, and were. 1°, that the sum granted was always to be expended in the building of schoolhouses; 2°, no grant was to be made unless one-half of the cost of building was met by voluntary contributions, and unless the application for the money was recommended by the national or the British and foreign school society; and finally, 3°, populous places were to have the preference in the allotment of the grants. When the subsidies were increased in amount, these rules were somewhat relaxed; so that, for example, teachers who had passed the committee's examination might be paid from the grant.

It will be noticed from this that all connection between the schools and the state was voluntary on the part of the schools; but, so long as this connection lasted, the school was subject to state inspection. Under this system great material progress was made, as is seen from the reports of the committee of the council of education. The most important for this purpose is that contained in Parliamentary papers, 1864, vol. xlv. This report marks the end of this first sub-period, and shows that during it the inspection districts had increased in number to sixty, that 4,628 schoolhouses had been erected, and that from 1839 to 1864 £7,400,000 had been expended. But the quality of the education given in the schools was very poor. The teachers originally had no pedagogic training whatever. The monitorial system of teaching, as developed by Bell and Lancaster, had been adopted. By it the pupils taught each other under the nominal supervision of a teacher. Instruction was principally in religious matters, since the schools were mainly sectarian; and though secular instruction was thus given a disproportionately small share in the system of education, yet no sound religious instruction was given to counterbalance this disproportion. This may be seen from the following written answers, from children of average intelligence in an inspected school, to the questions, 'What is thy duty towards God?' and 'What is thy duty towards thy neighbor?' "My duty toads God is to bleed in Him, to fering and to loaf withold your arts, withold my mine, withold my sold, and with my sernth, to whirchp and give thanks, to put my old trash in Him, to call upon Him, to onner His old name and His world and to save Him truly all the days of my life's end." "My dooty toads my nabers, to love him as thyself and to do to all men as I wed thou shall and to me; to love, onner, and suke my farther and mother; to onner and to bay the Queen and all that are pet in a forty under her; to smit myself to all my gooness, teaches, sportial pastures and marsters," etc.

To remedy a system which could lead to so lamentable and at the same time so grotesque results, a trained staff of teachers had to be obtained. This was done by establishing training-colleges, to which school managers were to send students, and from which they were to receive back teachers, to be paid in great part by the state, and provided with certificates granted by the state, which thus guaranteed their efficiency.

In 1851 as many as twenty-five of these training-colleges were established. But the establishment and maintenance of these institutions necessitated a great increase in the parliamentary grants, which in 1852 reached the sum of £160,000. As the greater part of these grants went to the schools founded by the national society, the agency of the state church, which did most of the educational work (during the years from 1839 to 1864, out of £7,400,000 the church schools had received £4,450,000), the dissenters became very much alarmed. They claimed that the grants were an artifice for increasing church revenues. In the course of this dispute there arose, for the first time in the history of English education, a party which advocated the adoption of a state "secular system, administered, irrespective of religious belief, by local and elective bodies;" while the dispute itself led to the appointment of what is known as the 'Commission of inquiry of 1858.' Though the plans proposed by this commission were not adopted in the form in which they were submitted, still they were the point of departure for the new movement, which we may say begins with the Revised code of 1863.

The second sub-period, then, is the period of the Revised code. The education department had been getting ready to revise its system. To do this, an abstract of all of its regulations was made in 1858. In 1860, Mr. Lowe, the vice-president of the committee of council, draughted the regulations in the form of a code, arranged in chapters according to subjects. It now fell to him to embody in his code the suggestions contained in the report of the commission of 1858. This he did by revising the code, which was thereafter known as the 'Revised code,' and by which the relations between the state and the educational system were to be regulated. The Revised code went into operation on July 1, 1863. The principal change introduced was the provision calling for an increase in the requirements which must be fulfilled in order to obtain a portion of the grant. For instance: it provided, that, to obtain a share of the grant, a school must be held in approved premises, and must be under the charge of a qualified teacher, who, though licensed by the state, was to be paid by the school managers: the attendance of the children must reach a certain specified minimum number; while their attainments must be proved by individual examinations in reading, writing, and arithmetic. A point in which this revised system differed from the former one was, that while, under the latter, the grant was either totally given or totally refused, it might now be given in part, the amount granted depending on how well the required conditions were fulfilled.

The immediate effect of the adoption of this Revised code was the falling-off of the grants; since the education which the children had received under the old system was so poor, that very many were unable to pass the standard examinations. Mr. Lowe's cynical remark — that "if the new system [i.e., the system of the Revised code] is costly, it shall at least be efficient; if it is inefficient, it shall be cheap" — was thus shown to be a correct forecast of the effect of the code. But while in this way the faults of the old educational system were demonstrated, complaints were made that school managers, in their efforts to comply with the provisions of the Revised code, in order to obtain large grants, pressed the children too hard, and limited the instruction given to the subjects required for the standard examinations. The purely educational result of the code was thus the reduction of the general intelligence of the pupils. To obviate this difficulty, an amendment to the code was adopted in 1867, which gave a special grant if certain new conditions were complied with, such as the teaching of subjects not required for the standard examinations. This and other amendments improved the code, so that, in its final form, it may be said to have been a success as far as it went. The grants increased after it was fairly in operation, amounting in 1869 to about £800,000. Accommodation was offered in the inspected schools for nearly 2,000,000 children, while about 1,300,000 were actually in attendance. But, as will have been noticed, the code did not at all change the voluntary character of the system. The actual motive power of the schools came from the 200,000 persons whose voluntary subscriptions started, and with the aid of the state supported, the schools. There was no legislative provision that would prevent the possible decrease or absolute cessation of such voluntary subscriptions; and in such case the whole educational system, built up by so many years of earnest effort, would vanish into empty air. Again: the problem of what and how religious instruction should be given, came to the front with special force, since almost all the state-aided schools were denominational or sectarian schools: therefore when the reform bill of 1867 was passed, by which the suffrage was greatly extended, it was felt that a corresponding strengthening and widening of the educational system was necessary. This led to the passage of the elementary education act of 1870, which, with its amendments, now regulates the primary education in England.

This brings us to the third sub-period, that of the present primary educational system. The main characteristic of the elementary education act of 1870, is, that though it was intended to supplement the previously existing system, yet it imposes on the various localities the legal duty of providing a sufficient amount of school accommodation in public elementary schools; i.e., in schools where the ordinary school-fee does not exceed ninepence a week, in which no attendance at religious instruction or at religious worship is required, in which a sufficient instruction is given in reading, writing, and arithmetic, and which is open to the inspection of the education department. Where a sufficient number of such schools does not exist in the district (which is made the unit for school administration, and is practically equivalent to the poor-law parish), the education department itself may, on the refusal of the district to act, form a school board to carry out the provisions of the act. If the district proceeds to the formation of such a board voluntarily, it may do so. These boards are composed of from five to fifteen members, chosen in the incorporated towns from those registered on the borough list, and in the parishes by the rate-payers; i.e., those who pay local taxes. Each elector has as many votes as there are members to be elected, and may distribute his votes as he wishes, massing them all on one candidate, or scattering them among as many candidates as he has votes. The intention of this clause in the act is to provide for the representation of ecclesiastical minorities; for, as we have seen, one of the great problems to be solved in the adoption of the educational system was the reconciliation of the different religious sects. The boards elected in this way have charge of the management of the schools which they establish, and have the power to make by-laws by which children from five to thirteen years of age may be compelled to attend school. This is the only provision in the act of 1870 relating to compulsory attendance, which was thus made absolutely dependent upon the will of the school boards. In the localities where no such board existed (i.e., in localities supplied with a sufficient amount of proper school accommodation), compulsion was impossible, while in those possessed of a school board it was in the power of the board not to adopt the necessary by-laws.

The expenses of the schools established by the local boards were to be defrayed from a school fund provided for by the act. This was to consist of school-fees, of parliamentary grants, and of a compulsory local rate. As much of the expenditure was of a permanent character, the school board was given the power to borrow money on the security of the school fund.

The whole educational system was kept under the control of the education department, which inspected all the state-aided schools, revised the accounts of the school boards, and could enforce the execution of the law by means of its power to step in and do any work that had been omitted by a defaulting district, at the expense of such district.

Such were the leading features of the act of 1870, whose main purpose, it has been said, "was to establish a fixed and statutory local authority where the casual efforts of local benevolence and zeal had failed;" and this purpose was in the main accomplished. Both the statutory and voluntary agencies increased greatly in number. School accommodation nearly doubled between 1869 and 1876. In 1876 the schools cost £3,500,000, of which £750,000 came from subscription, £370,000 from local rates, and more than £1,500,000 from the parliamentary grants.

One point for criticism and amendment yet remained, — the attendance was very small: indeed, it hardly exceeded 2,000,000. This subsequent statutes have attempted to remedy. The most important of them are the elementary education acts of 1876 and 1880. These made it the duty of the parent to have his child educated in the elementary branches, and also placed new restrictions on the employment of children when it might interfere with their education. They added a new local authority, called the 'School attendance committee,' which, as well as the school boards, must pass by-laws requiring compulsory attendance; and they gave the local school authorities more extensive powers for the enforcement of attendance in case of neglect, and for the encouragement of regularity among those children who professed to attend. The result of these acts was, that in 1885, when compulsion was in operation throughout the entire country, the average attendance was over 3,400,000; there was accommodation for more than 5,000,000; while the parliamentary grant had reached £2,867,000, the subscriptions £756,000, the local rates something more than £1,140,000, and the school pence £1,791,000. The schools thus cost, in all, for their annual maintenance, £6,550,000 in 1885.

From this short sketch of the history and present position of English primary education, we see that its characteristics are, 1°, universal compulsory attendance; 2°, obligatory maintenance of proper unsectarian schools by the various localities; 3°, supervision of the whole system by the central organization, — the education department, — which has power to step in and remedy the neglect of recalcitrant localities.

As a result of the fact that these elementary education acts are simply to supplement a system of schools existing at the time of their adoption, the present elementary schools of England fall into three classes. The first class is composed of the denominational schools, as they are called, supported by the school societies, and existing independently, as before, in all towns and places in which foundations, private subscriptions, and the large resources of the school societies, are sufficient to provide the school accommodation required by law. About one-third of all the school-children in England attend these schools even now. The second class is composed of schools denominational in name, and connected with church societies, but supported only in part by church funds, the remainder of the cost of their maintenance being made up from state grants or local rates. These are spoken of as public schools, are under the inspection of the school authorities, and are maintained as schools for all denominations. The majority of the schools belong to this class. The English church maintains most of them, receiving for so doing half of all the state aid granted. In the third class are the newly formed board schools, under the direct administration of the district boards, and existing in the poorer districts. These are continually increasing in number. They receive a sum from the state grant which is considerably larger than the amount received by all the denominational schools outside of those directly connected with the church.

Frank J. Goodnow.

The freshmen at Cambridge university, England, this term, number 938, of whom 197 go to Trinity college. The freshmen at Oxford number 616.

THE ASSIMILATION OF COURSES OF STUDY FOR BOYS AND GIRLS.[1]

Mrs. Fawcett has lately said that it had been reserved for the nineteenth century to discover that a woman was a human being. This is indeed a somewhat epigrammatic statement; but it expresses a fact which, in education as in other matters, has been too frequently overlooked. Boys and girls — for with them at present we have to deal — are both human beings, and as such have far more points of likeness than of difference, and possess many faculties in common. This sounds a truism; but nevertheless, in spite of this obvious fact, education in earlier days was conducted on the principle that boys had one set of powers, needing certain studies, and girls another set, needing quite other subjects in their school-work; and that, for instance, boys should learn Latin, while for their sisters there was, so to speak, the softer feminine of the Roman speech, Italian. This theory is somewhat as if, for physical development, boys were to be fed always on beef and mutton, and girls on ices and sugar candy. The common sense of mankind, however, overlooking the manifest physical difference as irrelevant in the matter of nutrition, has always considered that boys and girls need the same kind of bodily food, at all events; and in the present day, when the laws of health are more widely known, we all agree that these apply equally to both sexes, who alike need, for perfect growth, fresh air, cold water, and exercise. When, however, mental training and mental food are considered, a different opinion obtains, or, rather, has obtained. This is the more remarkable, for there is in this case no proved or manifest difference psychologically, and the scientific study of the mind has not given any reason to suppose that any such difference does exist. The error has arisen, perhaps, from an imperfect ideal of what education ought to be. If it is merely a sort of technical training for the practical work of adult life, then, obviously, as men and women will in general occupy different spheres of work, boys and girls should study different subjects, — boys, let us say, arithmetic, physics, geography, etc.; and girls, needlework, music, and household management. This narrow ideal of education has, we hope, few adherents among teachers. They recognize a noble end, — that of training all faculties of our nature to their highest degree, and of producing, not an engineer or an accountant, a nurse or a dressmaker, but a fully developed human being, with all powers so cultivated as to be able to act and to enjoy, to labor and endure, — in a word, to live, — as completely and perfectly as the allotted place given to the individual, man or woman, may permit. It would therefore seem to follow that any study which has been marked out for boys because of its value as training, would be equally valuable for girls, as the intellectual powers are common to both sexes, and there is no *prima facie* evidence that the mind is male or female, but rather a presumption in the other direction. Now, classics and mathematics have in modern times justified their place in the curriculum of our boys' schools by their value as training, either of the reasoning powers or the literary taste. Whether they, exclusively, induce such effects, is a question to which we shall return later. Granting that they do, they should be taught equally to boys and girls, and the ideal curriculum should be in most points the same.

Having discussed the theoretical considerations, we may now proceed to examine practical results, and see whether these bear out our theory. The first fact to be mentioned, and perhaps the most convincing, is, that an examiner of considerable experience has informed us that he does not notice any differences in papers submitted to him (which he, of course, knows only by their numbers) from which he can form any opinion as to the sex of the writer. The reports of the Cambridge local examiners, in which the work of boys and girls is separately mentioned, afford no definite evidence of any difference. We remember one report on English composition which did show such, but not at all what the average reader would expect. The girls' work showed much more accuracy and careful thought, and far less absolute nonsense; but the boys showed greater imagination. Again, boys and girls are prepared for the Matriculation examination of the University of London, and pass it equally well: we imagine, indeed, that the percentage of passes for girls is considerably higher. Whatever the positive meaning of this may be, it negatively confirms the theory. The results of the degree examinations are too well known to need remark. Other data come to us from Cambridge. It would have been said fifteen years ago, from those imagined inclinations of the feminine mind to the softer studies, that the mathematical tripos would have been the last to attract many of the students of Girton or Newnham. The facts are exactly opposed to this forecast. Up to the year 1882, a greater proportion of Girton students entered for the mathematical tripos than for any other; and, further, pupil after pupil from one of our girls' public schools went up to Cambridge to study mathematics; so much so, that it was found necessary to warn those who

[1] From *Educational times*, November, 1886.

intended to make teaching their profession, that the supply of women mathematical teachers would exceed the demand, and advise them to take up other branches. The reason was, doubtless, that in mathematics it was easier to make up for the lack of early training than in classics; and from the same cause many, especially those who went up in later life, took moral science. Now, when the movement is older, and girls are trained for Girton, as boys for Trinity or Balliol, classics has been, since 1882, the favorite subject, as far as numbers are concerned.

A teacher who has had considerable experience with girls, and some practice in teaching boys and men, may be forgiven, perhaps, for adding a few generalizations drawn from personal knowledge. It is perfectly possible to teach girls Latin and mathematics, and even to create enthusiasm for the study. On the other hand, some girls are careless over Latin, and hate mathematics; but this is due to the 'old Adam' of laziness, and could be matched, we imagine, in boys' schools. It is almost impossible to teach geometry or algebra to some girls; but there are men and boys with whom the same difficulty occurs. The writer has met with such, and so probably have most teachers; while history gives us no less eminent an example than Lord Macaulay. We have never come across a girl who absolutely could not do Latin, though we know many who do it badly. We also have read classics with a very good mathematical man whose Little-Go was a burden scarcely to be lifted, and have heard college fellows express a similar opinion about their own undergraduate days. Again: we have found that to teach an older man mathematics is very much easier than to teach a woman who begins at the corresponding age; but this we believe comes from the fact that the life-work of the man had been concerned in commerce, with numbers and measurement, while the woman probably never did any harder thinking than the ordering of a dinner or the planning of a gown. However, in all such cases there is a danger of forming inductions from few data, and individual experience can have only a value when strengthened by other evidence. Whether women, indeed, will ever do as well as men in the higher subjects of a university course, is a matter on which we have our doubts; but it is, at any rate, irrelevant to the case in point. Here we feel assured that our experience will coincide with that of most teachers and examiners, to the effect that the teaching, and the results of teaching, classics and mathematics, are — other things, as to time, teaching power, etc., being equal — very much the same for boys and for girls, whatever they may be for men and women. Having laid down, then, the general principle of identity of subjects, it remains to be seen what the subjects should be. And here, when a reform such as that of the scheme of the First-class college of preceptors' examination is proposed, such a question is of the gravest importance, on general grounds, for boys as well as for girls.

The key of the whole position is the discussion as to the exclusive advantages of classics as training. And here we should earnestly deprecate the assimilation of the scheme for girls to the *present* scheme for boys, because we firmly believe that the girls' curriculum in our public and higher-class private schools is nearer the ideal than that for their brothers. To argue the question would be merely to re-write Herbert Spencer's book on education. But the reform of boys' education, and the removal of that incubus of classical study which, as a heritage from earlier days, weighs so heavily on us now, is so important a question, that, like the 'Delenda est Carthago,' it needs naming again and again. When so many studies, far more useful both to men and to women in practical life, all but cry aloud for a fuller share of our limited school-time, we must be very certain of the superiority of classics as training, to keep it in the place of learning which would help our boys to appreciate more fully their own beautiful language and the works of nature around them, and — no unimportant thing nowadays — to maintain in their manhood that supremacy in arts, manufactures, and commerce, which our country now sees endangered on every side. And, indeed, as Herbert Spencer shows, the training of reason and observation *is* furnished by those very subjects which are most useful, for nature is economical of power. We therefore hail gladly the proposed alteration in the regulations of the First-class examination; for, while maintaining the identity of subjects and standard for boys and girls, it nevertheless allows for that more modern education to which the tendency of the age is rapidly bringing us. Not long ago at Cambridge a determined effort was made to oust Greek as a compulsory subject from the Previous examination, or Little-Go; and in the late revision of the regulations for the Matriculation examination at London university there was an equally earnest attempt to make permissive a choice of languages, and thus not necessitate Latin. For both these, the ancient superstition was too strong; but the time of success is, we may hope, not far distant. When Oxford, much to the disgust of some of her older professors, has spent thousands on schools for natural science; when Cambridge has allowed modern languages for the additionals, and has actually founded a modern and mediaeval languages tripos, — the younger universities and colleges will surely follow. To make Latin compulsory, therefore, is, from this point of view, distinctly inimical to educational progress, and is therefore unworthy of an institution which, like the College of preceptors, has in past years done so much to further the modern reforms in middle-class education.

Sara A. Burstall, B.A. Lond.

A SURVIVAL OF THE UNFITTEST.

In his inaugural address before the sanitary congress recently held at York, Sir T. Spencer Wells, the president of the congress, touched upon a subject of great interest to educators. He said, speaking as a sanitarian, that so far as concerns the mental and physical training of children, and giving women the option of other occupations than those of domestic life, he saw no great cause for alarm. It is an age in which education — at any rate, for the middle classes — must be pushed far beyond the limits which our fathers thought wide enough for us. Mere rule-of-thumb work is almost out of date; and there are so many industries in which scientific knowledge and exactness are requisite, that the want of early education cuts off a young man's chances of advancement. A workman must now be something more than a mere machine. He must have head as well as hands, brain as well as muscle; and, as uneducated brains are not worth more in the labor-market than untrained muscle, we must be content to make some sacrifice in their culture. As for the outcry about the dangers of women taking up men's work, it is breath wasted. A great many failures will outweigh the few successes, and bring the balance right.

"For my own part," continued the speaker, "I think women capable of a great deal more than they have been accustomed to do in times past. If overwork sometimes leads to disease, it is morally more wholesome to work into it than to lounge into it. And if some medical practitioners have observed cases where mental overstrain has led to disease of mind or body, I cannot deny that I also have at long intervals seen some such cases. But for every such example I feel quite sure that I have seen at least twenty where evils equally to be deplored are caused in young women by want of mental occupation, by deficient exercise, too luxurious living, and too much amusement or excitement.

"Again: we have heard much of late about overpressure from work in schools. This is one of the novelties of our time. No doubt it exists, and I think it may in part be traced to some of our sanitary success. We have reduced the mortality of early infancy. Many children who would formerly have died off-hand, are now saved, and find their way into the schools. They are survivals of the least fitted. They live, but they are not strong. They have to submit to the same routine, and be forced up, if possible, to the same standard as the rest. But the effort is too much for them. Their frames are not hardy enough to resist the mental strain. They show all sorts of nervous symptoms, disappoint the teachers, and are the types brought forward as victims of the system.

"The vice of the system is that it is indiscriminate. There is no revision of the recruits, and the tasks are not apportioned to the feeble powers of sanitary survivors. This is an evil which will remedy itself in time by the growing-up of a larger proportion of strong children; and the present difficulty may be got over by a little patience and moderation, — a little more regard to sanitary logic. The children must have training before education, and must be put upon something even less than a half-time system."

THE POSITION OF SCIENCE IN COLONIAL EDUCATION.

At the recent colonial and Indian exhibition, held in London, considerable attention was given to the condition of education in the colonies. At a conference held on this subject, William Lant Carpenter, B.A., B.Sc., whose scientific work is as well known in this country as it is in England, read a most interesting and valuable paper on the position of science in colonial education. Mr. Carpenter's paper is of such value that we reprint the major part of it from the London *Journal of education*. Mr. Carpenter said: —

The colonies to which your secretary desired me to confine my attention were, Canada generally; South Africa (the Cape of Good Hope and Natal); West and South Australia, Victoria, New South Wales, and Queensland; New Zealand and Tasmania, the last of which is unfortunately not represented at this exhibition.

If the term 'education' be used to include, not merely scholastic and collegiate training, but also any organizations and methods for drawing out the minds and faculties of the people, then a review of the position of science in colonial education should include all provisions for teaching it in any degree or form. Science in primary, secondary, and high schools of whatever kind, in technological schools with a view to its application to the industrial arts, and in universities or colleges, should come under review, as well as its promotion by scientific bodies or societies; also the means afforded for its cultivation among adults, by means of museums, botanical and zoölogical gardens, public lectures, evening and other adult classes, public libraries, etc. My inquiry has, as far as possible, ranged over all these subjects; but inasmuch as many of them are voluntary and not state-aided, and therefore not subject to inspection and report, it has been difficult in several instances to get accurate information about them.

There appeared to be two methods of presenting the subject: 1°. To take each means of advancing scientific education separately, and consider what is done in that particular matter by each colony; 2°. To take each colony separately, and give a general view of its various methods of promoting education in science. After careful consideration, I decided to adopt the second alternative, since comparisons — proverbially odious, and sometimes based on data not strictly comparable — would thereby be avoided.

This is scarcely the time or place to dilate upon the advantages to be gained by giving science a proper place in education; i.e., recognizing that it is of equal value to literature and art as an educational instrument: your presence here today proves that you have more or less sympathy with such proposals. To those, however, whose sympathy is *less* rather than *more*, I would commend a careful perusal of three Cantor lectures on science-teaching, recently delivered at the Society of arts (and since published separately) by Prof. Frederick Guthrie of the Science schools, South Kensington, whose powerful arguments, and clear, incisive style, can scarcely fail to make a decided impression upon unprejudiced minds. I wish that time permitted me to quote some of his amusing remarks.

In reviewing the whole subject, I have been very much struck with the fact, that, in every colony, education is a distinct department of the state, under a responsible minister of public instruction, the teachers themselves being in many instances civil servants. The advantages of this plan, enabling the minister, as it does, to take a broad and statesmanlike view of the whole subject, are well seen in a speech on public education in New Zealand, delivered on July 21, 1885, in the house of representatives, by the Hon. Robert Stout, minister of education. This case may be considered a typical one, and will be alluded to again in the detailed account of that colony.

Another noteworthy point is the obvious desire, on the part of nearly every colony, to realize Professor Huxley's aspiration [1] for Great Britain, that the state should provide "a ladder reaching from the gutter to the university, along which every child in the three kingdoms shall have the chance of climbing so far as he is fit to go." In most colonies, not even excepting South Africa, this appears to be more or less the case. A state-aided system of scholarships enables a boy in the primary schools to pass through the secondary and high schools, colleges, etc., and finally to study at the Colonial university. Sometimes the same system is so far extended that holders of such scholarships proceed to England, and take university degrees there, frequently in science.

I propose to consider the provisions for education in science in the following order, in each colony, and to take the colonies themselves in geographical succession, beginning with the most westerly: primary, secondary, and high schools; colleges, both special and general; universities, museums, libraries, scientific societies, lectures, and other means of encouraging a knowledge of science among adults.

Canada.

Province of Ontario (including Ottawa City). — In the public or primary schools, with the exception of a little descriptive geography and very simple object-lessons, no elements of science are taught. The high-school course, however, includes elementary physics and botany, even in its lowest classes. The course of study for all teachers, however, embraces the elements of natural science; and the Normal school at Toronto has, as Dr. Gladstone and I can personally testify, a magnificent collection of apparatus for the teaching of physical and other branches of science, a selection from which can be seen in the Canadian court, educational division. Various denominational colleges teach science to a limited extent; but the chief provision for higher instruction therein is to be found at University college, Toronto, where are three well-equipped laboratories, — chemical, physical, and biological, — the apparatus alone in which cost $27,500, and also three museums. In the School of practical science, connected with this, upon which $50,000 were expended, there are three courses of study, — engineering (civil and mining), assaying and mining geology, analytical and applied chemistry. The Agricultural college at Guelph has a reputation over the whole continent, and natural science is a large feature in its programme. Nearly a quarter of a million dollars were expended on its establishment, and the current annual expenditure exceeds $52,000.

For persons beyond the ordinary school age, there is an excellent organization throughout the

[1] *Fortnightly review*, January, 1878.

province, of the same character as that of the science and art department in South Kensington. Dr. S. Passmore May, the superintendent of mechanics' institutes, who takes the greatest interest in this movement, informs me that no less than sixty branch schools have been established within the last four years, in connection with these institutes. Its headquarters is in the Educational museum in Toronto. Here also is located the famous magnetical and meteorological observatory, established in 1841. The Canadian institute in Toronto, and various societies, more or less scientific in their aim, do good work in encouraging a taste for such studies.

Province of Quebec (including the city of Montreal). — Here the Council of public instruction contains two committees, a Catholic and a Protestant. The educational as well as other organizations are necessarily very often duplicated; but M. Ouimet, the superintendent of the department of public instruction, to whose courtesy I am indebted for much valuable information, informs me that the system has worked well, and without the least friction.

In the primary schools the instruction is almost entirely literary, with the exception of a little geography. Object-lessons, in the English sense of the term, appear to be conspicuous by their absence. A small manual of agriculture is used as a reading-book, but the subject itself is not taught: the idea is to show how to preserve the fertility of the soil. The secondary schools correspond to the French *lycées*, and in their courses chemistry and one or two other branches of science find a place. In the normal schools, also, scientific subjects form part of the training. Perhaps the most important recognition of the proper position of science in an educational course is to be found in the fact, that for the entrance examination to *all* the professions, without any exception, some knowledge of certain branches of science is compulsory. The Laval university at Quebec, for Catholics, and the McGill university of Montreal (of which Sir William Dawson, president-elect of the British association, is principal), both grant degrees in science; and in the latter there is a separate faculty of applied science, which provides a three or four years' professional training in civil, mechanical, and mining engineering, assaying, and practical chemistry, and grants degrees in these subjects. An excellent medical school and faculty of medicine is attached to the university also. The Catholic commercial academy of Montreal, conducted by the Christian Brothers, has a scientific and industrial course similar to that in McGill university; and the Quebec commercial academy, also conducted by the same body, has fairly equipped laboratories, and gives regular courses in science. The normal schools of the province are in each case affiliated to their respective universities. In connection with McGill university, we come across, for the first time, the progressive system of scholarships, reaching down from it to the primary schools; and here should be mentioned the Redpath museum in the university grounds, which is purely scientific in its aims. Except in connection with McGill university, there appear to be no scientific societies. The newly established Royal society of Canada, which draws its members from all parts of the colony, is formed somewhat on the same lines as the French académie des sciences.

New Brunswick. — It is somewhat remarkable that a small colony, mainly agricultural, should possess one of the most perfect systems of instruction in primary schools with which I am acquainted. As early as 1802, the provincial government and legislature recognized the fact that to make provision for the people's education was one of the duties of the state. "From the small beginning then made, there has been developed, by slow degrees, the present public-school system of New Brunswick, one of the most perfect, in principle at least, to be found in any state or country." There is a progressive course of instruction for all schools, in which the subjects appear to have been selected, arranged, and apportioned with a due regard for sound educational principles. It is arranged in two equal divisions, literature and science. Between the bottom of the primary and the top of the high schools there are eleven standards; and yet, even in standard I., in primary schools, plant and animal life, minerals, and geography are among the subjects dealt with, as well as familiar lessons on the conditions of health. Elementary physics makes its first appearance at standard V. Out of a total population, including adults, of 321,000, one-eighth, or 40,000 children, had lessons in hygiene, one-sixth in geography, and one-sixth in useful knowledge of plants, animals, and minerals, in the public schools in 1885. The province spends annually nearly one-third of its total revenue upon education. If local rates be taken into account, the expenditure on the common-school system alone is about £100,000, and this with a total population less than that of Birmingham. The normal school for training teachers was begun in 1847, and the spirit which now animates it may be judged from the following maxim enforced there: "The development of the faculties is of more importance than the acquisition of knowledge." It is in connection with the university at Fredericton, the degrees of which are universally recognized. There is a large system of scholarships and bursaries in connection with it. A good natural history society exists in St. John, with corresponding members in the country districts. A museum, mechanics' institutes, and similar agencies complete the facilities for the pursuit of science.

Nova Scotia. — In all grades or classes of the elementary schools, the teachers are expected to furnish suitable instruction in hygiene, and what are termed 'Lessons on nature,' or useful knowledge lessons, as well as geography. In grades 3 to 6, these lessons are chiefly biological and mineralogical; while, in grades 7 and 8, elementary physics, chemistry, and agriculture are introduced; and, in order that the teachers may be well prepared for this last, there is a school of agriculture in connection with the normal school. In the higher graded schools, the course includes geography and the elements of mathematics, physics, botany, physiology, geology, and chemistry. There are various colleges, and a university at Halifax, on the basis of that of London, to which most of the colleges are affiliated.

In concluding this brief sketch of the provisions for scientific education in the province of Canada, I feel that it would not be complete without an allusion to the schools for the blind, and for deaf-mutes, all of which come under the superintendents of public instruction, just as they do in the United States. The education of children so afflicted is not a matter of charity, as with us; but it is taken cognizance of officially, and, as I can testify from personal inspection, is carried out in a very scientific manner. What is taught is mainly objective and experimental. It may not be out of place, perhaps, to mention here that we owe the invention of the Bell telephone to researches undertaken by Alex. Graham Bell, in his official position as head of the Normal school for teachers of deaf-mutes, in Boston, Mass., in order to facilitate the instruction of children hitherto voiceless — I can hardly say, speechless.

South Africa.

Cape of Good Hope. — The system is a complete educational ladder, with the Kraal schools at the bottom, and the University of the Cape of Good Hope at the top; and every kind of educational institute is state-aided. I cannot learn that any science-teaching is given in primary schools. In the second-class schools a fairly high standard is aimed at, but how far it is reached may be gathered from the following sentence in a recent report of the inspector-general of schools: "But certainly the greatest want in the school curriculum is the almost general neglect of science-teaching in a scientific manner."

A friend writes to me, "In the schools near Cape Town, of which I had some experience, the idea of science was, getting by rote a few pages of a book on physical geography. At one or two schools, where I introduced simple lessons in physics, with experiments, I was surprised — though it was for this that I hoped — at the quickening of intelligent interest in the work." There is a university, but I regret to say that its examination schemes give no encouragement whatever to scientific training. Public libraries, museums, and botanic gardens exist, and are state-aided, as well as their country branches.

Natal. — A council of education controls state-aided schools of all kinds. The course in all primary schools includes theoretically the elements of natural and physical science. Even in the native schools a little physical geography is taught. In the higher schools, at Durban and Pietermaritzburg, scientific teaching is carried still further. A lady friend of mine, Miss Rowe, an ardent devotee of science, has lately settled in the latter city, at the head of a very high-class girls' school.

Australasian Colonies.

In every one of these, the state system of education is compulsory and undenominational. Public instruction is free in Victoria, Queensland, and New Zealand. In proportion to population, Victoria has more children at school than any other colony; but its age-limits, six to fifteen years, are greater. New South Wales heads the list in point of cost of instruction per scholar, with an expenditure of £8 2*s.* 8*d.* each per year, nearly double that of any other colony: but its system of instruction is far the most complete of any, as will shortly be seen.

Western Australia. — Its total population does not amount to 40,000. In 1884 about £10,000 was expended on education. In the schools throughout the colony, whether high or elementary, the rudiments of some branches of science form a part of the teaching. The wealthier classes of society send their children away for education, and this has not tended to encourage high-class teaching of any kind.

South Australia. — The schools are divided into public (or primary) and provisional. In the former, only certificated teachers are employed. Physical geography, object-lessons, and simple drawing all find a place in the compulsory course. The secondary schools and colleges are mainly denominational, receiving 'grants-in-aid,' and in the programmes of many of them science takes a fair position. The colony enjoys the distinction of being the only one of the mainland provinces of Australasia which possesses an agricultural college: it was opened in 1885, under the management of Professor Custance, formerly of Cirencester, and the course of instruction includes chemistry, geology, botany, mechanics, veterinary science, forestry, etc. The university has nine professors, the chairs being thus roughly classified: two literature, five science, one music, one law, in all of which subjects, and in medicine, it has power to confer degrees. The matriculation programme contains many optional subjects, and it would be possible, but not easy, to pass it without any knowledge of science. The bachelor's degree in either faculty involves three years' academical study, with an examination at the end of each, conducted in the best manner, viz., partly by the professors, partly by external examiners. This system obtains also in the Universities of Victoria and of New South Wales. The course for science degrees is distinctively good, and well arranged. This university opened its degrees to women in 1880.

In Adelaide, free popular lectures on scientific subjects are given by the university professors, and are very largely attended. The attendance at the courses on physiology was quite remarkable.

There are one or two scientific bodies or associations, such as the Royal society of South Australia, but they are all more or less connected with the university.

The system of state scholarships, enabling the holders to pass by successive steps from primary school to university, is very extensive, and holders of the 'South Australian scholarship' proceed to English universities every year. The public library, museum, and art gallery of South Australia form one state-aided institution, organized very much on the basis of the typical institution at South Kensington. Its work, however, is mainly literary and artistic, and it is affiliated with the university.

VICTORIA.

In this colony the whole subject of public education was the subject of a royal commission of inquiry, which presented a most valuable report in 1878 (mainly the work of Mr. Charles H. Pearson, M.A.), containing excellent suggestions for the organization of public instruction as a whole. I have been unable to learn how far these recommendations have been carried out, since I have had more difficulty in obtaining recent information about Victoria than in any other case.

In the primary schools, geography is a decided feature, but there are no 'object' or useful knowledge lessons. Of 7,000 children who, in 1884, paid for tuition in 'extra subjects,' one-fourth, or 25 per cent, took science if mathematics be included, but only 5.7 per cent if it be excluded. This speaks well for the recognition of mathematics as the basis of science. For teachers, however, all certificates above a mere 'certificate of competency' require several subjects, from one-quarter to one-half of which are scientific, and some science is compulsory.

All secondary education is under the control of private persons and proprietary bodies, usually connected with some religious denomination. There are eight exhibitions yearly, of £35 each for six years, enabling the holder to pass from state schools through certain approved grammar-schools and a university course.

As the colony owes much of its prosperity to its mines, it is natural to find two excellent schools of mines, — one at Sandhurst (formerly Bendigo), the focus of reef-mining; the other at Ballarat, the centre of alluvial mining. From a personal inspection of both these, a few years ago, I can speak in the highest terms of their efficiency. On Nov. 29, 1880, I wrote in the visitors' book at Ballarat, "The chief thing apparently required to make the school do even better work than it is doing, is that its pupils should come to it with some elementary knowledge of the principles of physical science, such as ought to form part of the necessary instruction in the higher classes of every state school." I have since experienced the pleasure of being informed that these few words, which were printed and widely circulated in the colony, exercised a most important influence for good upon the school.

Determined not to be behind South Australia, the colony has started an experimental farm, and is building an agricultural college in Melbourne. There is also a capital industrial and technological museum, in connection with which lectures are given.

The University of Melbourne ranks with those of Great Britain. Its magnificent buildings were opened in 1855, and women were admitted in 1880. The matriculation examination embraces fourteen subjects, six of which are scientific (including mathematics); but I regret to say that the university gives no encouragement to the study of science, since a candidate may matriculate without passing in either of these six, and, although there are literary honors lists, there are no science honors lists except in mathematics. Science finds a very subordinate place in the arts degree, and degrees in engineering have lately been instituted. Practically all the teaching of natural science in the university is confined to the medical school, one-third of the total number of degrees granted being medical, and one-half arts, the remainder laws. The Melbourne observatory, the Melbourne botanic gardens, and the Melbourne public library are all well known by repute to Englishmen. The zoölogical garden is only recently set on foot. Eight scientific or learned societies, headed by the Royal society of Victoria and the Royal medical society, keep alive an interest in various branches of science. The Australian health society, with its free lectures in Melbourne, and branch lectures in various provincial towns, does much practical good among the people, and the same may be said of the mechanics' institutes and public libraries to be found in most cities of this colony.

NEW SOUTH WALES.

Just as New Brunswick and Nova Scotia in the Canadian group of colonies appear to have worked out, theoretically at any rate, the most perfect educational scheme, so, in the Australasian colonies a similar place must be accorded to New South Wales. The whole of the present system, which, as usual, is under a minister of public instruction, dates from the act of 1880, which authorized, as state schools, five classes of schools, the recognition of four of which by the state was quite a new thing. These are, 1°, primary; 2°, superior public schools, for additional instruction in the higher branches; 3°, evening schools, for those who had no opportunity for education in primary schools; 4°, high schools for boys, which prepare for the university; 5°, similar schools for girls. In 1885 there were 605 pupils in these high schools, from a colonial population of 920,000. The gross annual expenditure of this act exceeds £700,000; and the total school population is 280,000, or approaching one-third the entire population of the colony.

In every public school, object-lessons, geography, and drawing are taught, even in the lowest classes. In the fourth class of primary schools, object-lessons include "natural history, manufactures, elementary mechanics, and the science of common things;" in the fifth class, "arts and manufactures, the laws of health, social economy, the duties of a citizen, the laws of the state, and experimental physics." Of course, the whole of this is treated in very elementary fashion; but the point to be observed is, that the same idea is carried out in the higher schools, of which I have already spoken. In the Sydney grammar-school, a school *sui generis*, there is now a modern side, in which natural science takes a prominent place. The university is now exceedingly well organized. It grants a B.Sc. and a D.Sc. degree, the latter requiring a research paper. It also grants corresponding degrees in engineering. Its degrees in arts involve attendance upon certain courses of lectures in natural science. I regret, however, to say that its matriculation examination can, if desired, be passed in literary subjects and mathematics alone, to the exclusion of science, which, as is well known, cannot be done in the University of London. The public examinations, however, set on foot to test the education in schools, include a large number of science subjects. In connection with the university are several denominational colleges; and a large and well-endowed new medical school has just been built in the university grounds.

The most remarkable feature, however, in the public instruction of this colony, is the state system of technical education. The subject was being discussed when I was there in 1880, and I remember being invited by Sir W. Manning and Sir Harry Parkes to address a meeting about it in Sydney. Since then it has made extraordinary strides, mainly under the guidance of Mr. Edward Combes, the president of its board of governors. It has followed the principles laid down by the city and guilds of London institute, and arrangements are in progress by which its work will now be tested by the examiners of that body. The Sydney college has 50 classes, in 13 departments, and itinerant lecturers give instruction in 16 of the principal towns of the colony. The number of individual students in Sydney alone last year was 2,634, or more than at the technical institute in Finsbury; and of these, 500 were women. In that year, also, 196 popular lectures were given in Sydney, entirely on scientific subjects, at which the average attendance was 208, the total being 40,767. In this exhibition are specimens of the work of the college. One remarkable feature of it has yet to be noticed: all this excellent work has been done in temporary and hired buildings; the college has actually no permanent abode.

Among the other means for spreading a knowledge of science, the magnificent museum, the exquisitely beautiful botanical gardens, the public libraries, the Royal society of New South Wales, the Linnean society, and similar smaller organizations, must not be forgotten.

QUEENSLAND.

The primary schools are divided into 'state' and 'provisional.' There are 425 of the former, and the free course of instruction includes geography, object-lessons, and elementary mechanics. Instruction in other subjects is charged for, and must be given out of the ordinary school-hours. The object-lessons are defined to include "an elementary knowledge of the science of common things — of the materials and processes necessary to produce the most common manufactured products — and of the laws of health." In 1884 there were 52 scholarships from primary to grammar schools, and these again are largely aided by government grants, £90,000 having been thus spent to the end of 1884. From these schools, since 1878, three exhibitions to the universities have been granted yearly, on the result of examinations conducted by the professors in Sydney. The holders of these scholarships have proceeded to the Universities of Sydney, Melbourne, London, Oxford, Glasgow, and Edinburgh, and in many cases have distinguished themselves there, often in scientific examinations.

TASMANIA.

Little or no elementary science is taught in the primary schools. A council of education takes cognizance of all secondary schools, and conducts examinations for scholarships and exhibitions, and for the degree of A.A. Holders of this degree can proceed to England to study for three years at government expense: 274 students have availed themselves of this, and have taken medical and legal degrees, and entered the church, but none have studied and applied their science in the colony. It is one of the duties of the analytical chemist to the government, to deliver free public scientific lectures in Hobart. The government has under consideration a scheme for introducing technical education into primary schools.

NEW ZEALAND.

I have already referred to the speech of the minister of education of this colony, delivered in the house of representatives in 1885. In general characteristics, the educational system here much resembles those we have been considering. The extent to which science is recognized in the primary schools will be seen from the following facts. With a population of about half a million, there are nearly 1,000 primary schools, in which almost 100,000 children received instruction in 1884: 55 per cent of these learned geography; 60 per cent, drawing; 75 per cent were taught 'object-lessons;' and 26 per cent received lessons in elementary science. The course of instruction in this interested me much, as it is so obviously based upon what has been so successfully worked in the board schools of Liverpool, Birmingham, Leeds, Nottingham, etc., and is being introduced in London also. It is confined to pupils in and above standard IV.; the boys being taught elementary physics, or agricultural chemistry, or botany, and the girls domestic economy, based on such excellent little books as that of Mrs. Buckton. The peripatetic system of teaching these subjects, so well worked in our large cities, cannot, of course, be carried out in New Zealand. The Maori native schools are, on the whole, in a flourishing position, and doing excellent work: 2,226 children are in attendance, and a text-book, 'Health for the Maori,' has been published in English and in the e rnacular.

In the secondary schools, academical traditions are still very strong, and in the position of science there is very great room for improvement. Under the guidance of the University of New Zealand, however, the provincial colleges affiliated to it are doing much to encourage the pursuit of science. In Canterbury college, out of six professors, four are scientific, and a similar proportion holds good in the so-called University of Otago, excluding the medical school. I believe a similar state of things exists also in the Auckland college. The University of New Zealand recognizes the claims of science to a greater extent, I think, than does any colonial university. The pass for a bachelor of science is as follows: mathematics, physics, chemistry, biology, and any two out of the five following subjects,—Latin, Greek, English, modern languages, mental science. A candidate can matriculate and proceed to the B.Sc. degree without any more classical knowledge than a trifling amount of Latin, such as the proverbial schoolboy ought to have at his fingers' ends. So anxious is the senate of the university to maintain a high standard for its degrees, that all the degree examination questions are set, and all the answers thereto are revised, by English examiners of either London, Oxford, or Cambridge universities. It is my privilege to be the agent of the university in England, and I am now seeing through the press about ninety examination papers for use in the colony next autumn. Mr. Stout says in his speech, that, "considering her population, New Zealand has as many students receiving a university education as any country in the world, and, relatively to her population, more university-trained men than any country in the world."

So much for the scholastic instruction. In the other great means of educating the people, museums, etc., New Zealand is in advance of the other Australasian colonies. The Canterbury museum, whose curator, Dr. Von Haast, is executive commissioner at this exhibition, excels those of Sydney and Melbourne; and in arrangement of exhibits for scientific purposes, the Otago museum is said to be second to none in the southern hemisphere. Those in Wellington and Auckland have also a well-deserved reputation.

GENERAL CONCLUSIONS.

Finally, I beg to offer a few general remarks and conclusions, founded upon the details which we have been considering. To those of us who are familiar with the very limited extent to which the teaching of science is carried out in the elementary schools of Great Britain, it would appear that its claims to a place in state-aided primary education are much more recognized in the colonies than in the mother-country; and this not merely because it is the only foundation upon which a system of technological education can be securely built, but for its value in drawing out the minds of the pupils.

In secondary, grammar, and high schools, however, where the academic influence and traditions are still strong, I incline to think that science scarcely occupies a position equal to that now attained in corresponding English schools. I should doubt, for example, whether there is any large high-class school in either of the colonies, where, as in Clifton college, a certain amount of attendance on science classes is required from every boy, no matter what his future is to be, in order that he may comprehend the meaning of scientific method and treatment of a subject. The colonial universities, too, though now generally modelled more or less on that of London, have usually so arranged their matriculation examination, unlike their prototype, that it is possible to pass it in purely literary subjects alone.

A glance through the calendars of the older colonial universities shows again, in a very marked degree, the strong influence of the older academic ideas of Cambridge and Oxford. I noticed this particularly in the case of Sydney, in 1880, where I had unusual opportunities of forming an opinion; and also, at the same time, in some of the provincial colleges in New Zealand. Within the last few years, however, a great change has come over colonial university opinion in this matter. Degrees in science have been instituted; faculties of science have been organized, and placed on an equal footing with those of arts, laws, and medicine. In the case of two, at least, of these universities, degrees in engineering science are now conferred, a proposal to establish which, as some present are aware, is now before the University of London.

Great as has been the progress of public opinion in England during the last few years, on the value of science as an element in education, I am disposed to think that the progress has been greater in the colonies in the same period. Certainly the development of that opinion to its present point has been much more rapid in the colonies than at home. In educational as well as in political matters the colonies are most valuable to the mother-country as localities where experiments in legislation may be, and often are, conveniently tried, the progress of opinion on certain subjects there being in advance of that in England.

To attempt a general review of all the other existing agencies for the promotion of a taste for science among adults would be almost hopeless. They are of the same general character as in England, modified to suit the special circumstances of each case; some of them being carried on, under circumstances of great difficulty and discouragement, by enthusiastic devotees of nature, while others, like the Royal societies of Canada, Victoria, and New South Wales, have achieved a reputation which extends wherever the English language is read.

EDUCATION IN SPAIN.

AN English writer, touching on the subject of education in Spain, complains that so different are the conditions in the various provinces of Spain, statistics mislead when they seem to show that Spain is one of the worst educated countries in Europe. While this is true, he says, of many districts, it is not true in all. The great drawback to the cause of education in Spain is the comparatively small educated public to which appeal can be made. Out of upward of sixteen millions of Spaniards, only four millions know how to read and write, and half a million more can read only. Thus only about twenty-five per cent of the population have any education worth speaking of.

Then, too, a corrupt and corrupting political and administrative influence is brought to bear on education. Nominally, and according to the letter of the law, education is compulsory on all Spaniards between the ages of six and nine. Yet the number of pupils on the school rolls is only 1,800,000, and the actual attendance is less than sixty per cent of the enrolment. The laws are violated in many particulars and neglected or evaded in many more. Of the 23,000 schoolhouses (and it must be remembered that the most of them escape inspection altogether), 7,999 are returned as *no decentes y capaces*.

The teachers' salaries are ludicrously small. Of 15,000 teachers, 1,273 receive less than twenty-five dollars a year, 2,827 receive from twenty-five to fifty dollars, and only half of them have a salary that amounts to one hundred dollars.

Between 1870 and 1880 some progress was perceptible in educational matters. The northern provinces are in advance of those of the south. Alava comes first, with sixty-three per cent of its male population able to read and write. The religious orders and corporations do not play so large a part in the education in Spain as is commonly supposed. In the matter of primary education, the whole number of pupils taught by the religious associations is only 30,879, while the returns from the Protestant schools show only 3,196 enrolled in them.

The chief trouble with Spanish education seems to be that it does not conform to the real needs of the nation. While seventy-five per cent of the total population can neither read nor write, the proportion of university graduates is as high as that in

France and Germany. The needs of Spanish education would therefore seem to be, first, vigorous and honest enforcement of the laws as they stand at present ; and, secondly, some means of extending primary instruction.

COLLAR'S LATIN BOOK.

THIS book is an outcome of the discussions of the past few years on the value of classical study. Its method is a complete change from the tedious study of grammar to a rational view of the language as a form of expression. Its aim, as stated in the preface, " is to serve as a preparation for reading, writing, and, to a less degree, for speaking Latin." This preparation it gives, not by getting the Latin language before the beginner as a collection of paradigms and rules of syntax, but as a vehicle of ideas. It is here that the book breaks away from the traditional method.

Immediately on opening it, one notices the absence of any reference to the grammars. The book is not, as so many are, a mere guide-post, telling the pupil where in the grammars he can find forms, rules, or exceptions. In a compact form it gives all necessary paradigms and rules, but with full and repeated illustration. The examples are chosen not merely to illustrate forms and rules, but to show that forms and rules are instrumental to expression, and that it is as possible for a boy to express his own ideas in Latin as it is to find out what some one else has expressed. Further aid in this direction is given by the arrangement which brings the verb near the beginning, before the completion of declension, enabling the pupil to construct sentences, and by inserting early in the vocabularies verbal forms. Thus a boy learns that *habet* means 'has' before he can conjugate, just as a child learns 'has' before he knows it is a part of 'to have.' By slight changes of meanings, the exercises and vocabularies are made suggestive, and the *colloquia* scattered through the book cannot fail to interest and stimulate to imitation.

The plan of the book rests upon the fact that the memory and not the judgment of the pupil is to be exercised ; that one can learn facts rapidly who cannot appreciate reasons. The unslaked thirst of memory that belongs to the age when Latin is usually begun is made use of, but is not quenched by a mass of unnecessary detail and unimportant exceptions. Explanations are omitted, except as they help the pupil to understand, not the theory of constructions, but their uses. The omissions of the book are noteworthy, and the editors have happily avoided the deplorable error "of failing to discriminate between the relatively important and unimportant." The subjunctive mood, that slough of despond for beginners, is treated briefly but clearly, and fully enough for such a book.

The chapter on derivation does not seem quite up to the general level of the book. The examples are apt and well grouped, but they will be taken as individual specimens rather than illustrations of principles. In other chapters, after the examples, the rule or principle covering them has been stated, and in this it would have been well to add statements of the meaning attached to certain terminations.

The book is a *live* one. No lazy teacher can use it with success. It gives suggestions, but requires attention, and, properly used, will fulfil the expectation of the editors that pupils can be prepared by it for Caesar within a year. It will meet with success, because it throws off the trammels of artificial methods, and seeks those that are rational and natural.

JOHN K. LORD.

The beginner's Latin book. By WILLIAM C. COLLAR and M. GRANT DANIELL. Boston, *Ginn*, 1886. 12°.

MONOGRAPHS ON EDUCATION.

THE publishers of this handy series of essays are doing an excellent work. As they state in their preface, " many contributions to the theory or the practice of teaching are yearly lost to the profession, because they are embodied in articles which are too long, or too profound, or too limited as to number of interested readers, for popular magazine articles, and yet not sufficient in volume for books." Every teacher knows how true this statement is, and should therefore welcome such contributions to pedagogics when presented in so attractive a form as that in which these monographs are issued.

Prof. Stanley Hall's monograph on reading [1] is an example of applied pedagogics. He outlines the various traditional methods of teaching children to read, and also some of those suggested by the psychologists, and reaches the eminently sensible conclusion that "there is no one and only orthodox way of teaching and learning this greatest and hardest of all the arts." We cannot believe, however, that Professor Hall means to be taken seriously when he says (pp. 17, 18) that " many of our youth will develop into better health, stancher virtue, and possibly better citizenship, and a culture in every way more pedagogical and solid, had they never been taught to read, but some useful handicraft, and the habit of utilizing all the methods of oral education within reach, instead. . . . The school has no right to teach how to read, without doing much more than

[1] *How to teach reading, and what to read in school.* By G. STANLEY HALL. Boston, *Heath*, 1886. 12°.

it now does to direct the taste and confirm the habit of reading what is good rather than what is bad." Of course, the school tries to form good habits, if it forms any at all, both of reading and of every thing else that falls within its scope, but we cannot admit for an instant that the school is responsible for the abuse of any power that it puts in the hands of its pupils. Moreover, while what Professor Hall says about men having gotten on pretty well before Gutenberg, and even before Cadmus (p. 17), is all true enough, yet it does not bear on the argument. The point is, that they would not get on at all now, unless they harmonized with the nineteenth-century environment; and of that the ability to read is an important part. However, we hardly think Professor Hall meant to be taken seriously, but was emphasizing what we all deplore, — the time wasted in reading useless and often positively harmful literature.

The remaining monograph that we have received is on the study of Latin, by Professor Morris of Williams college.[1]

It is a very good presentation of one side of the subject, based on the important distinction that the 'study of a language' is ambiguous, unless we know whether by it is meant the acquisition of the language for reading or speaking, the study of the literature written in it, the study of a language with a view to using it effectually in composition, or the investigation of the language itself as an organic growth.

HALL'S BIBLIOGRAPHY OF EDUCATION.

WITH the rapid development of the science of education there has grown up an increasingly voluminous and complex mass of pedagogical literature. Educational journals almost without number have been founded, and histories, criticisms, and constructive works dealing with educational subjects, have followed each other in bewildering succession. To all this literature a guide is necessary: the useful must be sifted from the useless, and some classification for the purpose of systematic study must be adopted. An attempt has been made to do all this by Prof. Stanley Hall and Mr. John M. Mansfield in the little volume before us.

The cautious wording of the title and the frank confessions of the preface disarm all serious criticism, and lead us to be thankful for what we have received, instead of complaining because of what we miss. It cannot be denied that the classification adopted is superficial and provisional,—it is the outgrowth of a series of topical reference-lists used by Professor Hall in connection with his lectures at the Johns Hopkins university,—and that typographical and minor errors are very numerous in the book; but the work is so comprehensive, and the result of such painstaking labor, that it will be found of great value to every student and reader in the broad field of pedagogics. In fact, because of its suggestiveness alone, it may fairly be said to be indispensable to every pedagogical library that pretends to be complete and abreast of the times.

The references in some departments are much fuller than those in others,— the result, we fancy, of the fact that many hands have co-operated in the production of the book; and the list of educational periodicals, while it names the best journals, is scanty. The volume will, however, give to many persons an idea of the scope and complexity of educational science that they have never before possessed, and we trust that it may have a cordial reception and an extensive use. A second edition will undoubtedly remedy many of the blemishes of the first, and will, we hope, afford an opportunity for adding to the editorial notes appended to the references, which are of great value.

PAINTER'S HISTORY OF EDUCATION.

THIS book calls for neither extended notice nor searching criticism. It is modest, compact, and satisfactory. In no sense is it an original work, but it shows good sense in the selection of material, and good judgment in its arrangement. We could wish that it had been more original in one or two particulars; for example, in its treatment of the universities. Compayré and most of the German manuals of the history of education touch too lightly on this great subject. We believe that due acknowledgment is rarely made of the great intellectual stimulus the western world received from the great universities. Professor Painter follows in the beaten path here, and says but little on the subject. Moreover, it seems fitting that a book having a chapter entitled 'Education in the nineteenth century' should say something of the great movement in the direction of manual training, industrial and technical education, that has manifested itself in Europe and America. Professor Painter has passed this by. Yet the book is a useful one, and it will find many readers among those educators who are striving to put their work in the line of historical and logical development from that of the great masters of education who have preceded them.

[1] *The study of Latin in the preparatory course.* By E. P. MORRIS. Boston, *Heath*, 1886. 12°.

Hints toward a select and descriptive bibliography of education. By G. STANLEY HALL and JOHN M. MANSFIELD. Boston, *Heath*, 1886. 12°.

A history of education. By F. V. N. PAINTER. New York, *Appleton*, 1886. 12°.

SCIENCE.

FRIDAY, DECEMBER 3, 1886.

COMMENT AND CRITICISM.

This is the season of governmental reports, and we are forcibly reminded by them of the intricate and complex administrative system that has been developed in the United States. Most of these reports are of real interest to the community, but all save the most important of them are never read. Yet some of the reports by minor officers contain a great deal of valuable information, and merit notice. One such is the report of the adjutant-general of the army, who touches on the condition of the militia of the various states. Inasmuch as our regular army is too small to merit the name, and since we must depend on our volunteer forces in case of war, the topic is of some importance. The adjutant-general approves of state encampments as a means of drilling and training the militia, but, soldier-like, criticises the prevailing tendency to make an encampment a sort of picnic for the state officials. To be of any real benefit, General Drum says that state encampments should be of ten days' duration, and established at a sufficient distance from the homes of the members of the command to overcome the social and business influences which otherwise interfere with military duties. The camp must be divested of any holiday appearance, and the time devoted to instruction and practice in skirmish and battalion drills, and guard duty, target-practice, etc.; for, says General Drum, "as most of the fighting of the future must be done in open order, a thorough acquaintance with the skirmish drill is of the highest importance." He also disapproves of mere exhibition drills, and favors arming the state troops with the best and newest arms and ammunition.

The superintendent of the naval academy, Commodore Sampson, devotes the major portion of his report to an argument in favor of shortening the present six years' course of study at that institution. He desires to have the fifth and sixth years of the course, now devoted to service on cruising vessels, done away with, and the cadets commissioned at the end of the fourth year, instead of, as now, at the end of the sixth, on the ground that the country gains no additional advantage from the last two years. Commodore Sampson also shows that under the existing system, which restricts each congressional district to a candidate every six years, one-third of the boys are never eligible for admission to the academy, because of the various restrictions as to age; whereas, if the course were reduced from six years to four, each congressional district would have an appointment once in four years, and all the boys of the country would be eligible at some time. At the last annual examination, 163 candidates reported; but only 86 fulfilled the requirements, and were entered as cadets.

But of the reports thus far made public, with the possible exception of the treasury statements, that of the postmaster-general will attract most attention. Using statistics gathered in 1884 — since which time our postal service has grown immensely — by the international bureau of the Universal postal union, Mr. Vilas shows that our postal machinery far exceeds that of any other nation on the globe. It is estimated that last year one hundred million more letters were mailed here than in Great Britain, — long the leading letter-writing nation, — and nearly that number more than were mailed in Germany, France, and Austria combined. Of pieces of matter mailed, the annual proportion per inhabitant is 19 in Germany, 57 in Great Britain, and 66 in the United States. At the close of the last fiscal year there were in this country 53,614 post-offices, and 497 stations or branch-offices: of this number, only 2,265 are so-called presidential offices. It is a curious and suggestive fact, that, of the new offices established during the year, over sixty per cent were located in fourteen southern states and Indian Territory. During the year the carriers handled 1,949,520,599 pieces of mail matter, an increase over the previous year of 11.75 per cent. About four millions of dollars were transferred on postal orders, and 1,118,820 special delivery stamps were used. The gross revenue for the year amounts to $43,936,000, leaving a deficiency of nearly $7,000,000 to be provided for by appropriation.

Figures are sometimes strange things, but no less convincing than strange. They frequently force a man to assent to a proposition against his will, and in opposition to what he has persuaded himself is true. The latest case in point, and the one we have in mind, is a contribution of the London *Economist* to the discussion on bad times and depression. Great Britain has been commiserating itself on its unprosperous financial condition, and John Bull has loudly asseverated that he is losing money. In the face of this comes the *Economist* with the statement, that, instead of having grown poorer, Great Britain has, during the last decade, saved and invested at least one thousand million pounds sterling, a sum one-third greater than the national debt. This immense sum is believed to be far within the truth, since it takes no account of the large sums annually spent in improvements, nor of the very considerable sum sent out of the country to secure foreign and colonial investments. The *Economist* proves its assertion by showing that within ten years the country has invested the following sums: house property, £400,000,000; home railways, £186,000,000; joint stock companies, £200,000,000; colonial loans, £80,000,000; loans to English local authorities, £72,000,000, — in all, £938,000,000. The *Spectator*, in noticing this fact, thinks that it is not so much, after all; for it is only a saving of "a hundred million pounds sterling a year, or a fifth more than is paid in national taxation, — probably not two shillings in the pound of national income, and certainly not a fourth of the income of those who pay the income tax." This may be so; but practically it may make considerable difference in the expenditures of a people, to find, that, instead of annually running behind, they are really getting ahead each twelvemonth. But be these figures what they may, it seems to be an undoubted fact that a large section of the British population feel that they grow poorer year by year; and, until we can determine more precisely what weight attaches to the statistics prepared by the *Economist*, we are unwilling to say emphatically that such feeling is without any justification in fact.

Few organized charities are so uniformly successful and so richly deserving as the Children's aid society of New York City, of which Mr. Charles L. Brace is the efficient and judicious executive officer. In describing the work of the society at the annual meeting of the trustees, Mr. Brace detailed the principles of the society and the results attained by proceeding upon them. The principles were defined as the absolute necessity of treating each youthful criminal or outcast as an individual, and not as one of a crowd; the immense superiority of the home or family over any institution in reformatory and educational influence; the prevention of crime and pauperism by early efforts with children, and the vital importance of breaking up inherited pauperism by putting almshouse children in separate homes; and, most of all, the immense advantage of 'placing out' neglected and orphan children in farmers' families. The records of the city police courts show how these principles work in practice. While in thirty years the city's population has increased from about six hundred and thirty thousand to nearly a million and a half, the number of girls committed for petty larceny has fallen in the same period from over nine hundred to less than two hundred and fifty. In the same time the commitments of female vagrants have decreased from 5,778 to 2,565.

The industrial schools, employing over one hundred teachers, and giving instruction to ten thousand pupils, are the most important branch of the society's work. Mr. Brace claims that "the industrial schools act especially in preventing the growth of a race of drunkards, as the children become elevated above the habit. The enormous decrease of some fifty per cent in cases of drunkenness known to the police during the past ten years is one proof of this. The remarkable decrease of some twelve and a half per cent in all crimes against person and property during the past ten years, as well as the decrease from previous years, is one of the most striking evidences ever offered of the effects of such labors as those of this society and of many similar charities. It has gone on regularly in years both of business depression and prosperity. It proves that such labors are diminishing the supply of thieves, burglars, drunkards, vagrants, and rogues." Another original and useful branch of the society is its lodging-houses, which combine the various functions of school, workshop, emigration agency, and lodging-house. Each child pays for his support by labor or money. The liberal benefactions of Miss Wolfe, J. J. Astor, and Mrs. R. L. Stewart, who have each put up large buildings for these purposes, have greatly aided the society. There are now six lodging-houses, and they have sheltered during the year over 11,000 children at an average cost per capita of $47.65.

A SIGNIFICANT ILLUSTRATION of the interest taken by Russians in anthropological research and the zeal and activity of Russian scientific bodies is furnished by the annual report of the Society of lovers of natural science anthropology and ethnology, read at its annual meeting in Moscow on the 27th ult. In the course of the past year the society has held fifty meetings, at which there were read one hundred and thirty papers and reports; it has organized and sent into the field seventeen scientific expeditions, including one to the Black Sea, one to the valley of the Ob in western Siberia, and one to the Caucasus; it has made valuable collections in all parts of the empire; and, finally, it has published eight volumes of memoirs embodying the scientific work of its members. Six medals of gold and six of silver were awarded at the annual meeting to members of the society who had especially distinguished themselves during the year in scientific research.

OPINIONS SEEM TO DIFFER as to the dangers connected with the use of cocaine. Dr. William A. Hammond does not believe that there is any danger of a person becoming so addicted to its use that he cannot discontinue it at any time. Dr. J. B. Mattison, on the other hand, looks upon it as a drug which already has entangled within its toils a number of persons, who are as unable to stop its use as if the drug were opium instead of cocaine, and for whose relief a proper course of treatment is necessary. The statistics thus far seem to indicate that physicians and apothecaries are especially prone to its unrestricted use, as, up to the present time, they form the larger part of its victims.

THE DISCOVERY of petroleum in Scotland, as mentioned in the *Glasgow herald*, is interesting in connection with the discoveries made many years ago of petroleum in small quantity in English coal-measures; but it is very probable that this locality, like those in England, will not yield oil in commercial quantity. It is worth while, however, to call attention to the fact that the distillation of oil from 'bog-head' coal and the Mid-lothian shales, with which this new pit is probably connected, led eventually to the production of petroleum in the United States.

THE *Lancet* records the case of a young girl who had attacks exactly resembling delirium tremens from the effect of tea-leaves which she was in the habit of chewing. We have already called attention to the many and varied disorders which may occur as the result of the excessive use of strong tea, and have no doubt that many persons suffering from dyspepsia and palpitation of the heart would find these symptoms to disappear, or at least be markedly diminished, if they would discontinue the excessive use of tea as a beverage.

IN COMMENTING UPON the extraordinary efficiency claimed for the Marchant steam-engine, which has been attracting considerable attention in England of late, *Science* of Oct. 29 intimated that in the tests made there might possibly have been some source of error, which would be revealed by further trials under more satisfactory conditions. Conclusive tests recently made in the presence of representatives of *Engineering*, the *Electrical review*, and other technical journals, prove that the amount of coal consumed for each horse-power per hour, as shown by the brake, was four pounds, instead of eight-tenths of a pound, as shown at previous trials.

MEASLES APPEARS TO BE very prevalent in New York City. For the week ending Nov. 20, there were 253 cases reported, of which 38 were fatal. During the first two years of the war of the rebellion there were 38,021 cases of this disease in the army, of which 1,864, or about 1 in 31, were fatal. Bartholow regards this as an underestimate. He thinks, that, if all the complications and sequels were taken into account, the mortality would be at least 1 to 5. The number of deaths in Brooklyn for the same period was but 4. It is difficult to estimate the probable number of cases of this disease in either city, the mortality varying so much at different times, and for reasons which are not ascertainable, although it is doubtless true that only a very small proportion of the cases are reported to the health authorities in any of our cities While New York is nearly free from small-pox, and has been for a long time, — but one case in many months, — Brooklyn appears to have the disease to a considerable extent, some forty or more cases having been reported within the past month. With so much of this disease in a neighboring city, it will be very strange if New York continues to be exempt.

MUSCLE-READING BY MR. BISHOP.

MR. W. I. BISHOP, a young American, who has given a number of exhibitions of muscle-reading in Europe and this country, gave a private performance recently in Boston. As considerable discussion has ensued in the daily press as to what the exhibiter did or did not do, and as the newspaper reports have been misleading, we present a brief account of the actual performances at Boston.

The principal feats were four in number: 1. The discovery of a knife hidden in an adjoining room, and the re-enactment of a pretended murder with the knife; 2. Writing on a blackboard the number of a bank-note; 3. Finding an object hidden at a distance from the hotel; 4. Playing a piece of music on the piano. While doing these feats, Mr. Bishop was blindfolded, and ascertained what he was to do through unconscious communications from a person who knew exactly what was to be done. There is no reason to doubt the fairness of the conditions, or to suspect collusion.

1. In the watched absence of Mr. Bishop, the Rev. James Freeman Clarke took a knife and pretended to stab Dr. C. C. Everett; he then, accompanied by Dr. Minot J. Savage, hid the knife. The performer returned and was blindfolded; he then placed Dr. Clarke's hand upon his own, and essayed unsuccessfully to find the knife. At the performer's request, Dr. Savage took hold of Dr. Clarke's wrist of the same hand Mr. Bishop was touching. With this double guidance, Mr. Bishop went quickly to the place where the knife was hid. found it, returned, stopped in front of Dr. Everett, and copied with his own hand but imperfectly the stabbing done by Dr. Clarke. During the whole time his hand was close to or actually touching Dr. Clarke's.

2. Dr. William James looked at the number on a bank-bill which comprised three digits unknown to Mr. Bishop. The latter drew some large squares upon a blackboard, one for each digit. He was again blindfolded, and, taking Dr. James's hand in his, stood in front of the board, and, while his guide fixed his attention upon the squares and the digits, he drew the three digits in succession correctly.

3. An open carriage seating four persons, with two quiet horses, was brought to the door of the Hotel Vendome, where the exhibition was given. A party of three gentlemen, all well known, had previously hid a scarf-pin in a private house a few blocks off. The three gentlemen, accompanied by Mr. Bishop, who was blindfolded and had a black hood over his head, got into the carriage. Each of the four had hold of the long piece of wire which Mr. Bishop had provided. Two of the gentlemen placed their hands upon Mr. Bishop's head. Mr. Bishop drove off, and, after a few false turns, came to the right house, got out there, and accompanied by his guides, and touched by at least one of them, found the pin, and then returned to the hotel. Two circumstances probably facilitated this performance. First, when the party returned, one of them touched Mr. Bishop, who was blindfolded; and the latter, while his guide was looking at the large map of Boston hanging on the wall, and thinking of the house where the pin was, put his own finger upon the right spot on the map. Mr. Bishop may have thus gained some general knowledge as to where the locality was. Second, the street on which he started runs east and west; there was a bright afternoon sun; it is probable that the light was sufficient to inform him at least as to the points of the compass. However, these sources of information, though helpful, were insufficient to show exactly where the pin was hid.

4. Mr. Bishop asked Mr. Whitney to think of some well-known melody, and suggested something from 'Il Trovatore.' Mr. Whitney adopted the suggestion, and informed the audience of his selection. Mr. Bishop placed himself in front of the piano, and, touching Mr. Whitney's hand, proceeded to strike the right notes on the keyboard. His guide's attention was concentrated on the melody, and on the movements of Mr. Bishop's hand over the keys.

Several other feats were attempted, but failed. The failures were presumably due to the guides not being good subjects.

According to the unanimous opinion of the most competent judges, the explanation of the feats accomplished is simple and obvious, and has already been given as regards Mr. Bishop personally by Professor Preyer. If the descriptions given above are recalled, it will be noticed, 1°, that nothing was done except when there was contact between the performer and the guide; and, 2°, that success required nothing but the execution of some movement on Mr. Bishop's part. Thus, in the first feat he had to go to a certain place, take a knife, return with it and strike a blow; in the second, to make certain marks upon a blackboard; in the third, to move, in part by the guided power of horses, to a certain place, and there move his hand to a particular spot and take hold of an object; in the fourth, merely to strike certain piano-keys. In spite, therefore, of the apparent diversity of things done, there was no real variety, and there is only one thing to explain. It is this: how did Mr. Bishop ascertain what movements or motions he was to execute?

That we have no reason to suspect trickery has already been said. We must also seek some means of communication of which the guides were unconscious. Mr. Bishop claims that he received his impressions by direct mind-reading, or, as it is now often called, telepathy ; and a certain number of persons appeared inclined to accept that explanation. But when Mr. Bishop's arguments are examined, they vanish : and in his replies in the newspapers to his critics he has insidiously and assiduously avoided discussion of any of the real objections to his assertion that his feats are done by genuine mind-reading ; so that we are compelled to think that his real purpose is to make his exhibitions assume a marvellous character in the mind of the public, or else that he really believes in his assertion, which, may we be pardoned for saying frankly, implies a notable ignorance of physiology and psychology, — a degree of ignorance not rare in itself, though rarely coupled with so much audacity of opinion.

The only explanation which we can consider tenable is the simple one of muscle-reading, already advanced by Professor Preyer. As already stated, Mr. Bishop was in every case in contact with his guide, and his feat was to make the motion which the guide knew he ought to make. In accordance with Preyer's view, we think that slight pressures of the guide's hand were exerted, that these were perceived by Mr. Bishop, and sufficed for his guidance. That the explanation is ample is apparently not questioned by any of those who have followed the recent discussions upon muscle-reading. It is now very properly held by, we believe, all qualified judges, that, when there is contact between the performer and the guide, there is no adequate reason to assume the occurrence of true mind-reading. Mr. Bishop, however, thinks the contrary, and says the impressions on his mind are telepathic, and not sensory, in origin. By a common mental flaw, Mr. Bishop, at least in our judgment, assumes a remote and improbable cause, instead of a near and probable one. To our mind it would be a like reasoning which said that love exerts a powerful attraction : stones are not drawn toward the earth by gravity, but by the love they have for the earth.

We may conclude by saying that we consider Mr. Bishop an exceptionally good muscle-reader, and regret that the mysteries with which he seeks to envelop his exhibitions give an effect of charlatanism, entirely distasteful to an honorable lover of scientific truth. We have therefore expressed ourselves more unreservedly than would have been fitting in the discussion of a subject concerning which an honest divergence of opinion were possible among scientific men.

A SUBMARINE VOYAGE.

The submarine torpedo-boat shown in the accompanying illustration has made frequent trial trips, during the past few months, in the Hudson River, off the foot of 86th Street, this city ; and the degree of success attained has been highly gratifying to her owners, the Submarine monitor company. A brief description and illustration of the boat were given in *Science* of Aug. 27, but several changes have been made in details of her construction and equipment since that date, so that she now presents a somewhat different appearance. A pair of horizontal rudders has been attached at the bow, so that the boat may be submerged 'on an even keel,' that is, in a horizontal position, instead of at an angle, as formerly. The boat can be submerged by means of the rudders only when she is in rapid motion, rising immediately to the surface if the engine stops, or if the rudders are changed from an inclined position, as in the engraving, to a horizontal position. When not in motion, the boat may be submerged or raised to the surface by taking in or forcing out water-ballast.

A fin, or vertical projection, has been attached to the upper part of the boat, amidships, extending 'fore and aft,' so as to guard the manhole and conning-dome or pilot-house from collision with the keel of a ship when passing under its bottom. A depression in the fin, between the manhole and the dome, is intended to afford a sort of resting or holding place for the boat when under a ship's keel while releasing torpedoes. A pair of sleeves or gloves of india-rubber project from the boat abaft the dome, one of which is shown in the picture. By inserting his arm in one of these sleeves, the captain of the boat can release the torpedoes at the proper moment, the torpedoes being attached by tripping devices to the outside of the boat.

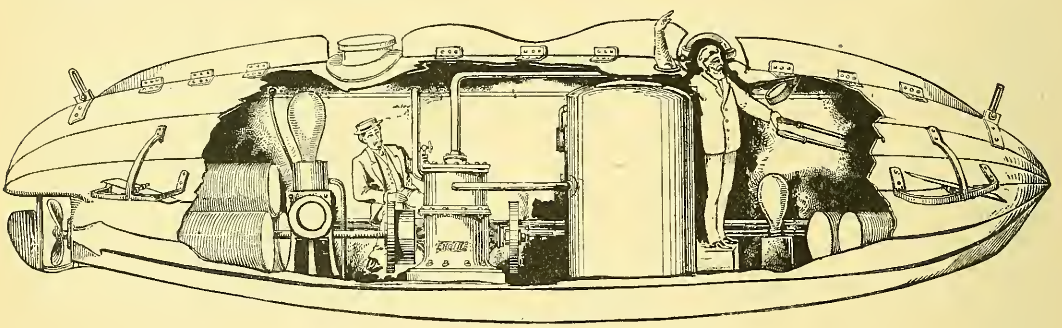
The proposed method of using the boat in actual warfare is as follows : she will be submerged by means of the rudders or water-ballast, or both. When at the proper depth, she will approach the vessel to be destroyed, and, as she passes beneath it, two torpedoes will be released, each attached to one end of a rope. The torpedoes will be lightened by cork or an equivalent, so that they will rest against the bottom of the vessel, one on each side of the keel. The boat will then be run ahead a safe distance, and the torpedoes exploded by electricity through wires leading from the boat, There has been no torpedo practice yet with the Peacemaker, as the new boat is called, but the intention of her owners is to make some experiments in that direction soon.

In the illustration the side of the boat is broken away to show the interior. In the bow are two cylindrical water-tanks, above which are two steering-levers, within easy reaching distance of the captain. There is also a small steam-pump for filling or emptying the tanks. The captain stands with his eyes on a level with the glazed apertures in the conning-dome, whence he has a view all around the horizon while above the surface. When submerged, he shapes his course by a compass. Near the middle of the boat is the steam-boiler, abaft of which is the engine. In the stern are three cylindrical water-tanks similar to those in the bow, and for the same purpose. A large steam-pump stands just forward of the tanks. Several compressed-air pipes, each six inches in diameter, extend along the sides of the boat, near the bottom.

When the boat was first built, electricity was tried as a motive power. The storage-batteries and electric motor, being found inadequate, were removed, and a Honigmann fireless boiler and a fourteen-horse-power steam-engine substituted. With these it is claimed that eight knots an hour for several hours may be maintained with one charge of caustic soda. The speed and steam-endurance depend, of course, upon the capacity of the boiler and the efficiency of the machinery.

The propulsion of the boat by steam power for any great length of time while submerged would not have been possible before Honigmann's invention, a few years ago, of the fireless boiler which bears his name. This invention is based upon the discovery that a solution of caustic soda liberates heat while absorbing steam, which heat may be utilized for the production of fresh steam. The Honigmann boiler, as used on the Peacemaker, is double, the inner part containing water and steam, and the outer surrounding vessel containing a saturated solution of caustic soda heated to within a few degrees of the boiling-point. The steam, after doing its work in the engine, is exhausted into the solution, by which it is absorbed, the process developing heat, which produces more steam in the boiler. This is continued until the solution will absorb no more steam, when the surplus moisture must be driven off before the operation can be repeated.

At a recent trial of the boat, a representative of *Science* was permitted to witness the operation of charging the boiler, and to become a passenger in the boat during her submarine voyage. Water, heated under pressure to above the boiling-point, was pumped from a boiler on the deck of the torpedo-boat's tender to the inner compartment of the boat's boiler, and the outer compartment was filled with the soda solution previously heated to about 260° F. in a tank on the tender. The captain and engineer, accompanied by the *Science* reporter, descended into the boat through the manhole, which was then securely fastened on the inside. The captain took his place at the steering-levers, with his head in the dome, the engineer and reporter stationing themselves at the engine. Light was furnished by two-candle-power electric lamps. The steam-gauge showed eighty pounds pressure. All being in readiness, water was admitted to the ballast-tanks until the dead-lights in the dome — which had up to this time been about a foot above water — were almost even with the surface. The order was then given to go ahead, the engine was started, and the boat shot ahead, showing only her 'fin' above water. The captain guided her movements with ease, describing curves, going straight ahead, or forcing her below the surface, until the pressure-gauge which communicated with the water on the outside showed a depth of forty feet. The steam-gauge showed a steady increase in pressure, from 80 pounds at the start, to 120 when the boat ran alongside the tender a half-hour later. The back-pressure gauge, which was connected with the soda-solution compartment of the boiler,



THE PEACEMAKER.

showed an increase in the same time from 0 to 5 pounds. During this half-hour the air in the boat seemed to be reasonably pure, the heat was not as great as that in the engine-room of an ordinary steam-vessel, and there appeared to be no reason why such a voyage could not be continued for several hours without inconvenience to those on board.

NEW JERSEY SANITARY ASSOCIATION.

THE New Jersey sanitary association held its twelfth annual meeting at Trenton on the 19th and 20th of November. There were in attendance about one hundred members. The meeting was regarded by all as the most interesting and valuable the association has ever held.

We can give but brief mention of the proceedings. A paper on 'Disposal of house-sewage in districts not provided with sewers' was read by C. P. Bassett, C.E., of Newark. In the state of New Jersey there are only about a dozen of the towns which have any system of sewerage, and several of these are in a miserable condition. After denouncing the methods in vogue in places where no sewers exist and privy-vaults and cesspools abound, he referred to the advantages of the movable pail system in use in Birmingham, England, where 40,000 pails, representing 250,000 people, are collected weekly and carried to the dumping-station, where the contents are placed in a tank, treated with sulphuric acid, dried, and bagged for sale. The net cost is less than a cent a head annually. He next referred to the dry-earth system, but believed it could not secure wide popularity, the difficulties connected with the procurement of a proper supply of earth and the proper subsequent management of the waste being very great. The 'sub-irrigation' system was then described.

Shippen Wallace, Ph.D., of Burlington, read a paper on 'Preserved foods.' There are at the present time 800 factories in the United States engaged in the canning of foods. In these factories 500,000,000 cans are packed annually : of these, 50,000,000 are salmon, 72,000,000 tomatoes, and 25,000,000 corn. Although much has been said in the public press and elsewhere about the possible danger of poisoning from the contents of these cans, he believed there was no case on record of poisoning, either fatal or otherwise, where the materials were sound when packed. In discussing this paper, Professer Wilbur of Princeton college thought more attention should be paid to the cleanliness of the surroundings of canning-factories. He had examined one where the premises were in the most filthy condition. Dr. Davis said he had occasion to examine a large number of operatives in canning-factories, and had found sores on their arms, and had reason to believe this was not uncommon. For this reason he thought that the sanitary authorities should make periodical visitations and inspections in all canning-factories. Dr. Quimby of Jersey City thought this sanitary supervision could be advantageously exercised over bakeries, sugar-houses, and candy-manufactories. Dr. Amering, president of the Society of American analysts, called attention to the sophistication of foods and drugs. In Philadelphia it was a common practice to use gelatine in cream-puffs, ice-cream, and charlotte russe, and the putrefaction of this had caused sickness in the consumers.

Dr. D. Benjamin of Camden followed with a paper on 'The relation between drinking-water and typhoid-fever.' He regarded the two as so intimately connected as to make it hardly ever worth the while to think of any other source for typhoid-fever. Dr. Baldwin of New Brunswick believed that it might be contracted in other ways; and Dr. Raymond of Brooklyn thought that it not infrequently was spread through the sewers, the infected discharges having been thrown into the soil-pipes without disinfection, and, through defects in the plumbing, sewer-air carrying the germs of the disease found its way into other houses. He regarded the two most important adjuncts in the eradication of typhoid-fever from towns or cities where the water-supply was good, and indeed for all places, as being a thorough disinfection of the discharges, and the correcting of all defects in the waste-pipes and traps. The total abolition of pumps in the city of Brooklyn had not produced much effect on typhoid-fever in that city, where it has existed with more or less prevalence from the time of the earliest records.

Other papers read were, 'Trap ventilation and the fresh-air inlets thereto,' by J. C. Bayles of Orange ; 'The physical laws of pipes and fixtures and their contents,' by C. F. Brackett of Princeton ; 'The duties of local inspectors, how best performed, and details of method,' by Henry Mitchell of Asbury Park ; 'The work of the present and the immediate future for New Jersey health boards,' by Ezra M. Hunt ; 'The physiological side of education,' by James M. Green of Long Branch ; 'Physical restraint and relaxation in the schoolroom,' by Charles Jacobur of New Brunswick ; 'The work of the plumber and the modes of conveying and disposing of sewage,' by J. J. Powers of Brooklyn ; 'The chief points in sanitary administration, and the requirements as to vital returns and the notification of disease,' by J. H. Raymond of Brooklyn ; 'What boards of health can do to prevent adulteration of foods and drinks and the sale of dangerous illuminants,' by W. R. Newton of Paterson. Dr. Newton was elected president for the ensuing year. The association adjourned to meet at Trenton next year.

NOTES AND NEWS.

THE limits of glacial action in Russia appear on all our maps, according to the observations of Murchison and his colleagues many years ago, at a time when the glacial theory was in its infancy, and when the investigation of glacial records was in a very crude state. It is therefore welcome news to students in this branch of geology to learn that Nikïtin, chief of the Russian geological bureau, has lately reviewed the question, utilizing all local information, so difficult of access to American readers from its being largely in Russian, and adding many special observations of his own. His discussion is published in the ninth number of Petermann's *Mittheilungen* for the current year, and is accompanied by a small-scale map showing the margin of the glaciated area, in which the characteristic indented outline clearly appears, though not on so remarkable a scale as in this country. The subdivision of the drift is not carried so far as it has been with us, and its influence on the topography is hardly considered: much further information may therefore be expected from later investigations.

— Although Mont Blanc has for a quarter of a century been French soil, its climbers have not usually shown an annual majority of Frenchmen; yet this has been the case this year. The ascent was made by 31 French (three of them ladies), 25 English (one lady), 10 Americans, seven Swiss (two ladies), six Germans, two Russians, two Swedes, one Italian, and one Belgian, — total, 85.

— Glanders is still quite prevalent in Brooklyn. But a short time ago the officers of Bergh's society found that a horse which had been transporting meat from a slaughter-house to the butcher-shops for eight months, had during all that time been suffering from glanders. The owner of the horse was arrested, and fined a hundred dollars, and, in default of its payment, was sent to jail. Three other horses have been attacked with the disease in the same stable, and all four have been killed. The number of horses which have been exposed during these many months is incalculable, and, unless rigid measures are taken, a wide-spread epidemic may be expected.

— The pharmaceutical society of Brooklyn has permanently established a course of lectures to be given annually to the drug-clerks of that society. The course for the coming year includes lectures on poisons and their mode of action, antiseptics and disinfectants, chemistry as related to pharmacy, the microscope and its uses in pharmacy, and other subjects of importance and interest. The plan is an admirable one, and is worthy of reproduction by the pharmacists of other cities.

— The superintendent of buildings in Kansas City says that he finds very few buildings in that city in which the plumbing is as it should be. He finds that in some cases the only escape for sewer-gas is through the sink, the bath-tub, or the water-closet. He recommends the appointment of an inspector, whose duty it should be to examine the plumbing of all houses.

— Dr. Cyrus Edson's vigorous inspection of the food-supply of New York City is kept up with unabated vigor, and is undoubtedly preventive of much disease among the lower classes of the population. Recently Mr. Edson visited a wine-manufactory in Front Street, and reported that wine was being made by the following process: dried fruits, such as raisins, currants, and peaches, of low grade, are macerated with water, to which a certain amount of sugar is added. The mixture is then fermented, and, when fermentation is considered sufficiently advanced, it is checked by the addition of salicylic acid. The so-called wine is then clarified, flavored, and colored to resemble port, claret, or any other desired kind, the object being to imitate and undersell natural native wines. Dr. Edson claims that salicylic acid taken constantly, even in small doses, produces a depressing effect on the nervous system, and he believes the adulteration dangerous, and liable to cause illness. The manufacturer uses $4\frac{1}{2}$ grains of acid to a pint, and Dr. Edson condemned and seized all the wine that he found on the premises.

— M. Paul Janet has in press a new and revised edition of his valuable and suggestive work entitled 'Histoire de la science politique dans ses rapports avec la morale.'

— The French demand for English and German philosophical works seems to increase rather than diminish. M. Alcan has now in press translations of Spencer's 'Principles of sociology,' and of Preyer's 'Die seele des kindes.'

— In Belgium a royal decree of recent date has established at Ghent an academy of scholars and literary men, having for its object the study and cultivation of the languages and literature of the Netherlands. It is named Koninklijke vlaamsche academie for taal-en letterkunde. The king of the Belgians is the patron of the academy, which is composed of three classes of members, — regular, honorary, and corresponding. The regular members are twenty-five in number, and the first eighteen nominations were made by the king. He named MM. Claeys, de Hondt, Delaet, Delcroix, de Pauw, de Potter, Gaillard, Genard, Gezelle, Hiel, Nolet de Brauwere van Steeland, Roersch, Rooses, Snieders, Stroobaut, van Beers, Vanderhiegen, and P. Willems. M. Willems is president, and M. de Potter secretary, of the academy. It was opened on Oct. 10 by the minister of agriculture, industry, and public works.

— The London *Times* notices that Signor Costanzo Stella, one of the Italian deputation which visited Spain last summer, has written an interesting account of what he saw, and in it shows that Spain, though behind most nations of western Europe, is not by any means absolutely unprogressive. Signor Stella says that in 1799 the population of Spain scarcely reached ten millions, but at the end of 1882 it exceeded eighteen millions, this being tantamount to an increase of 8.40 per 1,000 inhabitants every year. The agricultural population, which was only 3,615,000 eighty-five years ago, is now 9,328,000, and the area under cultivation has increased from 53,000,000 to 193,750,000 acres, while there are now 38,000,000 head of cattle as against just half that number at the beginning of the century. The industrial population of Spain has risen from 1,035,000 to 3,038,000, and the number of manufactories, etc., from 883 to 13,911. The trade of the country has increased in proportion. the progress during the last twenty-five years being particularly remarkable, as, while the imports and exports together amounted to only £25,800,000 in 1860, they have been gradually increasing, and now reach £56,000,000. The increase extends to all branches of trade ; for while Spain now produces 461,256,000 gallons of wine, of which about two-thirds are consumed in the country and the remainder exported, her railway system, which but five years ago did not reach 4,200 miles, is now not far short of 6,000 miles.

— The new edition of the 'Lectures and essays' of the late Professor Clifford brings the delightful writing and acute thinking of that wonderful intellect within the reach of a large number of readers. In this edition the introduction has been revised by its author, Frederick Pollock, and two essays which were included in the former edition have been omitted. They were those on 'Types of compound statement' and 'Instruments used in measurement,' and are to be found now among the 'Mathematical papers' published in 1882. We are glad to notice that Professor Clifford's portrait is retained.

— From the *Medical gazette* of Nantes, we learn that the Japanese have a remedy for hydrophobia which they call hoang-nan. It has recently been tried in twenty-four suspected cases. The daily dose of the drug in the form of the powdered root was from a hundred to a hundred and fifty grains. It is stated, that, up to the time of the last report, none of the patients had died. The histories of the cases are so incomplete that no inferences of any value can be drawn from them.

— A death has recently occurred from hemorrhage of the lungs, brought on by the irritation caused by the presence in that organ of six pine-leaves. Under what circumstances they found their way into the lungs is not reported.

— Professor Poncet, at a meeting of a medical society in Lyons, France, narrated an extremely interesting case in which pieces of bone were taken from a kid and grafted on to the tibia or leg-bone of a boy who had so suffered from the death of the bone as to necessitate the removal of a considerable portion of it. The wound in the leg healed, and the boy has now a firm and solid tibia.

— According to the *Medical record*, Dr. Louis Jobert has published a work on the cause and frequency of left-handedness. No purely left-handed race has ever been discovered, although there seems to be a difference in different tribes. Seventy per cent of the inhabitants of the Pendjab use the left hand by preference, and the greater number of the Hottentots and Bushmen of South Africa also use the left hand in preference to the right. Dr. Marro, as a result of his study of criminals, has found that from fourteen to twenty-two per cent of those who have been convicted of crime were left-handed, the highest ratio among people of all classes being only nine in the hundred.

— The contagiousness of leprosy has for a long time been a mooted question. The Royal college of physicians, in order to obtain the best information on this subject, sent inquiries to physicians throughout the world, whose practice had brought them in contact with the disease, and whose opinions would therefore be of value. Thirteen of these have no doubt of its contagiousness, and thirty-four entertain no doubt of its non-contagiousness. Twelve regarded leprosy and syphilis as being intimately related ; twenty-one believed there was no relation. Most of those to whom the inquiries were sent regard leprosy as hereditary, and also that it may originate spontaneously under suitable conditions.

— During a recent voyage of the U. S. S. Juniata to South America, observations were made as to the height and length of waves, with the following result, as reported by Commander Davis: height of wave from hollow to crest, 25 feet; length from crest to crest, 375 feet; wave-period, 7.5 seconds. The wind-velocity at the time was 10 miles per hour. The height of wave was measured by the elevation at which an observer could see over the crest when the ship was in the hollow. The wave-period was estimated by counting the average number of waves per minute. The wave-length was determined by the time occupied by the crest in passing a measured portion of the vessel's length.

— Mr. George A. Bacon of Syracuse, editor of the *Academy*, writes to tell us that the claim made in the newspapers that New York, Brooklyn, and Buffalo were the only cities in New York state without female representatives on the school board, to which we referred (*Science*, viii. No. 197), is without foundation. Mr. Bacon had before him, at the time of writing, the list of members of the school boards of Troy, Watertown, Saratoga, Ithaca, Auburn, Kingston, Syracuse, Poughkeepsie, Rochester, and Binghampton, and in no one of them did the name of a woman appear.

— The volume on Hume by Professor Knight of St. Andrews has been issued in Blackwood's series of 'Philosophical classics for English readers.'

— The report that Professor Tyndall would be able to give the course of Christmas lectures at the Royal institution proves to have been unfounded. It has been arranged for Professor Dewar to give them, and the subject will be the 'Chemistry of light and photography.'

— Dr. Thomas Dwight, the successor of Dr. Oliver Wendell Holmes as professor of anatomy at Harvard, has just published in the memoirs of the Boston society of natural history an article on the structure of bone. It is concerned chiefly with the arrangement of plates in the spongy bones as seen in sections made after maceration and drying. It is illustrated by three very beautiful photographic plates, and makes known a series of interesting observations. In the concluding section the author presents some general views, the character of which is indicated by the following quotations: "It is customary now to quote rudimentary organs and anatomical anomalies as evidences of descent; but it seems to me very improperly, occurring, as many of them do, quite out of the line of inheritance." "Clearly, the crude notion that accidental, purposeless, external forces should be sufficient to change by slow degrees one such organism into another of a different species, is untenable. The doctrine of chances alone shows it to be impossible. There is, moreover, the unanswerable argument of the inevitable uselessness of incipient structures. Where we see the need, we see the structure to meet it already perfect. We see also the combination of homology with teleology." "The changes must be, for the most part, comparatively sudden, and therefore due to an implanted, internal force acting in predetermined directions. On the theory of external accidental forces, the preservation of homology is incomprehensible." It will be seen that Dr. Dwight is frankly opposed to what might be called the orthodox evolution of the day.

— The detailed programme of the course of lectures on Roman archeology to be delivered at the Johns Hopkins university by Prof. Rodolfo Lanciani of Rome, of which mention was made in *Science* (viii. No. 194), is now published. The lectures will begin on Tuesday, Jan. 4, and continue on successive Wednesdays, Fridays, and Mondays until Jan. 24. The subjects of the lectures are as follows: I. The foundation and prehistoric life of Rome; II. Fora and parks of ancient Rome; III. Public libraries of ancient and mediaeval Rome; IV. The Tiber and maritime trade of Rome (quays, wharves, emporium, Ostia, *Portus Augusti*, treasures of the bed of the river); V. Police and garrison of Rome; VI. Palace of the Caesars; VII. House of the Vestals; VIII. House of the Vestals (continued); IX. The bronze statues of Rome, especially those lately discovered; X. The campagna (aqueducts, etc.).

— Alfred R. Wallace, LL.D., of London, is delivering a course of four illustrated lectures at the Peabody institute, Baltimore. His subjects are 'The theory of development,' and 'The origin and uses of color in animals and plants.'

— The Johns Hopkins university announces some new appointments to minor positions on the teaching staff. Adam T. Bruce, Ph.D., has been appointed instructor in osteology and mammalian anatomy, and Cameron Piggot, M.D., and Charles L. Reese, Ph.D., have been made assistants in the chemical laboratory.

— The water-tower near Coney Island which gave way while being tested recently, as mentioned in *Science* at the time, was 250 feet high, with a diameter of sixteen feet for the lower fifty feet. It then 'coned,' or decreased in diameter, in a length of twenty-five feet, to eight feet, which was continued to the top. The foundation, of concrete and brickwork, was twenty-two feet in diameter. The tower was constructed of steel plates, varying in thickness from one inch, in the plates at the lower part of the structure, to one-fourth inch in those at the top. Ten wire-rope guys were used to steady the tower. When the test was being made, the water had reached a height of 227 feet, when a crack appeared near the bottom, running up about twenty feet, accompanied by a sharp rending sound. This was followed instantly by the total shattering of the lower part, and the fall of the tower, large fragments of the plates being thrown fifty or sixty feet from the foundation. The scene was visited soon after the disaster by an expert in water-tower construction, who states that "there was a distinct circular impress in the ground, overlapping the base somewhat, which would indicate an almost vertical fall of the upper part of the tower before it toppled over." The *Engineering news* says that this agrees with other statements made, as well as with the appearance of the wreckage about the base. The utter destruction of the lower part, and the general appearance of the fallen tower, which was broken in two just above the cone, and presented an almost clean square cut below the cone, resembled the sudden smashing of the lower part of a high glass cylinder, and the vertical drop and then toppling over of the upper part. The guys may have had some effect in maintaining the structure in a vertical position for a moment after the plates in the lower part had given way. These plates, it is said, were defective, and could not have stood any considerable test for tensile strength.

— The exports of printed books from the United Kingdom during the first six months of the current year show an increase in quantity, but a decrease in value. The totals are 54,299 hundredweight, valued at £496,768, as against 52,858 hundredweight, valued at £516,266, in the corresponding period of last year.

— A report on the newspapers of the world has recently been laid before the Imperial German diet. It would appear that there exist 34,000 newspapers, the total issues of which, during the year, amount to 592,000,000. Of these, 19,000 papers appear in Europe, 12,000 in North America, 775 in Asia, and 609 in South America ; 16,500 are in the English language, 7,800 in German, 3,850 in French, and about 100 in Spanish.

— It will be remembered that Francis R. Brooks, formerly a student at Harvard, commenced suit against the authorities of that university to recover fifty thousand dollars damages for injuries which he received at the bursting of a retort containing sulphuric acid, which occurred during some experiments being made before the class last spring. The defendants have just filed their answer, in which they charge the plaintiff with lack of care, negligence, disobedience, and neglect of instructions.

— In the winter of 1884 a fatal case of typhoid-fever occurred in Brooklyn in a house the plumbing of which was in a defective condition. The widow of the deceased has commenced suit against the owner of the house to recover five thousand dollars for the loss of her husband, on the ground that the disease was contracted from the sewer through the defective house-drains.

— Dr. Hesse of Leipzig finds that bakers are especially liable to suffer from decayed teeth, and explains it by the lodgement of the dust from the flour in the teeth, where it undergoes acid fermentation.

— Dr. Foster Pratt, in the *Medical record*, estimates that our foreign-born population furnishes the great proportion of our criminal and diseased population. In 1850 they constituted one-tenth of the population, and furnished one-seventh of the insane ; in 1880 they formed one-seventh of the population, and furnished one-third of the insane. The proportion of insane to the sane among natives, in 1880, was 1 to 662 ; among foreign-born, 1 to 250. He considers that the country is being loaded down with the defective classes of Europe, and believes that the matter is of so much importance as to demand serious attention.

— Koch's museum of hygiene in Berlin has been opened.

— One of the methods employed for the detection of defects in the sewer-pipes of houses is by introducing the oil of peppermint, diluted with water, into the pipes, preferably on the roof of the house, where the soil or waste pipes terminate, and to search within the house for the odor of the peppermint, which will be detected at or near the point where the defect exists. The *Sanitary engineer* figures and describes an apparatus consisting of a receiver, a rubber ball or bellows, and rubber tubing, by means of which the test solution can be injected into the waste-pipes of the house in which defects are suspected to exist. How this works practically we do not know, but it certainly has some advantages over the old method, for, as is often the case, the pipes have no opening at the roof, or other convenient place, into which the solution can be poured. The tubing of the apparatus we here refer to can be passed into th soil-pipe through the trap, and the peppermint then injected.

— Cholera, whose presence in Hungary we had occasion to chronicle some time ago, appears to be still raging in that and neighboring countries. But one case has, so far as is announced, occurred in Vienna ; but of its true nature there is no doubt. At Szegedin, in the first nine days of its existence, 284 persons had been attacked, of which number 124 had died. In Trieste in one week there were 70 cases, of which 39 were fatal. The disease has existed in this city certainly since June, during which time it has attacked 859 persons, 271 of whom have succumbed. The disease has also ravaged Istria, having had since July, in that province alone, 662 victims, with 368 deaths. The appearance of this malady in Buenos Ayres seems to be well authenticated, and some of the southern ports of our own country, notably Galveston and New Orleans, which are in commercial intercourse with that country, have already instituted a quarantine against it. It is said that there are a number of vessels due in these two ports from Buenos Ayres about Christmas.

— The St. Petersburg *Oriental review* of Nov. 4 says that the eminent Mongolian explorer Potanin returned safely on the 22d of October to the Siberian frontier town of Kiachta, after an absence of three years spent in the exploration of Mongolia and China. Throughout his long and difficult journey, Mr. Potanin was accompanied by his wife. The expedition was undertaken by order and at the expense of the Imperial Russian geographical society; and the *Oriental review* says, "We expect the richest and most valuable results from this scientific exploration of China and Mongolia.

— The meeting of the next oriental congress has been postponed until 1890. The executive committee of the congress is preparing a memorial, which will be signed by the Archduke Renier, to the trustees of the British museum and the British secretary of state for home affairs, praying that a bill be introduced into parliament empowering the museum to lend the oriental manuscripts in its possession to foreign *savants*.

— The physical hydrographic field-work of the coast survey in New York bay and harbor has closed for the season, and Professor Mitchell is now at the home office working up his notes. The computations of pendulum work of Lieutenant Greely's party at Lady Franklin Bay are expected to be completed by Dec. 1. The coast survey report for 1885 will be ready for distribution about Jan. 1. It contains a number of valuable appendices, among them 'The magnetic dip intensities,' by C. A. Schott, and 'The currents and temperatures of the Gulf Stream,' by Lieut. J. E. Pilsbury, U.S.N. Owing to the lack of funds to prosecute the topographic work in California, all operations there will be closed for the season about Dec. 15.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Laws against quacks.

My attention has been called to an editorial note on p. 447 of *Science* (viii. No. 198), in which, apropos of a recent arrest of one violating the law regulating the practice of medicine in this state, injustice is done to the Medical society of the county of New York.

I assume that this injustice, which seems to have arisen out of a misapprehension both of the law and the facts of the case, was of course unintentional, and that you will give equal publicity to the statement of the counsel of that society, who caused the arrest, and was successful in the action, which, as you said, was brought against him for damages.

The part of your note to which I except runs as follows: "It is absurd as a matter of common sense that registration in one county should not be sufficient, rather than that a man should be required to register in all the counties of the state if he desires to practise in them; and, as appears from an unwritten opinion given by two judges of the supreme court of this state, it is equally absurd as a matter of law." As to the absurdity, from the stand-point of common sense, of requiring registration in every county in which a physician regularly practises, I venture to differ with you: that is a mere matter of opinion. The object of the law is to provide in every county a list of physicians regularly practising therein, for the information of the public and the protection of physicians against prosecution. The construction you give the law would necessitate the examination of the records in the offices of sixty county clerks, before any prosecution could be commenced; and you might with as much justice declare it a hardship to require a judgment to be docketed in every county in which it is to be enforced. The only theory on which it is absurd to require a physician moving from one county to another to register in the latter, is this: that the act of registration *per se* has some saving grace whereby a physician who performs it becomes wiser and more skilful in his calling. But, unless registration is analogous to baptism, I fail to see the absurdity you declare exists; although I readily admit that a state registration law, like that provided for in the medical act of Great Britain, would be a great improvement over the present clumsy system. The second part of your sentence, however, is a statement, not of opinion, but of fact, and is absolutely incorrect. No judge or judges in this state have rendered any such opinion as you mention. On the contrary, four years ago, in the case of Hayes *vs.* Webster, — an action against the president of the county society for malicious prosecution in causing the arrest of a practitioner registered in Queens county, — Judge Freedman, of the superior court of this city, directed a verdict for defendant on the ground that not only was the arrest on probable cause, but that it was President Webster's duty to make it. In the case against myself, to which you refer, Judge Lewis of the supreme court directed a verdict in my favor on the plaintiff's own testimony, upon the same grounds. The criminal courts have held in the same way. In Texas, under a statute like ours, the court of appeals has held, that, on removal from one county to another, a physician must register anew. The court said, "The object of the law was to protect the people against charlatans and quacks. To attain this purpose most effectually, no better plan could have been devised than to require that the people, at least, should be notified in advance, or have at their command the means of notifying themselves, of the authority and qualifications of those proposing to engage in a profession so nearly affecting the lives and health of themselves and families Without some such notice and information, *the law would become entirely nugatory*" (Hilliard *vs.* The state, 7 Tex. appeals 69). The clerk of Kings county in this matter is a law to himself. There is no decision to sustain his position, and I have his admission that what you call 'an opinion' is not an opinion in any legal sense of the term.

One word as to the facts in the case you refer to. A notice calling the attention of the person arrested to the law was mailed him, and another was sent to his house. No reply was received to either. A 'sandwich advertisement' paraded Broome Street, calling attention to the 'Live and let live dispensary' conducted in his name. It is true he was locked up for fifteen minutes, but owing, I was told, to his conduct in the court. His entire detention did not last three hours. I consented to his discharge when I found that he was technically able to obey the law. He claimed to have offended through ignorance, and I accepted his statement without thoroughly believing it. I could have convicted him. He rewarded my leniency by bringing his absurd suit, that had no chance of success. He admitted, on cross-examination, that his verified complaint did not truly and fully state the facts of his arrest and the charge against him.

I have written at some length because you have been evidently misled. It is not possible for you to find an instance — I will not say of a reputable practitioner — of a person technically qualified to practise physic, or able to so qualify, who has been improperly prosecuted by the society. What has been done during the year by them appears in their annual report.

W. A. Purrington.

New York, Nov. 29.

[The letter which we print above comes too late to enable us to ascertain whether the case to which our correspondent refers in the next to the last paragraph of his letter is the same as the one to which we had reference in the editorial on p. 447 of *Science* (viii. No. 198); but we shall immediately investigate it, and, if any injustice has been done in the matter, it shall be rectified. The facts as stated by us were received from the physician himself, and we have known him for many years as a reputable practitioner and a graduate of one of the best medical colleges in the country. In reference to the 'opinion,' we do not know exactly how formal a declaration must be to make it 'legal;' but there is in the office of the county clerk of Kings county a memorandum, made by the clerk in his official book of registration, that on a given date, which we do not now recall, in the year 1885, Justices Cullen and Bartlett of the supreme court, on an application for advice by the clerk, gave it as their opinion that it was absurd that a physician should be expected to register in every county of the state, and that opinion has been the guide of the county clerk in the matter. We regret that we are unable to give the exact language of this opinion by reason of lack of time, but will do so in our next issue. — Ed.]

The teaching of natural history.

Referring to your last issue, 'A. Reader's' difficulty seems to be that he looks upon the scientific name of an object as an *end-in-itself;* and, if I were to respond to his invitation to turn instructor in natural history for his special benefit, I should roughly counsel *him* (for he is evidently an old sinner), first of all to let names altogether alone. As, however, this is my first essay in teaching, I may be quite at fault, and perhaps am leaning too much on my own experience, when, after three years of working by myself on the name-plan, and thinking I knew a precious bit of entomology, I was brought to a dead halt by Agassiz, who gave me the outside of one dead fish to stare at for three long days, and afterwards some hundreds to describe and classify without any books and without any names. Letters and numerals were enough for that; and not till the work was done did I know what other people called these fish, otherwise than that Agassiz used the single word 'Haemulon' for them all, used simply as 'fish' might be, — as a mere convenience. Needless to say that I returned to entomology with a different and a more humble spirit. Looking as I do upon that lesson as my set-off in science, I may be giving it a too universal application, for I have had no experience in actual teaching; still, if I were to sum up my own conviction as to the proper method of teaching in natural history, it would be : specimens rather than (but not necessarily without) books; relationship rather than (but not necessarily excluding) names.

Now, to apply this to the little book (French's 'Butterflies') which seems to have sprung this discussion on a suffering public, and is thereby pretty well advertised. How much does it help a student to understand the relationship of our butterflies? There are three ways of doing this: 1°. By the actual arrangement of the material, a method which in the nature of things cannot be avoided. No reason for the particular sequence employed is given. 2°. By the definition of the groups. The arrangement provides for five families, twelve subfamilies or similar divisions, and fifty-one genera. Not a single one of the genera is defined; and, though short descriptions are given of the higher groups, these occupy, in all, scarcely more than 5 of the 305 pages given to the descriptive part of the book; all the rest is devoted to species. 3°. By analytical keys. One general key is given, and it occupies nearly twenty-six pages. Your reviewer called this "fairly good, so far as the perfect insect goes," and afterwards "faulty, because largely made up of unimportant characters, and because it takes no account of the earlier stages." 'A teacher' replies, "The key does trace into the families, the genera, and the species; and all the families and genera are more or less fully characterized either in the key or in the body of the work." As stated above, not one genus is characterized as such in the body of the work: therefore this must be interpreted as saying that all the genera are characterized in the key. This is true of all but Melitaea (the names of Neonympha and Calephelis having been accidentally omitted in their proper place); but let us see what the characterization amounts to, as a clew to arrangement or comparative structure. There are, in all, 443 categories used; but as 214 of these lead directly to species only, in which structural differences are much less to be looked for, and which therefore may be omitted so as to place the key in the most faverable light, there remain 229, which lead to families, genera, and groups of species. Now, what characters are employed in these higher categories? Will it be believed that there are only about one-fourth of them which have the slightest allusion to a single structural feature? That seventy-two per cent are altogether given up to the mere matter of the coloring of the wings, rarely including even the distribution of this color in patterns? This is the key which 'A. Reader' pronounces 'excellent;' which subserves no possible use as a guide to relative structure or affinities, but *only* to discover a *name*. Its author and 'A. Reader' appear to be afflicted with the same malady. Your reviewer surely made a mistake in calling the key 'fairly good,' for it teaches nothing of the basis of affinities, which it might have been made to do without lessening one whit its value in the special direction sought.

SAMUEL H. SCUDDER.

Cambridge, Nov. 26.

Abnormal embryos of trout and salmon.

In *Science observer*, vol. v. No. 1, pp. 1–8, S. Garman and S. F. Denton have figured and described a number of abnormal embryos of trout and salmon; and, under the head of 'Conclusions,' offered "a few conjectures as to the cause and manner of origin of these monstrosities." These conjectures appear to merit a word of comment. Considering it improbable that many of the forms described could arise by fission, an attempt is made to account for their origin at separate points of the surface of the vitellus. It is argued that several spermatozoa must penetrate the egg-membrane at different points. But how can they accomplish this when only one place — the micropyle — has been provided for their entrance? The possibility — not to say probability — of all passing through the micropyle does not appear as one of the conjectures. 'Plurality of micropyles' is noted as one of the possibilities, but another hypothesis is urged as the more acceptable; namely, imperfections in the egg-membrane, due to premature extrusion of the eggs. "The finishing touches being put on the outer covering of the egg, the capsule is most likely to prove unfinished if the eggs are taken too soon. . . . While the capsule in maturity may resist the intrusion of spermatozoa, compelling entrance at the micropyle, in imperfect condition the same capsule would prove a less effective barrier at its pores or elsewhere." All this seems to be disposed of by the well-known fact that the membrane is formed long before the egg is ripe enough to develop. It has been shown that the micropyle is only large enough to admit one spermatozoon at a time, and the impossibility of entering the minute pores has been pointed out more than once.

A strange assumption underlies most of these conjectures: it is the idea that a spermatozoon, without uniting with the female pronucleus, can give rise to an embryo. This point is not directly asserted, but taken for granted, as if it had nothing unnatural or preposterous in it. In the light of what is now known of fecundation, such an idea, to say the least, is wholly untenable. But if this idea is dropped, most of the 'conclusions' are left completely in the air.

That superfetation may be the cause, or one of the causes, which leads to the formation of monsters, has been made very probable by recent observations; but we can hardly regard this as a certainty so long as such men as Professor Kupffer maintain that more than one spermatozoon is required for the normal fertilization of these very fish-eggs.

As to the mode of origin of monsters, — if I may be allowed to express an opinion on the merits of the various theories that have been offered on the subject, — I should say that Lereboullet and Rauber are the only ones who have succeeded in presenting views which are acceptable from an embryological stand-point. Rauber has dealt with the subject in a very thorough manner, and has shown how two or more embryos could arise from the same germ-ring. If two embryos were formed at opposite sides of the ring, their final position would be on opposite sides of the egg, with the heads pointing in the same direction, precisely as represented in the figures of Garman and Denton. We can hardly do better than accept this view until something better is offered to replace it. In supposing themselves limited to the alternatives of, 1°, fission, and, 2°, formation at different germinal centres, these authors have entirely overlooked the more rational mode of interpretation suggested by Lereboullet (Ann. des sc. nat., 1863), and amplified and extended by Professor Rauber (Virchow's Arch. f. pathol. anat. lxxi. No. 1, and 'Primitivstreifen und neurula der wirbelthiere,' Leipzig, 1877).

C. O. WHITMAN.

Milwaukee, Nov. 25.

The deepest fresh-water lake in America.

Mr. L. W. Bailey's letter with the above heading (*Science*, viii p. 412), calling attention to the extraordinary depth of Crater Lake in Oregon, seems to indicate that he regards Lake Temisconata, in the Province of Quebec in Canada, as being an exceptionally deep fresh-water lake. The subjoined figures will illustrate to what extent this idea is sustained by actual soundings: —

Fresh-water lake.	Height of surface above sea.		Maximum depth.		
	Feet.	Metres.	Feet.	Metres.	
Temisconata	400	121.9	500	152.4	Bailey.
Superior.....	609	185.6	1,010	307.8	Lake survey.
Michigan....	582	177.4	864	263.3	" "
Huron.......	582	177.4	705	214.9	" "
Erie..........	573	174.6	324	98.7	" "
Ontario......	247	75.3	738	224.9	" "
Tahoe.......	6,247	1,904.1	1,645	501.4	LeConte.
Crater......	—	—	1,996	608.4	Dutton.
Leman......	1,226	373.7	1,017	310.0	Forel.
Como........	699	213.0	1,926	587.0	
Maggiore....	686	209.0	2,612	796.0	
Baikal.......	1,360	414.5	12,356	3,766.0	

There seem to be unaccountable discrepancies in the depths assigned by different authorities to the chain of lakes lying between Canada and the United States. The table of mean depths given in Johnston's 'Physical atlas' and in Herschel's 'Physical geography' must be erroneous. Some authorities give the maximum depth of Huron as about 1,800 feet. The depth of Lake Baikal appears to be almost incredible (*vide Nature*, xvii. p. 468).

JOHN LECONTE.

Berkeley, Cal., Nov. 17.

SCIENCE.—SUPPLEMENT.

FRIDAY, DECEMBER 3, 1886.

THE PANAMA CANAL.[1]

THE Isthmus of Panama is the narrow neck of land which connects North America with South America. It is bounded on the east by the Caribbean Sea, and on the west by the Pacific, extending northwards to the state of Costa Rica, and southwards to the territory of Colombia (New Granada).

The backbone of the isthmus is formed by a prolongation of the Cordilleras. Nearing Aspinwall, the town on the Atlantic side, the country presents little variety; but as one proceeds towards the interior, the landscape undergoes a rapid change, the country becomes mountainous, and is cut up into deep valleys, whose sides are covered with rich tropical vegetation.

From the hydrographical stand-point, one is struck by the number of streams, — one can scarcely call them rivers, — such as the Rio Trinidad and the Rio Gatuncillo, each of which, during the rainy season, has a volume of 14,130 cubic feet at its widest part. The most important of these streams, however, is the Chagres, which, rising near the north-west coast, makes an immense bend, and finally empties its waters into the Caribbean Sea. The volume of water discharged by the Chagres at its mouth is, in summer 460 cubic feet, in winter 21,190 cubic feet; but in exceptional circumstances it sometimes reaches as high as 56,510 cubic feet per second during the latter season.

The Panama canal company has erected an observatory at Gamboa, about 100 feet above the sea-level, where for some time observations have been carried on, with the result of establishing the following meteorological facts: —

	Rainy season.	*Dry season.*
Average temperature	86°.4 F.	89°.2 F.
Barometric mean	29.892 inches.	29.922 inches
Hygrometric mean	96.	88.

The temperature ranges between the extremes 25° and 35°.

The year is divided into two seasons, the dry (*verano*) and the wet (*invierno*). The dry season continues from December to May, the interval between it and the wet season being occupied by the short but delightful 'St. John's summer' (*veranito*).

[1] From *The Scottish geographical magazine*, November.

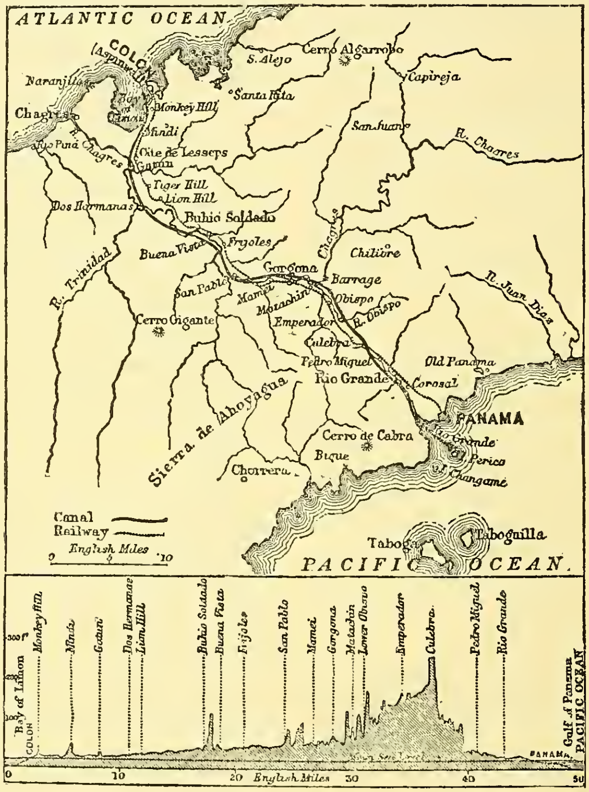
The advantages of establishing a waterway between the Pacific and the Atlantic were recognized in the beginning of the sixteenth century, and as early as 1550 four projects were already before the world, one of them suggesting a passage by the Isthmus of Panama. But the data were too vague to give rise to the formation of any definite scheme. The geography of the isthmus was practically unknown, and rumor whispered strange and disquieting reports of an inhospitable soil and dangerous natives. One explorer succeeded another without throwing any new light on the matter; and the seventeenth century passed away, leaving the great problem still unsolved. Not, indeed, until 1780 do we come upon any thing like an attempt at scientific exploration. In that year, however, an expedition was organized under the command of two engineers, — Martin de la Bastide, a Frenchman; and Don Manuel Galistro, a Spaniard. Unfortunately, when these men returned to Spain, they found the whole attention of the nation occupied by the political situation; and, the death of Charles III. occurring shortly afterwards, all hope of a practical outcome of their researches speedily vanished.

In 1844, a French engineer, Napoléon Garella, succeeded at length in establishing exact data for the simultaneous construction of a railway and canal across the isthmus. A French company was formed for the construction of the railway, but from one cause or another delays arose: the directors lacked energy, the revolution of 1848 supervened, and the work was finally carried through by an American company.

Convinced of the importance of an inter-oceanic canal, America inaugurated a series of investigations, some of which were never fully carried out, while others ended in failure, more than one explorer meeting an untimely if glorious death in the endeavor to achieve success. The American government itself fitted out a properly organized scientific expedition, but without any definite result: the problem still remained unsolved.

At last, in 1875, the Geographical congress at Paris, to which were submitted the various schemes already suggested, decided that a new and thorough investigation should be made. A society of exploration was formed, the necessary funds were raised, and two naval officers, MM. Reclus and N. B. Wyse, with an engineer, M.

Celler, were sent out to survey the isthmus and judge of the relative merits of the various regions suggested as suitable for the construction of a canal. After three years of incessant toil, they returned to Paris to give an account of their mission. Another congress met at Paris in 1879, and, after careful examination and consideration of all the proposed schemes, decided by a majority of seventy-eight that the canal should be constructed between Aspinwall and Panama, without tunnels or locks, from ocean to ocean. The routes by Tehuantepec, by Nicaragua, by Atrato and Napipi, by Darien (the proposal of San Blas), were, on the report of M. Voisin-Bey, rejected as unsuitable on account of technical difficulties. The cost was estimated by the commission of the congress at £44,585,000, exclusive of the interest on the capital engaged.



The route of the new waterway will be from the east side of the Bay of Limon on the Atlantic coast, by the valleys of the Chagres, the Obispo, and the Rio Grande to the Bay of Panama, entering the Pacific near the islands of Naos and Clamenca. Its total length will be 73 kilometres, or 45 miles, and, like the Suez canal, it will be absolutely open and unobstructed throughout. On the Pacific side a dock will be constructed so as to insure free communication with the ocean at all hours and all states of the tide. The width of the cutting at the bottom will be 72 feet; at the water-level it will be 164 feet in soil and 105 in rock; its average depth, 30 feet below the mean level of the oceans. There will be two ports, Colon and Panama, and a dam will be constructed at Gamboa to regulate the waters of the Chagres.

At Colon or Aspinwall the company has reclaimed from the sea a large tract of land, where a new town has been built, named after Christopher Columbus. The streets are wide and regular, affording free play to the fresh sea-breezes; and here a number of the officials of the company are already located in commodious dwellings.

The cutting of the canal presents no difficulty for the first fifteen miles after leaving Colon. For that distance, as also from the sixty-second ($38\frac{1}{2}$ miles) to the seventy-third kilometre (45 miles), the soil consists chiefly of clay and mud; so that for $21\frac{1}{2}$ miles operations may be carried on by means of dredging, the cheapest and most expeditious mode of excavation. From the twenty-fourth (15 miles) to the thirty-fifth ($21\frac{1}{2}$ miles) kilometre no serious obstacle to progress occurs, but between the thirty-fifth and sixty-second kilometres it will be necessary in great measure to carry on the work by means of dynamite.

The port at Aspinwall is already nearly completed, and that at Panama presents no technical difficulties. Outside the latter there will be 'roads' formed by a maritime channel, where vessels may lie previous to entering the canal. The left bank of this channel can easily be made to communicate by road with the Panama railway. At Panama the company has acquired land favorably situated for the construction of wet and dry docks, dockyards, and warehouses, and all the adjuncts necessary to the maintenance of an extensive mercantile and shipping industry.

From fifteen to twenty thousand workmen, mostly from Jamaica, Colombia, and the Antilles, are already employed on the canal banks, and this number could easily be doubled. The construction of the banks has been intrusted to a number of contractors, each of whom is bound down to have his portion of the work completed within a given time, the company retaining the power of breaking the contract at a moment's notice should the work prove unsatisfactory. It is confidently expected that the canal will be finished by the end of 1889.

It only remains for us now to consider briefly the importance of the canal for the commerce of the world in general. It is almost unnecessary to speak of the saving in time and money that will be effected when the necessity for the long and perilous voyage round Cape Horn has been obviated. The following table shows, in round numbers, the distance in miles saved between various ports: —

Names of ports.	Distance by Cape Horn.	Distance by Panama canal.	Distance saved.
London or Liverpool to San Francisco	16,900	8,200	8,700
Havre to San Francisco	16,100	7,900	8,200
London to Sydney	16,400	10,900	5,500
Havre to Sydney	16,100	10,600	5,500
Bordeaux or Havre to Valparaiso	10,900	7,450	3,450
London to Sandwich Islands	14,900	7,900	7,000
New York to Valparaiso	10,600	3,900	6,700
New York to Callao	11,200	3,000	8,200
New York to Guayaquil	12,000	2,400	9,600
New York to San Diego	15,400	3,700	11,700
New York to San Francisco	15,900	4,200	11,700
New York to Vancouver	16,600	4,600	12,000

This saving of distance will confer a great benefit on merchants and traders, who will thereby be enabled to get their goods more quickly into the market. It will also effect such a saving on insurance, both of goods and shipping, as will cover the extra expense of the dues levied on going through the canal.

The field for commercial enterprise opened up to the world by means of the Panama canal is immense, comprising, as it does, Peru, Chili, Colombia, W. Mexico, California, Oregon, the north of China, Japan, East Australia, and a great part of Polynesia. By request of the International congress of 1879, a report was drawn up by M. Levasseur, estimating the future traffic of the new route. From the statistics at his command, M. Levasseur estimated the total annual traffic at seven and a quarter million tons, of which five and a quarter million represents the traffic between Pacific and Atlantic ports; the remaining two millions, that between Europe and the east. This, however, he states to be only the net tonnage, which is less than the gross and actual tonnage by about a third,—a not unimportant consideration as regards the revenue of the canal. Thus, dues at the rate of 12s. 6d. per ton will annually be levied on ten millions aggregate tonnage; and the company has an additional source of income in an immense tract of land (1,930 square miles) with all the minerals it may contain, — the gift of the Colombian government.

The Panama canal will have no prejudicial effect on the Suez canal: rather it will be the complement of it. The two great highways of commerce and civilization are absolutely distinct, and there can be no rivalry between the two great maritime canals,—that of the east and that of the west. The Suez canal is the open door between Europe and the north of Africa, on the one hand, and the south of Asia and its archipelago, on the other. The Panama canal opens up a way for Europe and America to carry on their commerce with the western shores of the great western continents, with the north of China and Japan, and with Australia.

The commercial revolution effected by the cutting of the Suez canal will be altogether surpassed by the similar revolution now about to be effected by the cutting of the Isthmus of Panama. The Suez canal could only be used by steamers, and when it was opened the commercial world was not yet ready for it. The Panama canal, on the contrary, may be used by steamers and sailing-vessels alike. The commercial world is eagerly awaiting its opening, and from the very first the advantages it affords will be gladly seized. M. Amédée Marteau, the editor of the *Journal de Havre*, has devoted an article to the Panama canal, in which he estimates the number of tons that would have passed through it had it been open in 1884. Founding his conclusions on official documents, he says: —

"We are in a position to state exactly and precisely, without hypothesis and without exaggeration, the amount of tonnage now passing between Europe and America, Asia and Oceania, three-fourths of which must go round by Cape Horn or the Cape of Good Hope, a détour which the opening of the Panama canal will henceforward render unnecessary. The total tonnage is as follows: —

1.	Between Europe and the Pacific coasts	2,570,774 tons.
2.	Between Europe and Australia, Oceania, Malaysia, and the Philippine Islands	2,696,754 "
3.	Between the United States and the above regions (except San Francisco), besides India, China, and Japan	1,619,440 "
	Total	6,886,968 tons.

6,886,968 tons in 1884 represents 8,539,840 in 1888, the average increase of tonnage being six per cent per annum. Eight and a half million tons, paying dues at the rate of 12s. 6d. per ton, would give a revenue of £5,312,500, exclusive of the income derived from the company's land, passenger dues, etc.

"In this estimate," continues M. Amédée Marteau, "not having full statistics, we have taken no account of the present and future trade of the Atlantic ports of South America and the Antilles, with all parts of the Pacific, which cannot be reckoned at less than half a million tons. Neither have we attempted to estimate the increase of European and North American tonnage which must result from the impetus given to the trade with the Pacific and Oceania, and which probably would not amount to less than an additional one or two million tons."

The aggregate tonnage, therefore, that will annually pass through the canal must be reckoned at about eleven or twelve million tons. The cost of the canal is estimated at about £50,000,000, and the interest due annually to share and bond-holders amounts to £3,000,000.

FERDINAND DE LESSEPS.

A PLEA FOR THE SENSE OF SMELL.

THE division of the five senses into higher and lower has carried with it both a moral and an aesthetic implication. While it is granted as a general proposition that sight and hearing have been the aesthetic educators of our race, yet at various times have attempts been made to rescue one or other of the remaining senses from the aesthetic degradation to which they were consigned. The aesthetic value of the tactile-mater group of sensations is deduced from the educability of the blind as regards artistic conceptions. That taste and smell play a real and worthy *rôle* in aesthetic life is the claim of every epicure. The very word which we use to denote artistic appreciation, 'taste,' owes its origin to this class of sensations. A recent writer [1] in this field urges the claim that the sense of taste has no right to the aesthetic position it occupies, and that it has usurped the place that of right belongs to smell. The question discussed is that of the 'gastronomic value of odors.' The point of view can be most briefly described as epicurean. The thesis is, that the pleasures of the table usually assigned as 'matters of taste' are really 'matters of smell.'

Taste and smell have all along acted in such close association, — have, so to speak, gone to the same school, learned the same lessons, enjoyed the same pleasures, and suffered the same pains, — that they have almost come to be regarded as one sense : only by special artificial means do we fully realize their dual nature. That a blindfolded person, clasping his nose tightly, will not be able to distinguish between beef, mutton, veal, or pork will be similarly confused by bits of chicken, turkey, and duck, etc., is a familiar experience. Apart from the different kinds of feeling which these food-stuffs produce in the mouth, they are distinguished by smell alone. Hence, to get the real pleasure of eating, one must smell the food. True, society discountenances this proceeding if done in the ordinary way : but, says Mr. Fincks, there is a second way of smelling not usually recognized except unconsciously by gastronomists ; viz., by exhaling through the nose. In ordinary expiration the air does not touch the olfactory region of the nostril ; but by a special effort the air laden with all the perfumes that make up the epicure's paradise can be turned into that direction. On this depends the art of eating. There are great individual differences in the power of accomplishing this result, and perhaps color-blindness has its analogy in smell. On the other hand, gastronomic practice for smell is as essential as artistic training for color. In both cases the teaching is largely unconscious, and instinct points out the best method of enjoying food. The mistake is, that we call every mouth-sensation a taste, and do not analyze it physiologically.

Taste is a very meagre sense : at best we distinguish six kinds, — alkaline, metallic, bitter, sour, sweet, and saline. The first two have no gastronomic value ; salt is at best 'that which spoils the soup if it isn't put in,' and is not relished for its own sake ; while a taste for bitter is a morbid craving for contrast, at which the unsophisticated tongue of children would revolt. Even sour and sweet must be allied with fragrance, to yield much pleasure. What we call sour is usually a combination of tastes, smells, and touches. We distinguish one sour from another by the accompanying odor. Sweetness is the 'only original and genuine' pleasure of the overrated sense of taste. Yet even here the pleasure would be small if smell did not aid. "Were taste alone to be considered, confectioners might as well close their shops, and leave the sale of sugar to grocers." No one cares much for plain sugar : even children soon learn to prefer candy ; i.e., flavored sugar.

"A few gifted mortals, known as epicures, have had an instinctive knowledge of the importance of odors, and the same is true of a few original and immortal cooks." The two main obstacles to the recognition of the gastronomic reform embodied in the principle that the object of cookery is to develop the "countless delicious perfumes latent in the raw material of food, or to add others when the food is deficient in natural flavor," are the "amazing gastronomic indifference

[1] Henry T. Fincks, *Contemporary review*, November.

of mankind" and the "notion that there is something unrefined in the undisguised enjoyment of a meal." The cure for the first is a right education; the second is a relic of asceticism shown at its worst in the superstition that it is exquisitely refined and feminine for a girl to have no appetite. Epicures are healthy because they 'live on the quintessence of food' by constantly breathing through the nose. The epicure's habit of retaining this pleasure as long as possible leads to slow eating and complete mastication. Odors stimulate the flow of saliva and the other alimentary juices, and thus a gastronomist will never be a dyspeptic. Epicureanism is not gluttony: it is the ability to get pleasure out of commonplace foods. He may prefer "canvas-back duck to roast goose," but "he alone knows what an oriental rose-garden of magic perfumes may be found in the simplest crust of whole-meal or graham bread and butter."

In this strain Mr. Fincks develops the science of eating and of cooking, and applies its principles to several important classes of food-stuffs. He even proposes a new industry; namely, of so feeding poultry and other animals as to produce a special brand of meat with original *nuances* of flavor. And finally he promises us that the recognition of the royal position of smell in the gastronomic hierarchy would bring about an increase of twenty per cent or more in the average health and happiness of the community.

The notorious Jaeger holds that the soul is a smell: we have now been given reasons for believing that smell is at the least the breath of life.

J. J.

A RECENT CONTRIBUTION TO THE DISCUSSION OF HYPNOTISM.

THE French psychologists seem to be making their own the study of whole groups of mental phenomena. Of late years, almost all the valuable contributions to the subject of hypnotism, and all phenomena, have come from them. In fact, they have discovered so many new and striking facts, that almost all the old generalizations have been overthrown, and the multiplicity of facts has hardly as yet been digested into any new theory. One of the most interesting of recent discussions is that of Burgson in the November number of the *Revue philosophique*. It is valuable not only for the new light thrown upon some of the most mysterious phenomena of hypnotism, but for the suggestions which it offers to a study of the whole complex field of 'thought-transference.'

From time to time there have been reports of hypnotic persons who could see through opaque objects, tell what was going on at a distance, etc. The case of some boys who could tell the title of the chapter at the head of a page, or the number of the page, when a book was opened but was held with its cover towards them, was reported to Burgson. Upon trying it, he found that one of the boys told correctly at least every other time what was required. Some experimenters would have stopped short with this, and would have heralded abroad a remarkable case of telepathic action. But Burgson continued experimenting. He noticed three things. When the hypnotized subject was asked how he knew, for example, the figures of a page, he replied that he saw them; and when he was asked to touch the back of the book, instead of touching the cover, he put his hand under and touched the open page. Another fact was, that, when the boy did not guess right the first time, he would often correct it, if the book were moved a few inches nearer or farther from the eye of the operator. The third thing was, that the figures were often read reversed, as 213 for 312. This suggested to the operator that the patient seemed to be reading as if in a mirror, and he began to wonder if it were possible that the latter read the figures or word as reflected in the cornea of himself, the operator. Simple experiments revealed, that, if the operator's eyes were closed as soon as the figure had been seen, the patient was rarely successful; that the attitude which gave the best chance for the formation of a distinct image was that in which the guess was most uniformly successful; and that the correctness of the guess decreased as the light was changed so as to obscure the reflection. The image in the cornea could not be, however, more than .1 mm. in size. In spite of the well-attested hyperaesthesia of organs in hypnotic subjects, there might be some doubt of an ability to see any thing so small. Experiments were then tried with a view to deciding this point. The most satisfactory consisted in giving the subject a prepared section of an orchid the cells of whose tissue were only .06 mm. in diameter, and telling him to draw the same. With microscopic fineness of vision this was done.

It only remained to see if the hypnotic patient's power of forming conclusions from very subtle and ordinarily imperceptible signs was confined to cornea-reading. It was easily proved that it was not. The operator hypnotized the subject sitting before him, and then made the latter believe that he was one with the operator, so that whatever affected him would also affect the subject. Then a third person, standing behind the operator, pricked some part of the latter, generally a part of his hand held behind his back. The subject would then locate the spot where pain was felt in himself, and was correct even to a very narrow and definite limit. It seemed a wild guess to suppose that he formed his judgments from the small portions of the movements of the arms only of the third person, which were visible to him; and yet further experiment showed, that, if a screen were placed so that he could not see any of the movements of this third person, his ability to locate entirely disappeared. Experiments somewhat similar showed that the patient could tell what word the operator was writing, simply by the general movements of the arms of the latter.

Burgson himself calls attention to these experiments more as evidences of what he terms unconscious deception on the part of the hypnotized subject, than for other reasons. He calls attention, however, to the necessity of repeating those experiments of the English members of the Society of psychical research which seemed to point to mind-reading pure and simple. The average literary man who handles these latter facts does not seem to be aware of the great objection which holds against them scientifically. Absolutely the only way hitherto known of mental communication is the expression of an idea through physical media, and the retranslation of this back into a mental state. Mind-reading pure and simple does away with the intervening physical medium of expression. It is a fact of a different order from any now known. If it can be shown that what really takes place in these cases is cornea-reading, or some similar occurrence, the facts are reduced to those of the same order as ordinary mind-reading or muscle-reading, and they admit of a scientific explanation.

But these experiments also afford, as it seems to me, the most conclusive evidence yet offered of the law laid down by Helmholtz, that the existence of a sensation is always neglected in behalf of the meaning conveyed by it. Here the minute image on the cornea is perceived, not as what it is, but as a series of two or three figures which are definitely and correctly located in their proper spatial position. There is in these experiments no question of conscious deceit. The subject does not secretly and consciously perceive the image on the cornea, and then pass off the knowledge thus gained as if he had actually seen the figures. He himself is a victim of the deception. He thinks he sees them on the book. His sensations, in short, are mere signs or symbols, to which in themselves he pays no attention. He observes only the objective bearing, the information conveyed. The proof of the theory did not require such a crucial experiment as this, perhaps, and yet it is as striking an evidence as could be desired. But it also shows that the interpretation of the sensation is governed by the conceptions already in consciousness, and this affords a valuable contribution to the growing theory of apperception. There is an increasing tendency among psychologists to regard all perceptions as judgments passed upon sensations by means of the conceptions present in the mind at the time of their occurrence. The sensation is interpreted into harmony with these dominant conceptions; so that we see not merely what is really there to see, but what the mind is adjusted to see, what it can read in out of itself. All hypnotism is one page of evidence to the influence of dominant conceptions, but the present instance is typical of the extent to which it may be carried. It is to be hoped that some one will carry the experiments further, and particularly see how far unsuspected cornea and muscle reading has entered into the as yet unexplained cases of mind-reading, so called. J. D.

VOLUNTARY AMPUTATION AMONG CRAY-FISH.

In referring to limb-shedding as a voluntary act among certain crustaceans, Professor Huxley tells us in his 'Crayfish' that "this voluntary amputation is always effected at the same place; namely, where the limb is slenderest, just beyond the articulation which unites the basal joint with the next. The other limbs also readily part at the joints; and it is very common to meet with crayfish which have undergone such mutilation." Quite recently (Sept. 4) M. H. de Varigny, in a very instructive paper which he has published in the *Revue scientifique*, entitled "L'amputation réflexe des pattes chez les crustacés," presents us with the results of a long series of experiments of his, undertaken with the view of throwing additional light upon this subject. M. Varigny studied the phenomenon in quite a variety of species and in several hundred individuals. He claims that in every instance the amputation is voluntary, and is truly an amputation, and not a disarticulation due to the feebleness of the inter-articular membrane of the joint. Much less is the throwing-off of the limb ever due to a fracture.

Then referring to the previous researches of M. Frédéricq, M. Varigny further claims that this act on the part of the crustacean will not only follow a direct blow, but may often be induced through either scratching or bruising the claw, or simply rubbing it, or through the action of the electric current. Moreover, it is found that the amputation is reflex, and depends upon the action of the central nervous system, for when the latter is injured, or the animal brought under the influence of an anaesthetic, it cannot be performed; that when the amputation is voluntary, the crab loses but little blood, which is not the case when the limb is removed by the experimenter, thus going to show that the act is purely a protective one, often saving the life of the animal with the minimum amount of injury.

The power to perform the act with promptness varies with the different species, and in any of them, when the animal is fatigued, it is not apt to resort to it. In experimenting with vigorous specimens of Carcinus maenas, it was observed that when the ten limbs were successively struck, allowing sufficient time for each one to detach itself before the next leg was struck, a far greater number were thrown off than when they were all struck together, or in very rapid succession.

Then, in one hundred and ten specimens of the same species, it was found that a second blow upon the undetached claws would cause them, in nearly all cases, to come away likewise, especially after the animal had somewhat recovered from the shock caused by the loss of its other limbs. And when the same experiments are undertaken in the case of only five of the limbs, the number that come away was proportionately much greater. Further, it was noted that the animal was more successful in getting rid of its great claws, or pincers, than it was with the ambulatory limbs.

To sum up, then, M. Varigny believes this reflex function of defence, as performed among crustaceans, consists in a voluntary amputation, indifferently executed among those species wherein the musculature of the limbs is but feebly developed, and among individuals exhausted by severe pain, as in such cases where all the limbs have been simultaneously removed.

As the hemorrhage is so much less as resulting from the voluntary amputation, when compared with what takes place after the removal of the limb by artificial means, it will not be questioned but that this power as possessed by these animals is one of service to them.

Further investigations in this direction will be not only interesting, but valuable.

ELLIOTT'S ALASKA AND THE SEAL ISLANDS.

This handsomely illustrated and printed volume is evidently intended for a popular audience. Little of its contents is new. That which is original with the author, and due to his personal observation, is in great part a re-arrangement and amplification of matter printed by him two or three times previously, especially in the octavo report on the 'Condition of affairs in Alaska,' issued by the government in 1875, and in the quarto document of the census series of 1880, relating to the fur-seal fisheries and kindred topics, published in 1882, from which part of the illustrations of the present volume have been adapted or reduced. This, however, will not diminish the interest or value of the work for those who are not in the habit of consulting government documents, or who read merely for general information. The part of the work which is a re-arrangement of matter original with others is naturally less satisfactory than that on the Aleutian and Seal islands, where the author is at home in the scenes he, for the most part, very fairly and accurately describes. Many of the illustrations are faithful and good, especially those due to pen-and-ink sketches. From these, however, the human figure-pieces must be excepted: the faces in particular partake somewhat of caricature, are generally out of drawing, and have absolutely no anthropological value. The landscapes, excepting a few representing mountains, are generally very good. In the copy before us, Mount Shishaldin has disappeared from the plate which claims to give a glimpse of it (p. 146); Mount Iliamna is represented with a slope near the peak (p. 87) of about twenty-three degrees from the vertical; and Verstovia (p. 32) has hardly more than forty-five.

The book is to some extent a misnomer, the most interesting and available part of Alaska lying between latitudes 50° and 60° north, as does the greater part of the British Islands, which no one would think of calling arctic. The nomenclature and transliteration of Russian words are very irregular and often inaccurate, in no respect conforming to the systems generally adopted. Apart from the biology of the fur-seals and birds of the Seal Islands, the natural history of the book is very shaky, and the anthropology almost a minus quantity. But it is hardly worth while to lay much stress on its deficiencies from a scientific stand-point, since it is hardly likely to be consulted for precise data of that sort. Its historical errors are less numerous but more important. To give a single instance, the author repeats the error of Petroff in Bancroft's 'Alaska,' by stating that in 1868 Messrs. Hutchinson and Morgan passed the season in exclusive control of the sealing on St. George and St. Paul islands. As a matter of fact, there were five or more competing companies. There is an insufficient index; and the map, though well drawn and printed. in spite of the date, 1886, which it bears, is destitute of all the more important geographical discoveries of the last few years.

Our arctic province Alaska and the Seal Islands. By Henry W. Elliott. New York, *Scribner*, 1886. 8°.

CHALLENGER REPORTS.

THE number of species collected by the Challenger in the group Marseniadae was but three, two of which, however, belong to a new genus. Dr. Rudolph Bergh, who is monographing this family, has not only given very full accounts of the anatomy of the species collected, but has added to them a general history of the nomenclature of the family, a list of the known genera and species, notes on their geographical distribution, and other matter of importance. He regards the group as most nearly related to the Velutinidae, and even suggests that a more thorough knowledge of both families may render it necessary to consolidate them.

The report on the Scaphopoda (tooth-shells) and Gasteropoda, by Rev. Robert Boog Watson, exhibits a stupendous amount of labor. It is accompanied by an appendix in which the Marquis de Folin reports on the Caecidae, a group of minute and interesting shells. The collection included some 1,300 recognizable species, new and old, with some 400 undeterminable fragments or worn specimens. Shore-collections furnished 86 species, of which 7 were new. Dredging-stations to 400 fathoms yielded 604 old species and 405 new ones. From forty-one stations between 2,650 and 400 fathoms, 89 known and 135 previously unknown species were obtained. The greatest depth at which any gastropod was secured was 2,650 fathoms, at station 325. Here a Stilifer, parasitic on some echinoderm, was obtained. Basilissa, Dentalium, and Trochus were found in 1,900 fathoms; Dentalium, Cithna, and various Pleurotomas were found in between 2,000 and 2,500 fathoms; and the large and interesting Guivillea alabastrina was dredged off the Crozets in 1,600 fathoms. Oöcorys, Fusus, Cadulus, Seguenzia, Cylichna, and Actaeon are among the genera which presented themselves most frequently from the abysses. Leaving the shallow waters out of account, perhaps the richest haul of the voyage for the conchologists was that in 390 fathoms, off Culebra Island in the West Indies. This produced about 150 species, of which only about ten per cent were previously known to science. The average number of species of mollusks collected at a station was less than twelve. Mr. Watson's introduction is short. He lays stress on the importance to molluscan life of temperature; to a less degree, of depth; great differences in these respects operating as barriers against dispersion. He notes the importance of time in affording opportunities for distribution; so that species which are found fossil and still exist, being presumably ancient, may be expected to occur over wide geographical areas. Where barriers of depth and temperature do not check distribution, the species tend to become universal, and in some cases have attained universal distribution. Finally, Mr. Watson affirms that even in the oldest and most widely distributed forms there is no trace of essential, lasting, and progressive change. This assertion may well be accepted, for it is precisely among such ancient and universally distributed forms that we should expect those evidences of inflexibility which have been recognized as characteristic of certain species by naturalists from Darwin down. It is the local and restricted species which should be studied for evidences of change. Where each pond has its form of Limnaea, and each tree its Clausilia or its Achatinella, there should evidences of change or adaptation be most easily recognized. Every one who has occasion to deal with deep-sea mollusks will find the learned, painstaking, voluminous, and profusely illustrated report of Mr. Watson an absolute necessity; and for other malacologists it will be, not a mine, but rather a warehouse of elaborated and systematized information.

The number of chitons collected by the expedition was small, as they are chiefly littoral in habit. There are reported on by Professor A. C. Haddon some thirty species of fifteen genera, of which seven were previously undescribed, and others, though described, had not been figured. The really deep-sea chitons all belong to the genus Leptochiton, and, judging by their sculpture, are nearly related forms. Leptochiton Belknapi, Dall, was dredged in over one thousand fathoms near the Aleutian Islands by the U.S.S. Tuscarora, and by the Challenger in about the same depth off the Philippine Islands. An allied species (L. benthus, Had.) was found in twenty-three hundred fathoms in the North Pacific, nine hundred miles north of the Sandwich Islands. It is so far the most abyssal chiton known. In all these cases the temperature was low, not exceeding 37° F. The genus, as one might expect, appears in shallower water toward the poles. Professor Haddon gives a synopsis of Carpenter's classification, and of the genera of Leptoidea. In his discussion of the species, he gives a valuable *résumé* of the status of the genera, and proves beyond question that the genus generally known as Chitonellus must be referred to Cryptoplax, Blainville, the various subdivisions resting upon insufficient or erroneous figures and observations. The plates to Professor Haddon's memoir are particularly excellent, and the paper marks a distinct step in advance in our knowledge of this very interesting group.

Report of the scientific results of the voyage of the Challenger during 1873–76 Vol. xv.: Zoölogy. London, *Government*, 1886. f°.

SCIENCE.

FRIDAY, DECEMBER 10, 1886.

COMMENT AND CRITICISM.

THE OBLIGATIONS and the rights of physicians throughout the state of New York are matters of such importance that we propose to give those extracts from the laws which bear upon the question of registration, and also such opinions as have come to our notice under the law. This matter is being critically examined by very many practitioners, and it is a subject about which there should be no doubt: if any exists, the legislature should, at its coming session, enact such a law as will not be subject to the different interpretations which seem to have been given to the present law. The law under which physicians register is chapter 513 of the laws of 1880. Section 2 of the law reads as follows: "Every person now lawfully engaged in the practice of physic and surgery within the state shall, on or before the first day of October, eighteen hundred and eighty, and every person hereafter duly authorized to practise physic and surgery, shall, before commencing to practise, register in the clerk's office of the county where he is practising, or intends to commence the practice of physic and surgery, in a book to be kept by said clerk, his name, residence, and place of birth, together with his authority for so practising physic and surgery as prescribed in this act." Very many physicians neglected to register before the 1st of October, and in the following year another act was passed, and is chapter 186, laws of 1881. The section bearing on the point in question (section 1) is as follows: "Any person who was duly authorized to practise physic . . . and who shall not have registered as required by the provision of said chapter (513, laws of 1880) shall have until the first day of October, eighteen hundred and eighty-one, in which to register as prescribed by section two of said act, entitled 'An act,' etc."

Several questions have arisen since these laws were enacted, among others the following: can a physician register who is a graduate of one of the medical colleges of the state, but who was out of the state at the time these acts were passed, and did not return until after the 1st of October, 1881? The following case occurred in Brooklyn, and practically answers the question in the affirmative. The papers referring to it and the other cases mentioned hereafter are in the office of the clerk of Kings county, and the substance of them only is here given. Willis E. Crowell received a diploma in June, 1874, from the New York eclectic medical college, authorizing him to practise medicine. He subsequently left the state, being absent five years, and was not within the state to register in compliance with the law of 1880. In 1883 he applied to the clerk of Kings county for registration, but was refused. On Feb. 1, 1883, Hon. Charles F. Brown, justice of the supreme court, ordered the clerk to register his name. A similar case occurred in Brooklyn in 1885, in which the county clerk refused to register Horace B. Ransom, who had a diploma from the University of the city of New York, granted in 1857. Dr. Ransom had soon thereafter gone to Burlington, Io., not returning until 1885. Upon presentation of the facts to the Hon. E. M. Cullen, justice of the supreme court, he ordered the clerk to register him. The order is dated April 22, 1885. In January, 1886, Ashbel P. Grinnell applied to the clerk of Kings county to be registered, and was refused. The facts in the case were these: Dr. Grinnell received his diploma from Bellevue hospital medical college in March, 1869; afterwards he moved to the state of Vermont, where he resided until Jan. 1, 1886, when he again came within the state. In reference to this case, Hon. E. M. Cullen, justice of the supreme court, said, "I think, on making the affidavit or exhibiting the diploma or certificate, a physician is entitled to be registered at any time. The first of October, 1881, mentioned in the act, does not limit the time within which physicians can be registered, but any physician practising after that time without registering is guilty of an offence." It would appear from this latter case to be the opinion of Justice Cullen that a physician not only can register at any time, but must do so, even though he neglected to do so prior to Oct. 1, 1881, and that if he fails to do so he 'is guilty of an offence.' Until this decision was made, a considerable number of physicians had applied to be registered, who had, through neglect or absence from the state, failed to register before October, 1881, and whose subsequent application had been refused. Some of these are still unregistered, not aware of the fact that Justice Cullen has decided not only that they have the right to register, but that it is their duty to do so. If this statement comes to the knowledge of any such, they should at once apply for registration.

Another question has arisen in connection with the registration law, and that is, must a physician who has registered in one county of the state, if he desires to practise in another county, re-register in that county? We simply desire to have appear what the views of the two justices are on this question. Until the case comes before them in such shape that a judicial opinion in the strictly legal sense can be given, we do not know how their views could be better expressed. In the last number of *Science* (viii. No. 200, p. 515), we stated these views as those of Justices Cullen and Bartlett. We should have said Justices Bartlett and Brown. The entry in the county clerk's book is as follows: "Dr. John Smith registered as a physician in Greene county in 1880, in compliance with chapter 513, laws of 1880. Dr. Smith afterwards, on the 13th of March, 1885, applied to the county clerk of Kings county to be again registered; but the county clerk of Kings county refused to register him. The matter was brought before Judges Bartlett and Brown, who decided orally that Dr. Smith was not obliged to register in every county of the state." The deputy informs us that at the time one of the justices remarked that "it was absurd to suppose that a physician must register in the sixty counties of the state if he wanted to practise in them all." In view of all these facts, perhaps it would have been more exact if, instead of saying that re-registration was absurd as a matter of law, we had said that it was absurd as looked upon by a supreme court judge. That these views are not held by other judges appears from the letters of the counsel to the medical society.

WE HAVE RECEIVED a reprint of an article by Dr. Crothers of Hartford, which was printed recently in the *Alienist and neurologist*. It is entitled 'Certain hereditary and psychical phenomena in inebriety,' and contains some facts which are of great interest not only to students of psychological heredity, but to those taking part in the social and political arguments on the liquor-question. Dr. Crothers has found two sorts of instances of inheritance of the symptoms of inebriety, — one in which the symptoms of intoxication are present all the time; the other in which these symptoms only appear from some peculiar circumstance or exciting cause. In the first class some prominent defect, such as idiocy, imbecility, and congenital deformity, is present, and gives the case a distinctness irrespective of the signs of intoxication. These symptoms may appear after birth, or be slowly evolved with the growth of the child, coming into prominence at or before puberty. Among other instances, Dr. Crothers cites this one: "In the home of a former patient I found a little girl, an idiot, whose voice and rambling utterance, with intensely red eyes and drunken expression, pointed back to causes and conditions that had not been noticed before. Other defects and deformities of the face and body cover up these peculiar signs of intoxication."

The second class of cases is less common, but the symptoms are very distinct. Unlike the first class, here the persons affected possess average brain-power, and in many instances are men of positive force. They are usually temperate men, never using alcohol, yet under certain circumstances they act and appear as if intoxicated. In these cases some sort of mental shock takes place that destroys the balance and brings uppermost an inherited neurotic effect. These cases come from inebriate parents or moderate drinkers, and they have inherited some defective nerve-organization which thus manifests itself. Dr. Crothers cites this instance: "A merchant, in good health, and temperate, while at work in his counting-room, received a despatch of the death of his daughter. He lay down on a sofa in his office, and very soon became wildly intoxicated. A physician made this diagnosis, although there was no odor of alcohol in the breath. He was taken home, and remained in bed a week. Two opinions prevailed, — one, that he had drunk in his office; the other, that it was congestion of the brain. He denied having used spirits, but was confused about the events of the past. In this case an heredity from alcoholic ancestors was present."

Then there are cases of persons who have been inebriates or intoxicated, and have since become total abstainers, but from unknown causes suddenly manifest all the signs of intoxication. Dr. Crothers concludes, 1°, that symptoms of alcoholic poisoning cannot be trusted as evidence of the immediate use of alcohol; 2°, that the excessive use of alcohol leaves a permanent defect or impress on the brain, which will go down into the future with great certainty. The author says that he presents these facts as a sort of preliminary survey of a comparatively unknown field. The subject is of so great and so far-reaching interest, that we trust the survey will be speedily pushed to completion.

AT THE LAST GENERAL MEETING of the English society for psychical research there was some discussion over Mr. Myers's paper on multiplex personality, which was published in the *Nineteenth century* for November, and an extended account was given by Mr. Myers of some observations made by Mr. Gurney, Dr. A. T. Myers, and himself at a meeting in Paris of the Société de psychologie physiologique. At their conclusion, Prof. Henry Sidgwick, who was occupying the chair, made some remarks on the general subject of psychical research, which, both because of their import and the distinguished reputation of the speaker, will undoubtedly carry much weight and attract very general attention among scientific men. Professor Sidgwick said that the society for psychical research had now reached an important crisis. The work prepared by Messrs. Gurney, Myers, and Podmore, entitled 'Phantasms of the living," — of which we will give our readers an extended notice shortly, — was about to be put in the hands of the public; and for the first time the scientific world would have before it in complete form the grounds for the 'momentous conclusion' announced some time ago by the authors of the book, and in which he (Professor Sidgwick) *was entirely disposed to concur*, — the italics are our own, — that the mental state of one person might affect another otherwise than through the recognized channels of communication by the senses, and even at a distance so great as to render a physical mode of communication very difficult to conceive.

Were this result to be generally accepted by scientists, Professor Sidgwick continued, even those now most opposed to psychical research would admit the great importance of the achievements. However, he did not anticipate any such sudden conquest of the scientific world, though he thought that this failure to convince would result only from paying no attention to either the evidence or the reasoning of the authors of 'Phantasms of the living.' Undoubtedly some, not a few perhaps, would read the book and remain unconvinced. Professor Sidgwick cited as ground for this expectation the "thoughtful and instructive address of Prof. Simon Newcomb, president of the American society for psychical research, published last summer. Professor Newcomb had undoubtedly given serious and candid attention to the subject before pronouncing the discouraging opinion that the work of his society had "almost entirely removed any ground which might have existed for believing thought-transferrence a reality." While welcoming this candid criticism from Professor Newcomb and others, Professor Sidgwick could not accept it as valid, for it mainly rested on the fact that the English society had constructed no theory of thought-transferrence.

To this Professor Sidgwick answered, and we think his answer fully meets the objection, that the establishment of the fact of thought-transference, and the framing a theory to account for and explain that fact, are two very different things. The one cannot be legitimately rejected because the other is not immediately forthcoming. Still the crucial point is to exclude, in the experiments, all communications through the recognized channels of sense; and Professor Sidgwick expressed the hope that Professor Newcomb, and any others who shared his opinion, would indicate exactly how, in their view, the experiments could be made more conclusive. Professor Sidgwick's entire address was calm and judicial, and his avowal of his belief in the possibility of thought-transferrence, while guarded, is a serious blow to those who have been doubting the value of the very carefully and conscientiously conducted investigations and experiments of the English society for psychical research.

THAT PASTEUR'S VIEWS are not accepted by all was shown by the criticism passed upon his recent report which was read at the Academy of sciences, and to which our Paris letter alludes in this number of *Science*. In Pasteur's report there were included 1,700 French who have been inoculated for rabies. M. Colin, a veterinary surgeon, takes exception to these figures. He thinks that a very large number of dogs that have bitten people, and supposed to be rabid, were not rabid, and points out several other possible errors in Pasteur's deductions.

The unseemly wrangle that has been caused by the *Quarterly review* article on Mr. Edward Gosse has greatly excited the literary men at the universities. Whatever be the merits of the case, from this distance we can only see that the whole proceeding is derogatory to the dignity of men of literary reputation and culture. Journalistic quarrels are usually of no benefit and questionable taste, but it would be bad indeed if the outcome of this one should be, as one English critic insinuates, to prove that at one university is a professor who is not a scholar, and at the other, one who is not a gentleman.

THE AMERICANISTS.

The sixth session of the Congress international des Americanists was held in September last at Turin. It may not be amiss to say that the previous meetings were held at Nancy (1873), Luxemburg (1877), Brussels (1879), Madrid (1881), and Copenhagen (1883). The sixth session would have been held last year had not the cholera prevented. The congress held its meetings in the old chamber in the Carignan palace, where the deputies of the Sardinian kingdom held their meeting, while the capital of that kingdom remained at Turin. M. Desiré Charnay opened the real business of the meeting with an address complaining that too little attention was given in Europe to the study of American history, and too much to that of the east. "Why," said he, "men care more for the discovery of a finger of Venus or a toe of Mercury than they do for the finding of a whole city in America." He instanced especially the apathy with which Maudslay's work was received in England, saying that it took the directors of the Kensington museum three months to make up their minds as to whether they would accept a monolith as a gift.

The first discussion arose on a paper read by M. Guido Cora on the Zeni Brothers. The speaker delared that the well-known map which goes under the name of the Zeni map was the best authority in the case. He recognized the Faroe Islands in Frislanda; Iceland in Islanda; Greenland in Engronelant; and portions of North America in Estotiland and Drogeo. M. Beauvois thought that the Zeni explored Newfoundland, while M. V. Schmidt argued that Engronelant corresponded to the modern Angramanlant and Norway.

M. Jiminez followed with a very long and detailed communication on the migrations of the Carib race. In his opinion, that movement was by the Amazon and Orinoco rivers. Then M. le Baron de Baye presented a note by the Marquis of Monclar with regard to a trepanned skull from the upper basin of the Amazon, and M. Pigorini a memoir of M. Strobel upon picture-writing of South America. M. Grossi finally read a paper upon coins of the old and new worlds.

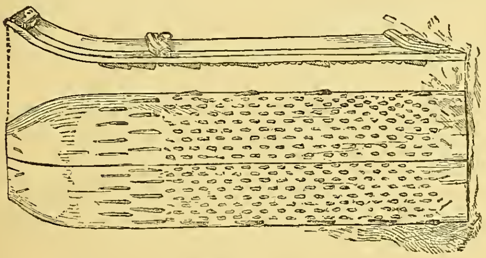
The next day M. Schmidt presented, in behalf of Dr. H. Rink, a paper describing the Eskimo tribes of the extreme west and east. He gave very detailed statements of the manners, customs, houses, dress. social order, myths, and traditions of those tribes. Dr. Rink agrees with Captain Hohn, that the Eskimos have occupied the coasts of Greenland on all sides.

A description, purporting to have come from Mr. A. S. Gatschet of the ethnological bureau at Washington, of the Maya dictionary, was then read. Without doubt it is of the greatest importance in the study of this ancient language, and the deciphering of the old inscriptions in that language. The dictionary, or rather vocabulary, forms part of the Carter-Brown library in Providence. The dictionary is in two parts, each forming a small quarto volume. Part i. contains the Maya-Spanish part; part ii., the Spanish-Maya part. It was probably composed between 1590 and 1600. It is named after the monastery where the author lived, Motul. The author is unknown, and the copy in question is not the original manuscript, but a copy. According to a somewhat minute calculation, it was estimated that the volume contained about 15,400 terms. Others have thought the number higher. It gives us the Maya tongue as it existed at the time or shortly after the conquest. A vote was passed asking the government of the United States to publish the dictionary at its own expense. The congress soon after adjourned, after providing for another meeting at Berlin in 1888.

ARCHEOLOGICAL ENIGMAS.

The meeting of the Anthropological society of Washington on Nov. 16 was devoted to the reading of two papers bearing on the antiquity of man in America. Mr. G. K. Gilbert, chief geologist of the U. S. geological survey, described minutely the finding of an ancient hearth on the southern shore of Lake Ontario, at the bottom of a well about thirty feet deep. The formation at the base of which the hearth was discovered is one of a series of shore-deposits left by the receding ice of the last glacial epoch. Mr. Gilbert described minutely the manner in which these old beaches were built up by moving gravel one after another by a series of inverted imbrications or overlappings, and relegated the hearth in question to one of the first of them laid down in this particular series, roughly estimating the time at about seven thousand years ago.

Mr. Gilbert was followed by Mr. W. J. McGee, who described the finding of an obsidian spear-head or knife, four inches long and beautifully chipped, in Walker River Cañon, Nevada. The greatest care was taken in removing this find, and all the intelligent forethought which a trained geologist could exercise was used to mark the exact conditions of the case. Not the slightest evidence of intrusive burial or bank veneering appeared, and Mr. McGee was convinced that the weapon was deposited when the stratum contain-



THRESHING-SLEDGE.

ing it was laid down, the time being approximatively that of Mr. Gilbert's find.

Mr. John Murdoch reported at the same meeting the discovery of a pair of wooden snow-goggles, like those now used by Eskimo to protect the eyes from the glare of the sun and driving snow, in a shaft which his party dug at the depth of twenty-seven feet below the surface. Mr. Murdoch's discovery made an interesting connecting link in the interpretation of Mr. Gilbert's hearth.

Two of these finds were neolithic of the most advanced type, and located at the close of the last glacial epoch: they certainly start ten times more questions than they answer.

The national museum has lately acquired two specimens from different parts of the world, which introduce an element of confusion into archeological speculations. Both of them represent the use of stone implements of the very rudest type by peoples above savagery.

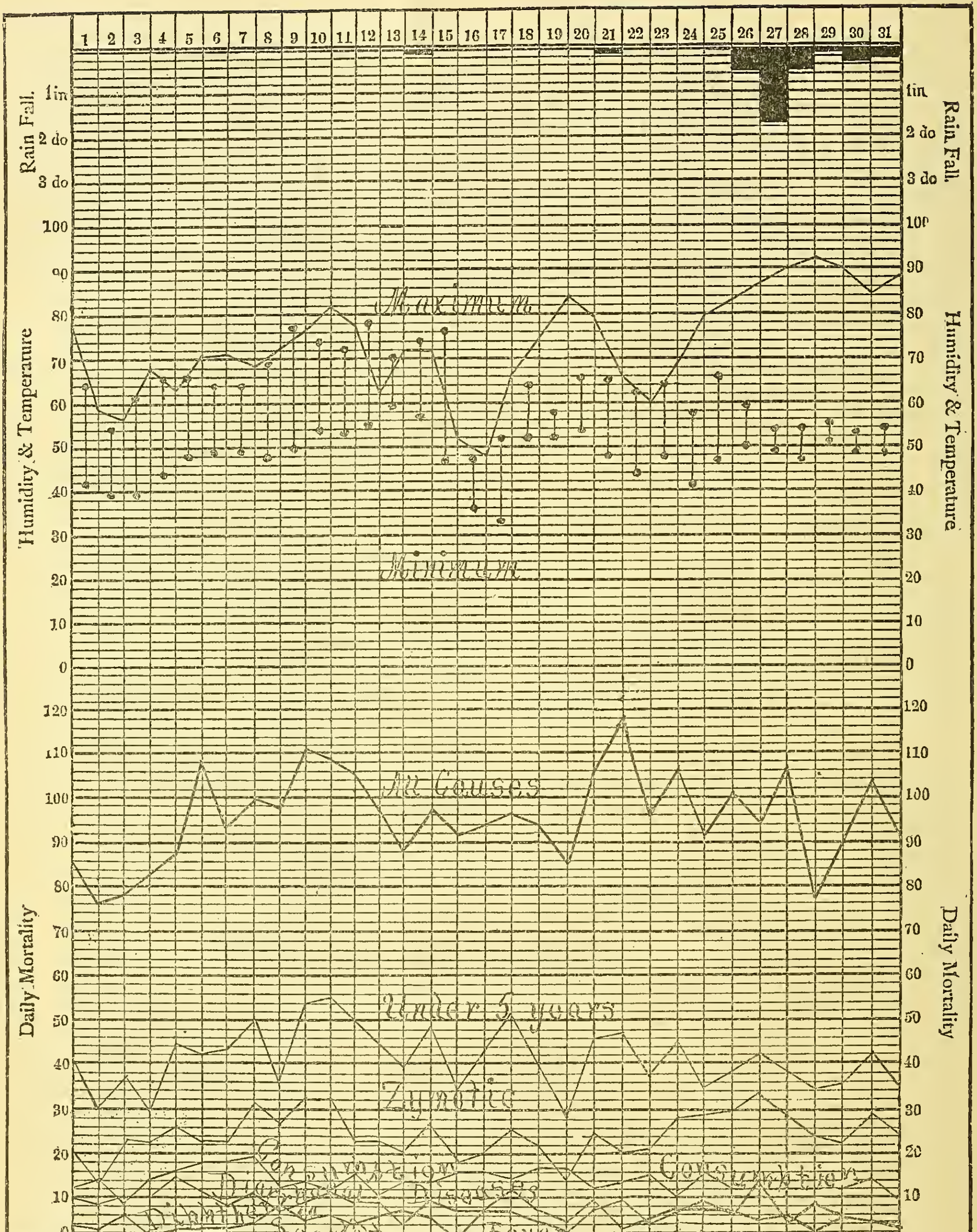
One of these specimens is a *tribulum*, or threshing-sledge, from Tunis. It is a low sledge or drag made of two planks, seventy inches long, nineteen inches wide, and ten inches thick, turned up slightly at the front, and narrowed like a square-toed shoe. Three stout battens across the upper side are securely nailed down. On the under side, just where the flat portion commences, are seventeen strips of iron, like dull knife-blades, arranged in two rows quincuncially. Along each margin of the under side are four similar dull blades. All the remainder of the bottom is occupied with sixteen rows of stone teeth, sixteen in a row, arranged quincuncially and projecting about an inch. These teeth are nothing but bits of jagged quartz, and, if picked up independently of their environment, would hardly be regarded as wrought by human hands.

The other 'paleolithic' civilized implement is a Spanish *Rallador*, or grater, from British Honduras. It consists of a plank of hard wood eighteen inches long and ten inches wide, into which have been driven nearly two thousand bits of quartz no larger than tiny arrow-heads, only they are not chipped in the least, and are less shapely.

With such material as the Gilbert hearth, the McGee spear-head, the Murdoch spectacles, the Tunis *tribulum*, and the Honduras grater accumulating around us every day, the question does not seem to be as to the antiquity of man, but whether or not archeology will help us in ascertaining his pristine condition on this continent. Dismissing the *tribulum* (the stone furniture of one of them would stock an African paleolithic cabinet), we have evidence which would satisfy some minds that at the end of the glacial epoch there lived men who built fires, chipped obsidian most beautifully, and wore snow-goggles, while in the nineteenth century A.D. men were still in the lowest story of the stone period. O. T. MASON.

THE HEALTH OF NEW YORK DURING OCTOBER.

THE health department estimates that on the 1st of October the population of the city of New York was 1,449,958. Of this number, 2,977 died during the month, which was an increase of 210 as compared with September: 1,275 of these deaths occurred among children under five years of age. There was a marked reduction of deaths from diarrhoeal diseases. The maximum mortality from this cause was in the month of July, when no less than 1,382 deaths took place; in August this was reduced to 705; in September, to 479; and in October, to 234, only about one-sixth the mortality of July. Fifty-eight more deaths are chargeable to consumption than in the preceding month, although the average for October is about that of other months of the year. But 18 persons died from scarlet-fever, — a small



Weekly Mortality	681	584	703	665	
Weekly mean Thermometer	56 1°F	59 0°F	54.6°F	52.2°F	
Weekly mean Barometer	30 085	29 999	30.171	30.012	

number, considering the size and circumstances of the great metropolis: in fact, the mortality from this cause during the entire year has been remarkably low. Diphtheria, on the other hand, has markedly increased, there being recorded 165 deaths, as against 85 for September. This is the largest number of deaths since February, with the exception of the month of May, when exactly the same number of deaths occurred as in October. A corresponding increase in this disease is noticeable in the city of Brooklyn. Diphtheria is very prevalent in other cities as well, notably in St. Louis and Chicago. The largest number of deaths in any one day in the month was 118, on the 21st. The largest daily mortality of the year was 240, on the 8th of July.

The mean temperature for October was 54.90° F., slightly below the mean for the past ten years, that being 56.33° F. At 3 P.M. on the 12th the thermometer registered the highest temperature of the month, 78° F. The mean for the past ten years in October is 79.5° F. The lowest temperature was 33° F., at 5 A.M. on the 17th, the mean for the ten years being 35.3° F. The rainfall during the month amounted to 3.07 inches, the average for the decade being 3.34 inches. Taken as a whole, October of the present year may be looked upon as an average October, differing in no important respects from the same month in other years.

CO-OPERATION IN A WESTERN CITY.

The American economic association is to be commended for the practical and educational value of its publications. This association has an object in view, and that object is, by historical and statistical inquiries and examinations into actual conditions, to reach conclusions which will aid in solving the social and economic questions now so prominent.

Following Professor James's admirable monograph on 'The relation of the modern municipality to the gas-supply,' which attracted such wide attention, the association publishes this history of co-operation in the city of Minneapolis, throwing light upon one of the most important phases of the labor problem. Dr. Shaw has had the opportunity of observing the development of the most successful examples of co-operation which this country has yet furnished, and in a clear and pleasing style has sketched their organization, growth, and results.

The most valuable part of this monograph is that giving the history of the co-operative coopers of Minneapolis. In the introduction, reference is made to the marvellous growth of Minneapolis, now the largest wheat-receiving market and flour-milling centre in the world; the daily capacity of the mills being about thirty-five thousand barrels. To supply the demand for barrels requires about seven or eight hundred coopers, a large majority of them working in co-operative shops.

Co-operation in a western city. By Albert Shaw. Baltimore, *American econom. assoc.*, 1886. 8°.

The co-operative movement in this city dates from the spring of 1868, when several journeymen coopers informally opened a co-operative shop. This experiment, owing to the want of proper organization and management, was short-lived. A like attempt in 1870 came to an end for similar reasons.

In 1870 began those experiments which have made Minneapolis the milling centre of the world, and as a consequence this city became a coopers' Mecca. From 1871 to 1874 the journeymen cooper's were able, through their union, to secure good terms from the 'bosses.' But, owing to the constantly increasing number of coopers, employment became precarious, and wages were forced down. To escape the unjust and often tyrannical treatment of the bosses, a number of the journeymen decided in 1874 to organize a co-operative company upon business-like principles.

In November, 1874, the Co-operative barrel manufacturing company was incorporated, and business was commenced with a brotherhood of sixteen men, each making an initial investment of fifteen dollars. The most important features of the company's by-laws "are those which provide that all members must be equal shareholders, and that the gains or losses of the business are to be apportioned, not *pro rata* among the members, but in proportion to the work they have done. Losses and gains of a different sort — for example, those resulting from the work of hired help, from outside ventures undertaken by the association, gains from the appreciation of real estate, or losses from fire or from non-paying creditors — are to be apportioned equally among the members. The distinction between the two kinds of profit and loss — one kind affecting the men as capitalists, and the other kind affecting them as laborers — shows keen economic insight, and has great practical value."

From its meagre beginning in 1874, this co-operative enterprise has prospered, until, in March, 1886, the president of the company estimated the cash value of its assets at $58,000, its total liabilities not exceeding $13,000. In addition to this, the entire membership of ninety are estimated as property-holders to an average amount of at least $3,000 each. A majority of the members own homes, and of this number it is interesting to note that probably two-thirds were aided by co-operative building and loan associations. Dr. Shaw attributes this remarkable success to co-operation; for, so far as he is aware, no cooper outside of the co-operative shops has similarly prospered.

The history of the other six co-operative barrel companies given in this chapter is in the main similar to that first noted.

From the experience of these companies, Dr. Shaw concludes that they are superior in stability to the non-co-operative shops; that co-operators as proprietors and capitalists have a manifest advantage in competition, for, if necessary, they can dispense with profits upon capital, and rely for support upon their wages as workingmen.

The lessons learned from the experience of these coopers can be applied in other branches of co-operation, especially where piece-work is possible, or where labor has greater relative importance than capital in production.

The account of the Co-operative agricultural colony, established near Minneapolis in April, 1886, contains many valuable suggestions; and, if this colony meets with the success indicated by present prospects, it will doubtless lead to the establishment of other co-operative colonies. A co-operative agricultural colony is apt to suggest the idea of a communistic body like the Shakers; and to correct this notion Dr. Shaw thus distinguishes them: "Communism and co-operation are antipodal in principle. Communism denies the right of private property. Co-operation proposes to enable the destitute to acquire private property. Communism usually asserts control over family relations, and it sacrifices personal liberty. Co-operation adds to the liberty of the individual because it enables him to 'pay the price of his industrial freedom;' and, as I have shown in the case of the coopers, it supplies the conditions that are most favorable to the family institution."

In giving an account of co-operative profit-sharing in the Pillsbury mills, he says, "From the employers' stand-point, I have Mr. Pillsbury's assurance that it pays." It brings about pleasant relations between employer and employee, and works to mutual advantage. The system is not, however, without its inconveniences and petty annoyances.

The Minneapolis co-operative mercantile company was established by the co-operative coopers in 1885, and its success has been very satisfactory. There is no reason why this form of co-operation which has proved so advantageous to workingmen in England should not have like results in this country.

In addition to those co-operative industries mentioned above, Minneapolis has a co-operative laundry, a co-operative painters' association, co-operative building associations, and other co-operative enterprises whose forms of organization are admirably sketched in this monograph.

Dr. Shaw attributes the fresh impulse now being manifested among workingmen to join in co-operative effort chiefly to the growth and activity of the knights of labor.

Co-operation is not prescribed as a panacea for all the present ills of labor. The author recognizes that there must be improvement along many lines, but holds that within certain limits co-operation has not only immediate applicability, but also great remedial virtue. The moral effects are reckoned its highest success. It makes men provident, temperate, and self-reliant. Co-operation is not a religion, and calls for no renunciations. It is merely a question of business advantage, and those engaged in it would not hesitate to give up the system if their condition would be bettered thereby.

This contribution to the labor literature of the day will doubtless be widely read, and lead to good results.

PARIS LETTER.

THE very sad and unexpected news of Paul Bert's death reached us yesterday, exciting much surprise, as it was scarcely known that he was ill. As a politician, M. Bert was a man of passionately strong opinions; and his anti-clerical efforts, which soon became an anti-religious warfare, made him many bitter enemies. As to his work in Tonquin, it can hardly be appreciated, as it had only begun. As a scientist, M. Bert had already been virtually dead many years. He had almost entirely given up work of a physiological nature, his attention being given altogether to politics. I have had the pleasure of meeting M. Bert two or three times in his laboratory, and of listening to some of his conversations with his assistants, while he was discussing new experiments and explaining the methods that ought to be followed; and, as he spoke, new ideas appeared to be constantly coming. With a trained and intelligent corps of assistants, he would have done great work. His head was ever full of new ideas, of ingenious methods, but he required assistants to catch the ideas as they came, and to work according to his directions.

At a recent meeting of the Academy of sciences, M. Pasteur read an interesting paper on the progress of anti-hydrophobic inoculation. Up to the 31st of October, 2,490 persons had been treated at his laboratory after having been bitten by rabid or presumably rabid animals. Of this number, 1,700 were natives of France, among whom the resulting deaths were ten, — 1 in 170. The number of cases of hydrophobia recorded in the Paris hospitals is usually ten or twelve per annum; during the year ending November, 1885, it was twenty-one. Since that date, only three cases have occurred. One was a person who had been treated by M. Pasteur, while two were persons who had not been so treated. Upon the whole, the mortality among those treated was shown to be much less than among those not treated. The most important point in M. Pasteur's paper is, that the treatment must not be the same in all cases; that where the wounds inflicted are of a serious nature, in the face especially, stronger doses are required. Such was the treatment in the case of the nineteen Russians, who, it will be remembered, were sent here from Smolensk after having been severely bitten by a rabid wolf. One died during treatment, and two others a few days afterward. Pasteur, fearing for the safety of the others, treated them anew, ending with very strong doses, which he believes is the reason for their survival. In cases where there are severe wounds of the head or face, he now proceeds as follows: on the first day he uses medulla virus 12 days old at 11 o'clock, 10 days old at 4, and 8 days old at 9; on the second day, at the same hours, he uses medulla virus of 6, 4, and 2 days respectively; on the third day, medulla virus of 1 day. The treatment on the fourth day is the same as on the first, that on the fifth the same as on the second, and the sixth as on the third; on the seventh he uses a 4-day medulla, on the eighth a 3-day, on the ninth a 2-day, and on the tenth a 1-day medulla. The process may be repeated two or three times. M. Pasteur has used this method some two months in cases such as those mentioned, with good results. Part of the paper was devoted to the effect of anti-hydrophobic treatment of dogs after inoculation, the results in dogs being exactly the same as in man, experiments having shown that prompt action and high doses are necessary, just as in the case of hydrophobia among human beings. The paper was heartily applauded by the members of the academy.

M. Loret of Lyons, in the course of his studies on ancient Egyptian funeral rites, has given some attention to the perfumes then in use; and by means of his botanical knowledge, aided by some inscriptions in ancient laboratories, he has been able to discover the ingredients composing some of them, such as 'kyphi' and 'tasi,' which were used in Greece and Rome after the conquest of Egypt. These he has reproduced from the old Egyptian formulas, 'tasi' being compounded of storax, benzoin, myrrh, and other resins, while 'kyphi' is made from roots, leaves, and seeds of different plants.

A new treatment of phthisis is proposed by Dr. Berjon of Lyons, entirely different from the bacteriological treatment recently proposed by Cantani, and unsuccessfully tried by several Italian and Spanish physicians. The new treatment is based on the fact, demonstrated by Cl. Bernard, that some gases, such as sulphuretted hydrogen, which cannot be inhaled without danger, can be introduced into the digestive tract through the rectum, passing off through the lungs without inconvenience after being absorbed by the mucous membrane of the rectum and passed through the circulatory system. Dr. Berjon uses carbonic acid mixed with sulphydric acid. Tuberculous patients have shown much improvement under this treatment, though the reason for it is not obvious, and M. Berjon does not explain why he uses the gases named rather than others. Under this new treatment, it seems that after a time the purulent discharge ceases, nocturnal sweating disappears, there is a marked increase in weight, but the bacilli are still present. Dr. Berjon's experiments are so very recent, that their results cannot yet be judged. Those who desire full information upon this subject are referred to the *Semaine médicale* of July 14 and Oct. 20, 1886. The same method has been tried in cases of asthma, and with good results. The reason for this is enigmatical, but the subject is well worth investigation.

Dr. Guilbeau, a blind professor in the Institut national for the blind, has conceived and put into execution the excellent idea of establishing a museum to contain samples or specimens of all articles specially devised for the use of the blind. He has already made quite a collection. This museum will contain much to interest not only those deprived of sight, but the general public as well, as it will present in a graphic manner a history of the efforts made to increase the comfort and the knowledge of the blind. The display of the different kinds of letters invented for reading by touch is very complete, containing all varieties introduced since Haüy's first large letters in relief and Braille's improvement, up to the latest methods.

Some time ago, M. Moissan, a young chemist, had a letter read before the Academy of sciences, announcing that he had been able to isolate from hydrofluoric acid a new substance possessing very peculiar qualities, and which he believed to be fluor. A committee was appointed, and at the meeting of the academy, on Monday last, I heard part of M. Delray's report upon the subject. After having recalled past experiments in that direction, M. Delray stated that M. Moissan's method consisted in submitting hydrofluoric anhydric acid to the action of very strong electrical influence and intense cold (from — 23° to — 51° C.). After two or three hours of this treatment, a gas is obtained which it does not seem possible can be any thing but fluor.

The ancient Sorbonne re-opened its venerable doors some days ago; M. Lavisse, professor of modern history in the literary faculty, delivering the opening address. A new chair, that of physical geography, has been created, which will be filled by M. Vélain, a geologist.

The Musée du Louvre some time ago received several fine specimens of Persian art of very great antiquity. They consist of a series of warriors, in relief, natural size, of enamelled and colored bricks. They come from the palace of Darius, in Susa, having been brought thence by M. and Mme. Dieulafoy. These specimens of Persian art are the first that have been found, and have excited much admiration here. Unfortunately the venerable warriors are not as well suited by the climate of Paris as by that of the Susian province, the dampness of the air disagreeing with them; and, to prevent the crumbling of these remains of the great Darius's palace, they are to be submitted to a preservative process, — heating to a high temperature after having been covered with spermaceti. The operation will be an extensive one, as each brick must be treated separately.

Among the books recently published, I would call special attention to Vulpian's second volume on diseases of the spinal cord, which came from the press two days ago. In this excellent work the able physiologist makes known all that his clinical experience and physiological experiments have taught him these many years. A good book, also, is that of Alex. Peyer: 'Atlas de microscopie clinique.' It is a collection of a great number of figures relating to pathological substances and morbid products. Each plate is accompanied by a lengthy explanation. This book will prove very useful to the practitioner as well as to the student, and is gotten up in very handsome style. V.

Paris, Nov. 13.

NOTES AND NEWS.

THE annual report of the surgeon-general of the navy, Francis M. Gunnell, says that 8,429 patients in the navy were treated during the year, with 52 deaths, — less than 1 to 162. He complains that the navy has not sufficient inducements in rank and pay for young physicians to become medical officers, while the army has many applicants. An appropriation is urged for a yellow-fever hospital at Widow's Island, near Portsmouth, N.H.

— Commander Schley has received the gold chronometer voted to him by the Maryland legislature as a testimonial in consideration of his bravery and efficiency in the rescue of Lieutenant Greely.

— Gas has recently been discovered at several places in Indiana in supposed paying quantities. The following places are reported to have wells which have been sunk to a successful end: Eaton and Muncie in Delaware county, and Kokomo in Howard county. Prospecting is being carried on in most of the larger towns of northern Indiana.

— Captain Anderson of the Norwegian bark Hebe reports to the U. S. hydrographic office that on Aug. 24, 1886, while in the Indian Ocean (11° 52′ south, 90° 17′ east), a tremendous sea passed the vessel, looking as if it had come from shoal water. The sea, just before and after the passage of the wave, was perfectly smooth; light breeze at the time from the south-east. No soundings were taken. The charts in this locality give no soundings, and the captain is of the opinion that the wave may have been due to an earthquake.

— The French ministers of foreign affairs and of public instruction will shortly place before the Chamber of deputies a *projet de loi* relating to literary and artistic copyright, in order to carry out the conclusions of the Berne international convention.

— The president and council of the Royal society have awarded the Copley medal to Franz Ernest Neumann of Königsberg, for his researches in theoretical optics and electro-dynamics, and the Davy medal to Jean Charles Galissard de Marignse of Geneva for his researches on atomic weights. Prof. S. P. Langley of Alleghany City was awarded the Rumford medal for his researches on the spectrum by means of the bolometer. At the same time Francis Galton, F.R.S., and Prof. Guthrie Tait were nominated for the royal medals, the former eminent for his statistical inquiries into biological phenomena, and the latter for his various mathematical and physical researches.

— In a pneumatic street-car system for which a patent has recently been granted, air is compressed at a central station, and distributed through pipes to reservoirs, situated between the tracks and below the street surface, at points on the road where supplies of compressed air for the pneumatic locomotives are needed. Tanks on the locomotive hold sufficient compressed air to propel it from one reservoir to the next, where the supply is replenished by means of a quickly adjusted tapping-pipe which connects the reservoir with the tanks. A similar system, differing in details, was projected some years ago, but without tangible results.

— Vol. xviii. of the Tenth census of the United States ('Social statistics of cities,' part i., by G. E. Waring, jun.) treats of the principal cities of the New England states, and of New York, New Jersey, Pennsylvania, and Delaware, to the total number of 53. Part ii. will describe the principal cities of the rest of the United States. The character and scope of the work may be seen in the following list of subjects, in accordance with which each city is treated more or less fully: history; site, elevation, topography, climate, and tributary country; means of communication; streets, pavements, and public parks; sewerage, water and gas supply; police, fire. and health departments; schools, churches, and cemeteries; hospitals, penal and reform institutions; etc. At the present time, when the movement of our population toward cities is so rapid, and the problems of municipal drainage, water-supply, paving, etc., so press for a solution, the value of this compilation is apparent. The volume is freely illustrated with maps showing past as well as present conditions. The historical maps of Boston are especially worthy of notice.

— Vol. xx. of the Tenth census of the United States ('Statistics of wages, necessaries of life, trades societies, strikes and lockouts,' by J. D. Weeks), though long delayed, makes a very timely appearance, as its contents throw a flood of light upon the condition of the laboring classes, and will doubtless aid in the solution of the question, 'Do strikes pay?' It appears that during the year 1880 there occurred 762 strikes or lockouts. Of these, details were obtained regarding only 226, or less than one-third. As a consequence of these 226 strikes and lockouts, there was a loss in wages of $3,711,097. If the same proportion carries through the others, there was a direct loss to the laborer of nearly $12,000,000, or fully one per cent of the total wages paid. This takes no account of industries which were broken up or driven away in consequence of such strikes. An examination of the comparative tables of wages does not indicate that the results in raising wages have been commensurate with this loss.

— According to the vital statistics of Germany for 1885, 4,091 males and 1,209 females committed suicide. The methods of self-destruction were as follows: hanging, 3,567; drowning, 1,177; shooting, 611; poison, 232; cutting their throats, 112; throwing themselves under railroad trains, 77; throwing themselves from heights, 49.

— Captain Gager of the steamship Louisiana reports to the U.S. hydrographic office at New Orleans, that, on his last trip from New York to that port, he found an almost entire absence of current in the Gulf Stream. Captain Gager states that this has generally been his experience when the water in the Mississippi was unusually low, and connects the absence of Gulf Stream current with this fact. This is not unusual after a strong northerly wind.

— The *Boston medical and surgical journal* says, that, in estimating human character, the ear affords a better criterion than any of the other features. An ear which presents no well-defined elevations and depressions indicates selfishness and want of delicacy of perception. The possessor of a thick, well-shaped, highly tinted appendage, set well forward, is usually ungrateful, grasping, and lacking in depth of feelings. A thin ear indicates keen susceptibility; and an ear that projects from the head, alertness. A broad ear is more coarsely practical. The perfect ear is one which lies close to the head, and is gracefully rounded with pretty curves, strong lines, and firm, delicately tinted cartilage.

— Numerous instances have been recorded of late in the medical journals, of the complete reunion of portions of fingers which had been cut off from the hand, in some cases by the knife, and in others by the axe. In one case a man, in cutting kindlings for the morning fire, accidentally cut off the end of his thumb. He had gone from the place some twenty feet, when he returned, picked up the end, wiped it and replaced it, binding it in its original place as nearly as possible. The wound united; and the finger is now as good as ever, save that its sensibility is somewhat diminished. In another case a boy chopped off the ends of three fingers. He was seen by a physician three or four hours after the accident. The ends of the fingers had been found in the snow, and were brought to him. He attached them, and two of the three united.

— A physician, in a letter to the *Medical record*, narrates a case in which one of his patients, who is suffering from dyspepsia accompanied by the eructation of gas, burned his hair, eyebrows, and mustache by the ignition of some of the gas as it came from his mouth, while at the time he held a lighted match in his hand.

— At a recent meeting of the New York pathological society a case was reported in which a negro child, which died at the age of two months, had but one lung, the left. The right was rudimentary, and had never been inflated. The heart was also malformed, having but one auricle and one ventricle, both being the left.

— The *New York medical record* has the following, not very flattering account of the family of the great Caesar : "In the Claudian-Julian family, beginning with Julius Caesar himself, and ending with Nero, we have an almost unbroken line of neuroses. Caesar himself was epileptic ; but probably the disease developed late in life, from exposure and excesses, and did not much affect his health. Augustus, his grand-nephew, had, it is believed, writer's cramp. Julia, his daughter, seems to have been little more than a nymphomaniac ; she had an imbecile son. Tiberius was a man naturally heartless, cruel, and licentious ; in his later years he seems to have lost all moral sense, and illustrated the most shameless sensibility and cruelty. Caligula, reputed great-grandson of Augustus, was epileptic as a boy, badly formed and weak-minded as a man. He stuttered, was insomnious, and apparently had hallucinations. Claudius was also weak-minded, timid, and credulous, with unsteady gait, weak knees, shaking head, and dribbling lips."

— In speaking of the preservation of dead bodies, *Gaillard's medical monthly* says that Edward I., who died in 1307, was found not decayed four hundred and sixty-three years subsequently. The flesh on the face was a little wasted, but not putrid. The body of Canute, who died in 1017, was found fresh in 1766. Those of William the Conqueror and his wife were perfect in 1522. In 1569 three Roman soldiers, in the dress of their country, fully equipped with arms, were dug out of a peat-mass near Aberdeen. They were quite fresh and plump after a lapse of about fifteen hundred years. In 1717 the bodies of Lady Kilsyth and her infant were embalmed. In 1796 they were found as perfect as in the hour they were embalmed. Every feature and limb was full. The infant's features were as composed as if he had only been asleep for eighty years. His color was as fresh and his flesh as plump and full as in the perfect glow of health. The smile of infancy and innocency was on his lips. At a little distance it was difficult to distinguish whether Lady Kilsyth was alive or dead.

— The British schooner Souvenir (Captain Fraser) reports to the U. S. hydrographic office that they encountered a very severe electric storm on the 24th of November, off Block Island. A heavy gale was blowing from south-west to west. There was terrific squalls with remarkably brilliant lightning and tremendous thunder, and torrents of rain. The vessel was completely covered with St. Elmo's fire, and the sea was full of phosphorescence. The compasses and barometer were very greatly affected, the former varying from one to three points either way, and the mercury in the latter trembling and 'pumping' violently.

— During the annual meeting of the American society of microscopists at Chautauqua, N.Y., last August, some of the members under charge of the 'working session committee,' collected, by means of a surface-net, quite a number of fresh-water forms from the lake. The Crustacea found included, of the Copepoda, two species of Diaptomus, two of Cyclops, and one each of Episcura and Ergasilus ; of the Cladocera, there were found Daphnella brachyura (Lievin), Daphnia cederstromii (Schoedler), Chydorus sphaericus (O. Fr. Muller), Leptodora hyalina (Lilljeborg) ; also Ceriodaphnia and Bosmina. The Crustacea were put in the hands of Mr. C. S. Fellows for identification, who will report at the next meeting of the association.

— The Brazilian government has appropriated ten thousand dollars for an agricultural experiment-station, and inquiries are being made abroad for a competent specialist to take charge of it. There is an agricultural school near Bahia, in charge of Dr. F. M. Draenert, a German, but thus far there are no experiment-stations in the empire.

— Despatches from Buenos Ayres state that cholera is on the increase there. Seventeen new cases and nine deaths were reported in the city in one day. In Rosario thirty-four new cases and twenty-five deaths occurred, and at Cordova twelve cases and five deaths.

— A case of actinomycosis is said to exist in Springfield, Ill., in the person of a young lady employed in a manufacturing establishment in that place. Its common name is 'lump-jaw,' and appears as a tumor of the jaw. Although affecting cattle and swine, it very rarely attacks human beings. This is certainly true for this country, although thirty cases are said to have occurred in Germany in four years. It is a disease caused by a vegetable parasite, the actinomycis or ray-fungus. Some place this parasite among the Schizomycetes, others among the fungi. The disease may also appear in the lungs and in the intestines. The germs are supposed to enter the jaw through decayed teeth or the tonsils, and the resulting tumor shows itself at the angle of the jaw.

— The nineteenth annual meeting of the Kansas academy of science was held at Emporia, Kan., Nov. 17, 18, and 19. The welcoming address was given by Pres. A. R. Taylor of the State normal school, and evening lectures by the president of the academy, Prof. E. L. Nichols, of the University of Kansas, on 'The sky,' and by Prof. John C. Branner, of the University of Indiana, on 'Geologists, professional and unprofessional.' The following papers were read: F. H. Snow, Rain cycles in Kansas; E. B. Cowgill, Meteors of the Biela train; T. H. Dinsmore, jun., The meteors of 1885 and 1886; T. H. Dinsmore, jun., and A. D. Crooks, Color-blindness in the State normal school: E. L. Nichols, On black and white; W. S. Franklin, On some curves allied to Lissajou's figures: E. L. Nichols and W. S. Franklin, A preliminary note on the electro-motive force due to magnetism; E. B. Cowgill, On the magnetization of a ring; T. H. Dinsmore, jun., A new illustration of the arc light; D. S. Kelly, The coal-measures of Lyon county; Robert Hay, Historical sketch of geological work in Kansas; A. H. Thompson, Additional notes on history of geological work in Kansas: F. H. Snow, On the species of Dakota leaves in the museum of the University of Kansas; Joseph Savage, Pink and white terraces of New Zealand; Concretionary forms; Robert Hay, Natural gas in eastern Kansas; G. H. Failyer and J. T. Willard, Preliminary report on the chemistry of the natural gases of Kansas; E. H. S. Bailey, Miscellaneous chemical notes; G. H. Failyer and J. T. Willard, Some notes on the determination of lithium, and on its occurrence in a mineral spring in Jewell county, Kan.; On some mineral waters of Kansas; E. H. S. Bailey, On the composition of the lime solution in which straw is digested in the straw-paper manufacture; E. C. Franklin, Proximate analysis of Artemisia annua; L. E. Sayre, A preliminary analysis of Astragalus mollisimus (loco weed); J. T. Willard, On variations in the sugar-content of Sorghum vulgare, with an account of some efforts to improve the species; T. H. Dinsmore, jun., New distillation apparatus; T. H. Dinsmore, jun., and W. S. Picken, Notes on the effects of oxygen on animal life; M. A. Bailey, The minus sign; B. B. Smyth, Figurate series; A. H. Thompson, Ethics among animals; J. A. Udden, Some mounds on Paint Creek, McPherson county; John D. Parker, On mounds in Davis county; J. R. Mead, Explorations among the Pueblo ruins of New Mexico; L. L. Dyche, Notes on the humming-birds; N. S. Goss, Additions to the catalogue of the birds of Kansas; L. L. Dyche, List of birds observed near Hermit's Peak, Las Vegas, N. Mex., with notes; F. H. Snow, Note of the occurrence in Kansas of the Mississippi shapper, or alligator turtle; F. W. Cragin, On a new variety of a rare Sonoran reptile from Kansas; J. R. Mead, List of the fresh-water Mollusca of Sedgwick county; E. A. Popenoe, A list of Kansas Hymenoptera in the museum of the state agricultural college; C. L. Marlatt, On the cedar saw-fly; W. Knaus, On the distribution of species of Kansas Coleoptera; E. A. Popenoe, A revised list of the Coleoptera of Kansas; C. L. Marlatt, Notes on the oviposition of the Buffalo tree-hopper; F. H. Snow, A preliminary list of Kansas desmids; W. A. Kellerman and M. A. Carleton, Second list of Kansas parasitic fungi; W. A. and Mrs. Kellerman, Kansas forest-trees identified by leaves and fruit; J. H. Carruth, Scraps of botanical history; F. H. Snow, A list of plants collected in New Mexico by the scientific expeditions of the University of Kansas.

— Messrs. Ticknor & Company, Boston, announce the publication of Goethe's 'Faust, a commentary,' by Denton J. Snider (2 vols., 12°, $3.50). This is a treatise on the greatest of German poems, giving its history, critical standards, and outline, and analyses and explanations of all the scenes and situations, as seen from a philosophical point of view.

— The seventh annual meeting of the American society of mechanical engineers was held in this city from Nov. 29 to Dec. 3, Vice-President Towne presiding in the absence of President Sellers. The opening address was a review of the early history of steam-engines in this country, by Horatio Allen. The following papers were read: Prof. F. Reuleux, Friction in toothed gearing; Prof. R. H. Thurston, Friction of non-condensing engines; A. Wells Robinson, Dredging machinery; Benjamin Baker, The working-stress of iron and steel; Andrew C. Campbell, A new conicograph; Prof. G. Lanza, Strength of shafting; William Kent, Heating capacity of water-gas: Professor Alden, Formulae and tables for calculating the effect of reciprocating parts of high-speed engines; William Cowles, Fire-boats; George H. Barrus, The new calorimeter; Oberlin Smith, Intrinsic value of special tools; W. E. Partridge, Capital's need of high-priced labor. Among the topics discussed were the following: Transmission of power by flying rope; Practical value of the sand-blast for sparpening files; Feed-pumps and injectors; Effects of exposure upon aluminium bronze; Annealing-furnaces for small gray-iron castings; Grit in grinding-rooms, yards, and shops; Expansion and contraction of drawing-paper; Cutting of intricate templets from very thin metal; Equipment of mechanical engineering laboratory; Problems for students of mechanical engineering in the last year of their regular course; Power required to drive modern American machine-tools. The officers elected for the ensuing year are, president, George H. Babcock; vice-presidents, Joseph Morgan, jun., Charles T. Porter, Horace S. Smith; managers, Frederick G. Coggin, John T. Hawkins, Thomas R. Morgan, sen.; treasurer, William H. Wiley.

— It is announced that the British government has taken possession of the island of Socotra, in the Indian Ocean, heretofore belonging to the imamat of Muscat. For many years the British government had subsidized the governor of the island, but had had no direct control over it. Socotra lies about 120 miles east of Cape Guardafui, near the entrance to the Gulf of Aden, and in the direct route of vessels passing between Suez and India. The island is 70 miles long by 20 miles broad, with an area of about 1,000 square miles, and a population of nearly 5,000, mostly Arabs, negroes, and Portuguese. A range of granite and limestone mountains extends through the middle of the island, rising in places to a height of 5,000 feet. The low coast-lands are fertile, producing aloes, dragon's-blood and other gums, tamarinds, dates, and tobacco.

— Snow hall, for the uses of the natural history department of the University of Kansas, at Lawrence, was formally dedicated on Nov. 17.

— The government of Queensland is taking vigorous measures to guard that colony against the rabbit-plague mentioned in *Science* of Nov. 12. A rabbit-proof fence of wire netting will be erected along the boundary-line between Queensland and New South Wales, with an extension of a hundred miles northward along the boundary of South Australia. For this purpose, 2,550 miles of fencing wire and 450 miles of wire netting have already been purchased in England.

— While the question of the advisability of women studying medicine is being discussed, the women are settling it for themselves by entering the medical schools in no inconsiderable number. At Zurich twenty-nine are now pursuing that study; in London, forty-eight; and at Paris, one hundred and three. At the latter eighteen have obtained their diplomas of doctor during the past seven years.

— An unsinkable lifeboat recently patented by a gentleman in Buffalo, N.Y., possesses some novel features. The entire lower part of the boat is filled with sheets or slabs of cork, set up edgewise and fastened together. Above this is a filling of rushes, set up vertically and having their ends rendered water-proof. Above the cork and rushes is a water-tight deck, which separates the lower half of the boat from the upper half, where seats are provided for crew and passengers.

LETTERS TO THE EDITOR.

Fort Ancient, Warren county, Ohio.

HAVING recently, in company with Messrs. W. H. Holmes and Charles M. Smith, visited some of the more noted ancient works of Ohio, among them the one mentioned above, I have concluded that a few words in regard to its present condition might be of interest to general readers as well as to archeologists.

This work has been so often described, that most readers interested in our antiquities are familiar with it. The first notice and plan were given in the 'Portfolio' (1809). Both plan and description were copied by Caleb Atwater in his memoir in the first volume of the Transactions of the American antiquarian society (1820). About twenty years later it was carefully surveyed by Prof. John Locke, his description and plat being published in the Transactions of the Association of American geologists and naturalists (1843). This plat was copied by Squier and Davis in 'Ancient monuments,' and is the one from which all subsequent figures have been taken. It is quite accurate in the main; so nearly so, in fact, that another complete survey may be deemed unnecessary. Some slight corrections might be made; but these, with two exceptions, which will be named, are of minor importance.

As remarked by Squier and Davis, this is "one of the most extensive, if not the most extensive, work of this class in the entire west." It is also one of the best preserved, the main portion having suffered but little from the plough; the surrounding wall being uninjured save at the points where the turnpike cuts through it, and at a few places where ravines have been recently formed. As earthen walls change but little so long as they are covered with vegetation, it is more than probable that we see this great structure (with the exceptions hereafter noted) as it was when abandoned by those last occupying and using it. For example: the wall at *d* (Squier and Davis's figure), in the north-eastern corner, although in an open field, shows no signs of material wearing; the height being now a little over nineteen feet, and width at base sixty-seven feet, — almost exactly the measurements given by Atwater. Growing on the top are some large trees whose roots are not at all exposed. With the exception of a short stretch at the point mentioned, the wall throughout is still in the unbroken forest.

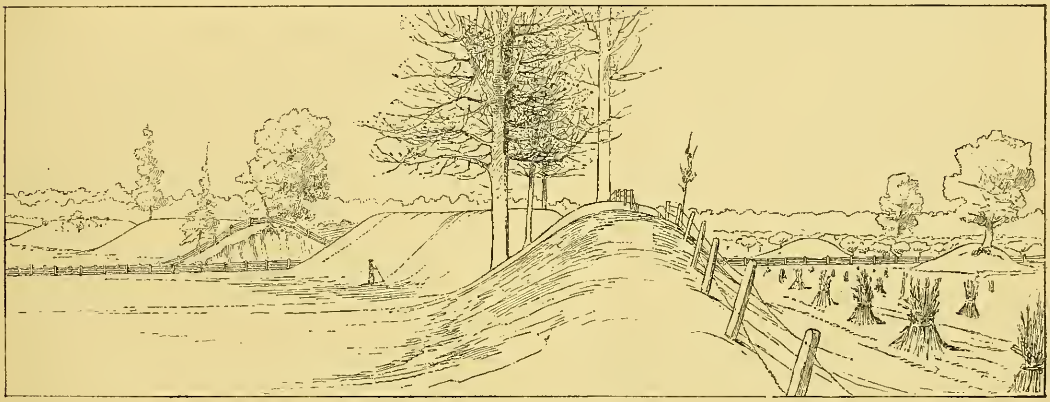
Evidences of wearing are observable at some of the ravines it crosses, and a few of the smaller gullies appear to have been worn since the wall was built (a fact also mentioned by Atwater), though in most cases the adaptation of the wall to the slopes shows that these existed when it was thrown up. Professor Locke states that the "embankment is in several places carried down into ravines from fifty to one hundred feet deep, and at an angle of thirty degrees, *crossing a streamlet at the bottom*, which, by showers, must often swell to a powerful torrent. But in all instances the embankment may be traced to within three to eight feet of the stream." Although our visit was during an unusually dry season, when the ravines contained no water, the indications observed did not bear out what seems to be implied by Professor Locke's language, — that the wall originally crossed the ravines: on the contrary, they appear to show that the wall stopped on the sides at the points reached by the streamlets in time of highest water. It is true that at some points it has been broken through by the pressure of water accumulated behind it, but in all these cases it is apparent that the ravines have been formed since the wall was built. At only one point did we observe a break made since Professor Locke's survey. This is through the long, curved stretch directly east from where the so-called 'two large mounds' are represented on the plat.

If these ravines were defended, as is quite probable, it must have been by some other means than a wall of earth, which could not have withstood the pressure through a single rainy season.

Although the wall is built chiefly of earth (composed largely in most places of clay) gathered from the adjacent surface, and from the interior ditch where it exists, it is partially underlaid at numerous points with stones, which in some cases were laid up loosely. This was noticed at the north-western corner, where the wall has been cut through to make way for the turnpike, and also at the extreme south-eastern corner. At almost every point where a slight cut has been made for a farm-road or other purpose, stones were observed.

generally crossed at the upper terminus by a wall of the ordinary height, the ridge immediately outside being cut down several feet so as to present a steep slope corresponding with the outside of the wall. This gives the appearance of a terrace on the hillside a few feet below the wall. On the other hand, where similar ridges form approaches to the south portion, and also, at some places, to the north portion, the defences are formed by raising the wall considerably above the ordinary height.

The isthmus, or point where the opposite walls approach nearest to each other, just north of the so-called 'two large mounds,' is undefended, though on the right or east side the ascent is by no means difficult: the declivity on the west forms a sufficient defence without a wall. The plat at this point is slightly erroneous, as the wall on the west side does not extend quite so far north as represented. It is possible that this extension was made theoretically, on the supposition that the wash which is apparent here (shown in Atwater's figure) had carried away the wall. That a small portion of the extreme end was carried down, is true, but the ridge on which it



WALL OF FORT ANCIENT.

Mr. George Ridge, who lives near the two mounds at the north-eastern corner, and who has for years studied the fort, insists that the wall is to a considerable extent underlaid with stone. This fact is also mentioned by Squier and Davis, who state that "they are *water-worn*, and seem for the most part to have been taken from the river." This is certainly an error, as they are almost entirely of flat pieces of limestone, showing no indications of having been water-worn, such as could be obtained on the surface or immediately below the brow of the hill.

The two points at the isthmus, or neck, marked on the plat '*two large mounds*,' are not 'mounds' properly so called, but the elevated terminations of the walls on the sides, the opening here being an important gateway. The point at the extreme south-eastern corner, marked on the plat '*mound*,' is only an elevated portion of the wall thrown up to defend an easy approach at this point.

One of the most interesting facts observed, of which mention has not heretofore been made, is the different methods adopted of defending the more easy approaches. On the north, these approaches, which are usually narrow, ascending ridges, are

runs never crossed the gap. Besides, in the original plat, as given in the 'Portfolio,' the wall is represented as extending *up to* the so-called 'wash' (which is not a 'wash,' but a small land-slide), and stopping there. The wall never existed along the top at this point.

The parallel walls starting out from the two mounds near the north-eastern corner, represented in 'Supplementary plan A,' Squier and Davis's figure, are entirely obliterated except at the fence crossings, where slight traces of them are visible. The included mound at the east end is yet distinctly visible. Mr. Ridge informed us that he has discovered, at a depth of about eighteen inches, a pavement of stone reaching from wall to wall, and from the mounds eastward over a hundred yards. We had an opportunity of inspecting this at only one point, and know nothing further in regard to it than his statement, which I believe to be trustworthy.

Some of the problems presented by this work are very difficult to solve, though others can be, in a measure at least, satisfactorily determined without resort to mere speculation.

That it was built and intended as a work of defence is so apparent, that it is scarcely possible there should be conflicting opinions on this point. The situation chosen, and the character of the work, seem sufficient to place this conclusion beyond doubt. Yet there are few, if any, satisfactory indications, aside from the character and extent of the work, that any portion of the enclosed area was occupied for any considerable length of time as a village site. That a work of such magnitude and extent could have been hastily cast up for temporary protection by a savage, or even by a semi-civilized people, is incredible. Moreover, there are reasons for believing that the whole fort was not built at one period of time, but was progressive. The southern part was apparently built first, the northern section being a subsequent addition, made possibly because of increase in the population, most likely by the incoming of parties or clans seeking protection.

On the other hand, the evidences of long-continued occupation, such as are seen in and about other works, — as, for example, the Etowah and Messier groups in Georgia, the Cahokia group in Illinois, and several of the works in south-eastern Missouri, — are wanting. This is also singularly true of several other noted works of Ohio. The refuse and *débris* of a populous village, occupying for a long time a comparatively limited area, could not, as is proven by the instances referred to, be entirely dissipated by sixty years of cultivation, even though carried on continuously. The areas forming the sites of some of the mound-builders' villages of south-eastern Missouri, are yet, after half a century of constant cultivation, a foot or more above the surrounding level.

What is the explanation of this singular fact? I can think of but one which seems at all satisfactory, and that is, that these works were built by a populous tribe, which was being pressed step by step before a victorious foe.

The defensive works of Ohio present to me no evidences of great antiquity: indeed, the indications are in the opposite direction; and, in my opinion, we are not warranted in assigning to them an age antedating the latest possible period which we are justified in fixing upon as that at which the Indians first entered this territory.

I give herewith a figure, from a sketch by Mr. Holmes, showing that part of the wall which crosses the field near the two mounds at the north-eastern corner, including the part where the turnpike cuts through, marked *d* by Squier and Davis.

There is evidently a very great mistake in Dr. Locke's estimate as to the amount of earth in the embankment. If we take the length of the wall at four and one-half miles, the average height at ten feet, and the average base at thirty-five feet, the volume is about 154,000 cubic yards, or less than one-fourth the amount given by Dr. Locke, his estimate being 628,800 cubic yards. If there is any error in my figures, it is such as will overrun the true amount, rather than fall below it. Cyrus Thomas.

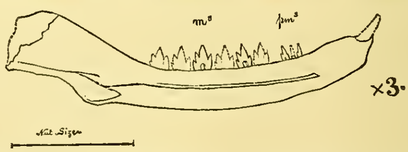
Milk-sickness.

In the milk-sickness district, referred to in my letter in *Science* of Nov. 26, the belief prevails, and assertions are made, that the disease disappears so soon as the land is cleared and cultivated, and some cite instances where denuding the land of its forest-growth has caused the disease to cease: so it may be set down as a fact, with considera le credibility, that, as a general rule, clearing and cultivating the land removes the cause of the disease, and any thing to the contrary will be an exception to the rule. I can refer definitely to only one of these exceptions, yet I have heard of a few others. Dr. W. S. Sims of this place tells of a farmer in Hamburg township, Jackson county, N.C., who has a half-acre lot enclosed with his dwelling. In this enclosure are fruit-trees and some of the native grasses, and the place has been under cultivation for twenty years or more, and yet whenever cattle are turned upon that lot during grazing season they are sure to die with the disease in a few days. From what I learned in Macon county, N.C., if they were not practising on my credulity, I am satisfied that that section will afford isolated exceptions to the general rule. In the lot above referred to, there is no water obtainable except from a large creek of swift-running water, that bounds one side of the lot. In that immediate vicinity there is no milk-sickness outside the enclosed half-acre. J. W. Walker.

Pine Mountain, Ga., Dec. 2.

A new mammal from the American triassic.

In 1857, Professor Emmons (American geology, part vi. p. 93) described the left lower jaw of a small mammal from the Chatham coal-field in North Carolina, naming it Dromatherium sylvestre. His description was based upon one nearly perfect jaw and two fractured specimens. The first, or type specimen, is now in the geological museum of Williams college, and one of the others is in the collection of the Philadelphia academy. Through the kindness of Prof. Samuel F. Clarke, I have recently had an opportunity of comparing these rare specimens, and find that the Philadelphia fossil belongs to a genus quite distinct from Dromatherium, and unlike any thing hitherto described by Professors Owen or Marsh. The jaw is two-thirds as long as that of Dromatherium, and much more slender. The symphysial and angular portions are broken away. A faint impression upon the matrix seems to indicate that



the coronoid process was low. The lower border has a downward process like that in Peramus. It is uncertain whether the inner or outer aspect is uppermost. The teeth are represented by two molars, probably the second and fourth, and two so-called premolars. The series as a whole occupy a greater linear space than those of Dromatherium. The premolars are simple, erect cusps, with a posterior basal cusp. The molars give the principal character to the jaw. Each has a central cone supporting two smaller cones on its anterior and posterior slopes. Hence, together with the slender character of the jaw, the fossil may be called Microconodon tenuirostris. In the drawing the dotted lines indicate the probable shape and position of the four missing molars. Henry F. Osborn.

Princeton, N.J., Dec. 1.

SCIENCE.—SUPPLEMENT.

FRIDAY, DECEMBER 10, 1886.

SCIENTIFIC MEN AND THEIR DUTIES.

THE honor of the presidency of such a society as this — carrying with it, as it does, the duty of giving at the close of the term of office an address on some subject of general interest — has been aptly compared to the little book mentioned in the Revelations of St. John, — the little book which was 'sweet in the mouth but bitter in the belly.' I can only thank you for the honor, and ask your indulgence as to the somewhat discursive remarks which I am about to inflict upon you.

There is a Spanish proverb to the effect that no man can at the same time ring the bell and walk in the procession. For a few moments to-night I am to ring the bell, and being thus out of the procession I can glance for a moment at that part of it which is nearest. At first sight it does not appear to be a very homogeneous or well-ordered parade, for the individual members seem to be scattering in every direction, and even sometimes to be pulling in opposite ways; yet there is, after all, a definite movement of the whole mass in the direction of what we call progress. It is not this general movement that I shall speak of, but rather of the tendencies of individuals or of certain classes; some of the molecular movements, so to speak, which are not only curious and interesting of themselves, but which have an important bearing upon the mass, and some comprehension of which is necessary to a right understanding of the present condition and future prospects of science in this country.

The part of the procession of which I speak is made up of that body or class of men who are known to the public generally as 'scientists,' 'scientific men,' or 'men of science.' As commonly used, all these terms have much the same significance; but there are, nevertheless, shades of distinction between them, and in fact we need several other terms for purposes of classification of the rather heterogeneous mass to which they are applied. The word 'scientist' is a coinage of the newspaper reporter, and, as ordinarily used, is very comprehensive. Webster defines a scientist as being 'one learned in science, a savant,' — that is, a wise man, — and the word is often used in this sense. But the suggestion which the word conveys to my mind is rather that of one whom the public suppose to be a wise man, whether he is so or not, of one who claims to be scientific. I shall therefore use the term 'scientist' in the broadest sense, as including scientific men, whether they claim to be such or not, and those who claim to be scientific men whether they are so or not.

By a scientific man I mean a man who uses scientific method in the work to which he specially devotes himself; who possesses scientific knowledge, not in all departments, but in certain special fields. By scientific knowledge we mean knowledge which is definite and which can be accurately expressed. It is true that this can rarely be done completely, so that each proposition shall precisely indicate its own conditions, but this is the ideal at which we aim. There is no man now living who can properly be termed a complete savant, or scientist, in Webster's sense of the word. There are a few men who are not only thoroughly scientific in their own special departments, but are also men possessed of much knowledge upon other subjects, and who habitually think scientifically upon most matters to which they give consideration; but these men are the first to admit the incompleteness and superficiality of the knowledge of many subjects which they possess, and to embrace the opportunity which such a society as this affords of meeting with students of other branches and of making that specially advantageous exchange in which each gives and receives, yet retains all that he had at first.

Almost all men suppose that they think scientifically upon all subjects; but, as a matter of fact, the number of persons who are so free from personal equation due to heredity, to early associations, to emotions of various kinds, or to temporary disorder of the digestive or nervous machinery, that their mental vision is at all times achromatic and not astigmatic, is very small indeed.

Every educated, healthy man possesses some scientific knowledge, and it is not possible to fix any single test or characteristic which will distinguish the scientific from the unscientific man. There are scientific tailors, bankers, and politicians, as well as physicists, chemists, and biologists. Kant's rule, that in each special branch of knowledge the amount of science, properly so called, is equal to the amount of mathematics it contains, corresponds to the definition of pure science as including mathematics and logic, and nothing

President's address before the Philosophical society of Washington, D.C., Dec. 4, 1886, by John S. Billings.

else. It also corresponds to the distinction which most persons, consciously or unconsciously, make between the so-called physical, and the natural or biological sciences. Most of us, I presume, have for the higher mathematics, and for the astronomers and physicists who use them, that profound respect which pertains to comparative ignorance, and to a belief that capacity for the higher branches of abstract analysis is a much rarer mental quality than are those required for the average work of the naturalist. I do not, however, propose to discuss the hierarchy of the sciences; and the term 'science' is now so generally used in the sense of knowledge, more or less accurate, of any subject, more especially in the relations of causes and effects, that we must use the word in this sense, and leave to the future the task of devising terms which will distinguish the sciences, properly so called, from those branches of study and occupation of which the most that can be said is that they have a scientific side. It is a sad thing that words should thus become polarized and spoiled, but there seems to be no way of preventing it.

In a general way we may say that a scientific man exercises the intellectual more than the emotional faculties, and is governed by his reason rather than by his feelings. He should be a man of both general and special culture, who has a little accurate information on many subjects and much accurate information on some one or two subjects, and who, moreover, is aware of his own ignorance and is not ashamed to confess it.

We must admit that many persons who are known as scientists do not correspond to this definition. Have you never heard, and perhaps assented to, some such statements as these: "Smith is a scientist, but he doesn't seem to have good common sense," or "he is a scientific crank"?

The unscientific mind has been defined as one which "is willing to accept and make statements of which it has no clear conceptions to begin with, and of whose truth it is not assured. It is the state of mind where opinions are given and accepted without ever being subjected to rigid tests." Accepting this definition, and also the implied definition of a scientific mind as being the reverse of this, let us for a moment depart from the beaten track which presidential addresses usually follow, and, instead of proceeding at once to eulogize the scientific mind and to recapitulate the wonderful results it has produced, let us consider the unscientific mind a little, not in a spirit of lofty condescension and ill-disguised contempt, but sympathetically, and from the best side that we can find. As this is the kind of mind which most of us share with our neighbors, to a greater or less degree, it may be as well not to take too gloomy a view of it. In the first place, the men with unscientific minds form the immense majority of the human race.

Our associations, habits, customs, laws, occupations, and pleasures are, in the main, suited to these unscientific minds, whose enjoyment of social intercourse, of the every-day occurrences of life, of fiction, of art, poetry, and the drama, is perhaps none the less because they give and accept opinions without subjecting them to rigid tests. It is because there are a goodly number of men who do this that the sermons of clergymen, the advice of lawyers, and the prescriptions of physicians have a market value. This unscientific public has its uses. We can at least claim that we furnish the materials for the truly scientific mind to work with and upon; it is out of this undifferentiated mass that the scientific mind supposes itself to be developed by specialization, and from it that it obtains the means of its own existence. The man with the unscientific mind, who amuses himself with business enterprises, and who does not care in the least about ohms or pangenesis, may, nevertheless, be a man who does as much good in the world, is as valuable a citizen, and as pleasant a companion, as some of the men of scientific minds with whom we are acquainted.

And in this connection I venture to express my sympathy for two classes of men who have in all ages been generally condemned and scorned by others, namely, rich men and those who want to be rich.

I do not know that they need the sympathy, for our wealthy citizens appear to support with much equanimity the disapprobation with which they are visited by lecturers and writers, — a condemnation which seems in all ages to have been bestowed on those who have by those who have not.

So far as those who actually are rich are concerned, we may, I suppose, admit that a few of them — those who furnish the money to endow universities and professorships, to build laboratories, or to furnish in other ways the means of support to scientific men — are not wholly bad. Then, also, it is not always a man's own fault that he is rich; even a scientist may accidentally and against his will become rich.

As to those who are not rich, but who wish to be rich, whose chief desire and object is to make money, either to avoid the necessity for further labor, or to secure their wives and children from want, or for the sake of power and desire to rule, I presume it is unsafe to try to offer any apologies for their existence. But when it is claimed for any class of men, scientists or others, that they do not want these things, it is well to remember the remarks made by old Sandy Mackay after he had heard a sermon on universal brotherhood: "And so the deevil's dead. Puir auld Nickie; and him so little appreciated, too. Every gowk laying his sins on auld Nick's back. But I'd no bury him until he began to smell a wee strong like. It's a grewsome thing is premature interment."

I have tried to indicate briefly the sense in which the terms 'scientist' and 'scientific man' are to be used and understood, and you see it is not an easy matter. The difficulty is less as regards the term 'man of science.' By this expression we mean a man who belongs to science peculiarly and especially, whose chief object in life is scientific investigation, whose thoughts and hopes and desires are mainly concentrated upon his search for new knowledge, whose thirst for fresh and accurate information is constant and insatiable. These are the men who have most advanced science, and whom we delight to honor, more especially in these later days, by glowing eulogiums of their zeal, energy, and disinterestedness.

The man of science, as defined by his eulogists, is the *beau idéal* of a philosopher, a man whose life is dedicated to the advancement of knowledge for its own sake, and not for the sake of money or fame, or of professional position or advancement. He undertakes scientific investigations exclusively or mainly because he loves the work itself, and not with any reference to the probable utility of the results. Such men delight in mental effort, or in the observation of natural phenomena, or in experimental work, or in historical research, in giving play to their imagination, in framing hypotheses and then in endeavoring to verify or disprove them, but always the main incentive is their own personal satisfaction (with which may be mingled some desire for personal fame), and not the pleasure or the good of others. Carried to an extreme, the eulogy of such men and their work is expressed in the toast of the Mathematical society of England: "Pure mathematics; may it never be of use to any man!" Now, it is one thing to seek one's own pleasure, and quite another thing to pride one's self upon doing so. The men who do their scientific work for the love of it do some of the best work, and, as a rule, do not pride themselves on it, or feel or express contempt for those who seek their pleasure and amusement in other directions. It is only from a certain class of eulogists of pure science, so called, that we get such specimens of scientific 'dudeism' as the toast just quoted, opposed to which may be cited the Arab saying that "a wise man without works is like a cloud without water."

There are other men who devote themselves to scientific work, but who prefer to seek information that may be useful; who try to advance our knowledge of nature's laws in order that man may know how to adapt himself and his surroundings to those laws, and thus be healthier and happier. They make investigations, like the men of pure science, — investigations in which they may or may not take pleasure, but which they make, even if tedious and disagreeable, for the sake of solving some problem of practical importance. These are the men who receive from the public the most honor, for it is seen that their work benefits others. After all, this is not peculiar to the votaries of science. In all countries and all times, and among all sorts and conditions of men, it has always been agreed that the best life, that which most deserves praise, is that which is devoted to the helping of others, which is unselfish, not stained by envy or jealousy, and which has as its main pleasure and spring of action the desire of making other lives more pleasant, of bringing light into the dark places, of helping humanity.

But, on the other hand, the man who makes a profession of doing this, and who makes a living by so doing, the professional philanthropist, whether he be scientist or emotionalist, is by no means to be judged by his own assertions. Some wise German long ago remarked that '*esel singen schlecht, weil sie zu hoch anstimmen*,' — that is, 'asses sing badly because they pitch their voices too high,' — and it is a criticism which it is well to bear in mind.

In one of the sermons of Kin O[1] the preacher tells the story of a powerful clam who laughed at the fears of other fish, saying that when he shut himself up he felt no anxiety; but on trying this method on one occasion when he again opened his shell he found himself in a fishmonger's shop. And to rely on one's own talents, on the services one may have rendered, on cleverness, judgment, strength, or official position, and to feel secure in these, is to court the fate of the clam.

There are not very many men of science, and there are no satisfactory means of increasing the number; it is just as useless to exhort men to love science, or to sneer at them because they do not, as it is to advise them to be six feet three inches high, or to condemn a man because his hair is not red.

While the ideal man of science must have a "clear, cold, keen intellect, as inevitable and as merciless in its conclusions as a logic engine," it would seem that, in the opinion of some, his greatness and superiority consist not so much in

[1] *Cornhill magazine*, August, 1869, p. 196.

the amount of knowledge he possesses, or in what he does with it, as in the intensity and purity of his desire for knowledge.

This so-called thirst for knowledge must be closely analogous to an instinctive desire for exercise of an organ or faculty, such as that which leads a rat to gnaw or a man of fine physique to delight in exercise. Such instincts should not be neglected. If the rat does not gnaw, his teeth will become inconvenient or injurious to himself, but it is not clear that he deserves any special eulogium merely because he gnaws.

It will be observed that the definition of a scientific man or man of science, says nothing about his manners or morals. We may infer that a man devoted to science would have neither time nor inclination for dissipation or vice ; that he would be virtuous either because of being passionless or because of his clear foresight of the consequences of yielding to temptation.

My own experience, however, would indicate that either this inference is not correct or that some supposed scientific men have been wrongly classified as such. How far the possession of a scientific mind and of scientific knowledge compensates, or atones for, ill-breeding or immorality, for surliness, vanity, and petty jealousy, for neglect of wife or children, for uncleanliness, physical and mental, is a question which can only be answered in each individual case ; but the mere fact that a man desires knowledge for its own sake appears to me to have little to do with such questions. I would prefer to know whether the man's knowledge and work are of any use to his fellowmen, whether he is the cause of some happiness in others which would not exist without him. And it may be noted that while utility is of small account in the eyes of some eulogists of the man of science, they almost invariably base their claims for his honor and support upon his usefulness.

The precise limit beyond which a scientist should not make money has not yet been precisely determined, but in this vicinity there are some reasons for thinking that the maximum limit is about $5,000 per annum. If there are any members of the Philosophical society of Washington who are making more than this, or who, as the result of careful and scientific introspection, discover in themselves the dawning of a desire to make more than this, they may console themselves with the reflection that the precise ethics and etiquette which should govern their action under such painful circumstances have not yet been formulated. The more they demonstrate their indifference to mere pecuniary considerations, the more creditable it is to them ; so much all are agreed upon ; but this is nothing new, nor is it specially applicable to scientists. Yet while each may and must settle such questions as regards himself for himself, let him be very cautious and chary about trying to settle them for other people. Denunciations of other men engaged in scientific pursuits on the ground that their motives are not the proper ones, are often based on insufficient or inaccurate knowledge, and seldom, I think, do good.

This is a country and an age of hurry, and there seems to be a desire to rush scientific work as well as other things. One might suppose, from some of the literature on the subject, that the great object is to make discoveries as fast as possible : to get all the mathematical problems worked out ; all the chemical combinations made : all the insects and plants properly labelled ; all the bones and muscles of every animal figured and described. From the point of view of the man of science there does not seem to be occasion for such haste. Suppose that every living thing were known, figured, and described. Would the naturalist be any happier? Those who wish to make use of the results of scientific investigation of course desire to hasten the work, and when they furnish the means we cannot object to their urgency ; moreover, there is certainly no occasion to fear that our stock of that peculiar form of bliss known as ignorance will be soon materially diminished.

From my individual point of view, one of the prominent features in the scientific procession is that part of it which is connected with government work. Our society brings together a large number of scientific men connected with the various departments ; some of them original investigators ; most of them men whose chief, though not only, pleasure is study. A few of them have important administrative duties, and are brought into close relations with the heads of departments and with congress. Upon men in such positions a double demand is made, and they are subject to criticism from two very different stand-points. On the one hand are the scientists, calling for investigations which shall increase knowledge without special reference to utility, and sometimes asking that employment be given to a particular scientist on the ground that the work to which he wishes to devote himself is of no known use, and therefore will not support him. On the other hand is the demand from the business men's point of view, — that they shall show practical results ; that in demands for appropriations from the public funds they shall demonstrate that the use to be made of such appropriations is for the public good, and that their accounts shall show that the money has been properly expended, — 'properly' not merely in the sense of usefully, but also in the legal sense, — in the sense which was meant by congress in granting the funds. Nay, more, they must consider not only the intentions of congress, but the opinions of the accounting officers of the treasury, the comptroller and auditor, and their clerks, and not rely solely on their own interpretation of the statutes, if they would work to the best advantage, and not have life made a perpetual burden and vexation of spirit.

There is a tendency on the part of business men and lawyers to the belief that scientific men are not good organizers or administrators, and should be kept in leading-strings ; that it is unwise to trust them with the expenditure of, or the accounting for. money : and that the precise direction in which they are to investigate should be pointed out to them ; in other words, that they should be made problem-solving machines as far as possible.

When we reflect on the number of persons who, like Mark Twain's cat, feel that they are 'nearly lightning on superintending,' on the desire for power and authority, which is almost universal, the tendency to this opinion is not to be wondered at. Moreover, as regards the man of science, there is some reason for it in the very terms by which he is defined, the characteristics for which he is chiefly eulogized.

The typical man of science is, in fact, in many cases an abnormity, just as a great poet, a great painter, or a great musician is apt to be, and this not only in an unusual development of one part of the brain, but in an inferior development in others. True, there are exceptions to this rule, — great and illustrious exceptions ; but I think we must admit that the man of science often lacks tact, and is indifferent to and careless about matters which do not concern his special work, and especially about matters of accounts and pecuniary details. If such a man is at the head of a bureau, whose work requires many subordinates and the disbursement of large sums of money, he may consider the business management of his office as a nuisance, and delegate as much of it as possible to some subordinate official, who, after a time, becomes the real head and director of the bureau. Evil results have, however, been very rare, and the recognition of the possibility of their occurrence is by no means an admission that they are a necessity, and still less of the proposition that administrative officers should not be scientific men.

I feel very sure that there are always available scientific men, thoroughly well informed in their several departments, who are also thoroughly good business men, and are as well qualified for administrative work as any. When such men are really wanted, they can always be found, and, as a matter of fact, a goodly number of them have been found, and are now in the government service.

The head of a bureau has great responsibilities ; and while his position is, in many respects, a desirable one, it would not be eagerly sought for by most scientific men if its duties were fully understood.

In the first place, the bureau chief must give up a great part of his time to routine hack work. During his business, or office, hours he can do little else than this routine work, partly because of its amount, and partly because of the frequent interruptions to which he is subjected. His visitors are of all kinds, and come from all sorts of motives, — some to pass away half an hour, some to get information, some seeking office. It will not work well if he takes the ground that his time is too important to be wasted on casual callers, and refers them to some assistant.

In the second place, he must, to a great extent at least, give up the pleasure of personal investigation of questions that specially interest him, and turn them over to others. It rarely happens that he can carry out his own plans in his own way, and perhaps it is well that this should be the case. The general character of his work is usually determined for him either by his predecessors, or by congress, or by the general consensus of opinion of scientific men interested in the particular subject or subjects to which it relates. This last has very properly much weight ; in fact, it has much more weight than one might suppose, if he judged from some criticisms made upon the work of some of our bureaus whose work is more or less scientific. In these criticisms it is urged that the work has not been properly planned and correlated ; that it should not be left within the power of one man to say what should be done ; that the plans for work should be prepared by disinterested scientific men, as, for instance, by a committee of the national academy ; and that the function of the bureau official should be executive only.

I have seen a good deal of this kind of literature within the last ten or twelve years, and some of the authors of it are very distinguished men in scientific work ; yet I venture to question the wisdom of such suggestions. As a rule, the plans for any extended scientific work to be undertaken by a government department are the result of very extended consultations with specialists, and meet with the approval of a majority of them. Were it otherwise, the difficulties in obtaining regular annual appropriations for such work would be great and cumulative, for in a short time the disapproval of the majority of the scientific public would make itself felt in congress. It is true that the *vis inertiae* of an established bureau is very great. The heads of departments change with each new administration, but the heads of bureaus remain; and if an unfit man succeeds in obtaining one of these positions, it is a matter of great difficulty to displace him; but it seems to me to be wiser to direct the main effort to getting right men in right places rather than to attempt to elaborate a system which shall give good results with inferior men as the executive agents, which attempt is a waste of energy.

You are all familiar with the results of the inquiry which has been made by a congressional committee into the organization and work of certain bureaus which are especially connected with scientific interests, and with the different opinions which this inquiry has brought out from scientific men. I think that the conclusion of the majority of the committee — that the work is, on the whole, being well done, and that the people are getting the worth of their money — is generally assented to. True, some mistakes have been made, some force has been wasted, some officials have not given satisfaction; but is it probable that any other system would give so much better results that it is wise to run the risks of change?

This question brings us to the only definite proposition which has been made in this direction, namely, the proposed department of science, to which all the bureaus whose work is mainly scientific, such as the coast survey, the geological survey, the signal service, the naval observatory, etc., shall be transferred.

The arguments in favor of this are familiar to you, and, as regards one or two of the bureaus, it is probable that the proposed change would effect an improvement; but as to the desirability of centralization and consolidation of scientific interests and scientific work into one department under a single head, I confess that I have serious doubts.

One of the strongest arguments in favor of such consolidation that I have seen is the address of the late president of the Chemical society of Washington, Professor Clarke, 'On the relations of the government to chemistry,' delivered about a year ago. Professor Clarke advises the creation of a large, completely equipped laboratory, planned by chemists and managed by chemists, in which all the chemical researches required by any department of the government shall be made, and the abandonment of individual laboratories in the several bureaus on the ground that these last are small, imperfectly equipped, and not properly specialized; that each chemist in them has too broad a range of duty and receives too small a salary to command the best professional ability. He would have a national laboratory, in which one specialist shall deal only with metals, another with food-products, a third with drugs, etc., while over the whole, directing and correlating their work, shall preside the ideal chemist, the all-round man, recognized as the leader of the chemists of the United States. And so should the country get better and cheaper results. It is an enticing plan, and one which might be extended to many other fields of work. Granting the premises that we shall have the best possible equipment, with the best possible man at the head of it, and a sufficient corps of trained specialists, each of whom will contentedly do his own work as directed and be satisfied, so that there shall be no jealousies, or strikes, or boycotting, and we have made a long stride toward Utopia. But before we centralize in this way we must settle the question of classification. Just as in arranging a large library there are many books which belong in several different sections, so it is in applied science. Is it certain that the examination of food-products or of drugs should be made under the direction of the national chemist rather than under that of the departments which are most interested in the composition and quality of these articles? This does not seem to me to be a self-evident proposition by any means. The opinion of a scientific man as to whether the government should or should not undertake to carry out any particular branch of scientific research and publish the results, whether it should attempt to do such work through officers of the army and navy, or more or less exclusively through persons specially employed for the purpose, whether the scientific work shall be done under the direction of those who wish to use, and care only for, the practical results, or whether the scientific man shall himself be the administrative head and direct the manner in which his results shall be applied, — the opinion of a scientific man on such points, I say, will differ according to the part he expects or desires to take in the work, according to the nature of the work, according to whether he is an army or navy officer or not, according to whether he takes more pleasure in scientific investigations than in administrative problems, and so forth.

It is necessary, therefore, to apply a correction for personal equation to each individual set of opinions before its true weight and value can be estimated, and, unfortunately, no general formula for this purpose has yet been worked out.

I can only indicate my own opinions, which are those of an army officer, who has all he wants to do, who does not covet any of his neighbors' work or goods, and who does not care to have any more masters than those whom he is at present trying to serve. You see that I give you some of the data for the formula by which you are to correct my statements, but this is all I can do.

I am not inclined at present to urge the creation of a department of science as an independent department of the government having at its head a cabinet officer. Whether such an organization may become expedient in the future seems to me doubtful; but at all events I think the time has not yet come for it.

I do not believe that government should undertake scientific work merely or mainly because it is scientific, or because some useful results may possibly be obtained from it. It should do, or cause to be done, such scientific work as is needful for its own information and guidance when such work cannot be done, or cannot be done so cheaply or conveniently by private enterprise. Some kinds of work it can best have done by private contract, and not by officials; others, by its own officers. To this last class belong those branches of scientific investigation, or the means for promoting them, which require long-continued labor and expenditure on a uniform plan; such as the work of the government observatory, of the government surveys, of the collection of the statistics which are so much needed for legislative guidance, and in which we are at present so deficient, the formation of museums and libraries, and so forth.

Considering the plans and operations of these government institutions from the point of view of the scientific public, it is highly desirable that they should contribute to the advancement of abstract science, as well as to the special practical ends for which they have been instituted; but from the point of view of the legislator, who has the responsibility of granting the funds for their support, the practical results should receive the chief consideration, and therefore they should be the chief consideration on the part of those who are to administer these trusts. It must be borne in mind that while the average legislator is, in many cases, not qualified to judge *a priori* as to what practical results may be expected from a given plan for scientific work, he is, nevertheless, the court which is to decide the question according to the best evidence which he can get, or, rather, which is brought before him, and it is no unimportant part of the duty of those who are experts in these matters to furnish such evidence.

But in saying that practical results should be the chief consideration of the government and of its legislative and administrative agents it is not meant that these should [be the only considerations. In the carrying out of any extensive piece of work which involves the collection of data, experimental inquiry, or the application of scientific results under new conditions, there is more or less opportunity to increase knowledge at the same time and with comparatively little increased cost. Such opportunity should be taken advantage of, and is also a proper subsidiary reason for adopting one plan of work in preference to another, or for selecting for appointment persons qualified not only to do the particular work which is the main object, but also for other allied work of a more purely scientific character.

On the same principle it seems to me proper and expedient that when permanent government employees have at times not enough to do in their own departments, and can be usefully employed in scientific work, it is quite legitimate and proper to thus make use of them. For example, it is desirable that this country should have such an organization of its army and navy as will permit of rapid expansion when the necessity arises, and this requires that more officers shall be educated and kept in the service than are needed for military and naval duty in time of peace. It has been the policy of the government to employ some of these officers in work connected with other departments, and especially in work which requires such special training, scientific or administrative, or both, as such officers possess. To this objections are raised, which may be summed up as follows: —

First, that [such officers ought not to be given positions which would otherwise be filled by civilian scientists, because these places are more needed by the civilians as a means of earning subsistence, and because it tends to increase the competition for places and to lower salaries. But in other words, the argument is that it is injurious to the interests of scientific men, taken as a body, that the government should employ in investigations or work requiring special knowledge and skill men who have been educated and trained at its expense, and who are permanently employed and paid by it. This is analogous to the trades union and the anti-convict labor platforms.

The second objection is that army and navy officers do not, as a rule, possess the scientific and technical knowledge to properly perform duties lying outside of the sphere of the work for which they have been educated, and that they employ as subordinates really skilled scientific men, who make the plans and do most of the work, but do not receive proper credit for it. The reply to this is that it is a question of fact in each particular case, and that if the officer is able to select and employ good men to prepare the plans and to do the work, this in itself is a very good reason for giving him the duty of such selection and employment.

A third objection is that when an officer of the army or navy is detailed for scientific or other special work, the interests of this work and of the public are too often made subordinate to the interests of the naval or military service, more especially in the matter of change of station. For example, civil engineers object to the policy of placing river and harbor improvements in the hands of army engineers, because one of the objects kept in view by the war department in making details for this purpose is to vary the duty of the individual officer from time to time so as to give him a wider experience. Hence it may happen that an officer placed on duty in connection with the improvement of certain harbors on the Great Lakes shall, after three or four years, and just as he has gained sufficient experience of the peculiarities of lake work to make his supervision there peculiarly valuable, be transferred to work on the improvement of the Lower Mississippi, with which he may be quite unfamiliar.

In like manner Professor Clarke objects to having a laboratory connected with the medical department of the navy on the ground that the officer in charge is changed every three years; consequently science suffers in order that naval routine may be preserved.

There is force in this class of objections, but the moral I should draw from them is, not that army and navy officers should not be allowed to do work outside their own departments or in science, but that when they are put upon such duty, the ordinary routine of change of station every three or four years should not be enforced upon them without careful consideration of the circumstances of the case, and satisfactory evidence that the work on which they are engaged will not suffer by the change. And, as a matter of fact, I believe this has been the policy pursued, and instances could be given where an officer has been kept twenty years at one station for this very reason.

I pass over a number of objections that I have heard made to the employment of army and navy officers as administrators, on the ground that they are too 'bumptious,' or 'domineering,' or 'supercilious,' or 'finicky,' because every one knows what these mean and their force. An army officer is not necessarily a polished gentleman; neither is a civilian; and a good organizer and administrator, whether officer or civilian, will at times, and especially to some people, appear arbitrary and dictatorial.

There is another objection to special details of army or navy officers for scientific duties which comes not so much from outside persons as from the war department and the officers themselves, and it is this: among such officers there are always a certain number who not only prefer special details to routine duty, but who actively seek for such details, who are perpetual candidates for them.

The proportion of men whose ideas as to their own scientific acquirements, merits, and claims to attention, are excessive as compared with the ideas of their acquaintances on the same points, is not greater in the army than elsewhere; but when an army officer is afflicted in this way, the attack is sometimes very severe, and the so-called influence which he brings to bear may cause a good deal of annoyance to the department, even if it be not sufficient to obtain his ends. I have heard officers of high rank, in a fit of impatience under such circumstances, express a most hearty and emphatic wish that no special details were possible, so that lobbying for them should be useless. This, however, seems to me to be too heroic a remedy for the disease, which, after all, only produces comparatively trifling irritation and discomfort.

The same evil exists, to a much greater extent, in the civil branches of the government. Few persons can fully appreciate the loss of time, the worry, and the annoyance to which the responsible heads of some of our bureaus for scientific work are subjected through the desire of people for official position and for maintenance by the government. They have to stand always at the bat and protect their wickets from the balls which are bowled at them in every direction, even from behind by some of their own subordinates.

It is true that a great majority of the balls go wide and cause little trouble, and a majority of the bowlers soon get tired and leave the field; but there are generally a few persistent ones who gradually acquire no small degree of skill in discovering the weak or unguarded points, and succeed in making things lively for a time. Considered from the point of view of the public interests, such men are useful, for although they cause some loss of valuable time, and occasionally do a little damage by promoting hostile legislation, yet their criticisms are often worth taking into account; they tend to prevent the machine from getting into a rut, and they promote activity and attention to business on the part of administrative chiefs. It is a saying among dog-fanciers that a few fleas on a dog are good for him rather than otherwise, as they compel him to take some exercise under any circumstances.

At all events, I think it very doubtful whether the jealousies and desire for position for one's self or one's friends which exist under present circumstances would be materially diminished under any other form of organization, even under a department of science.

Some conflict of interests now exists, it is true; some work is duplicated; but neither the conflict nor the duplication are necessarily wholly evil in themselves, nor in so far as they are evil are they necessary parts of the present system. This system is of the nature of a growth; it is organic, and not a mere pudding-stone aggregation of heterogeneous materials, and the wise course is to correct improper bendings and twistings gradually, prune judiciously, and go slow in trying to secure radical changes lest death or permanent deformity result.

It will be seen that in what I have said I have not attempted to eulogize science or scientists in the abstract. I should be very sorry, however, to have given any one the impression that I think they should not be eulogized. Having read a number of eloquent tributes to their importance by way of inducing a proper frame of mind in which to prepare this address, it is possible that I overdid it a little, and was in a sort of reaction stage when I began to write. But the more I have thought on the subject, and the more carefully I have sought to analyze the motives and character of those of my acquaintances who are either engaged in scientific work or who wish to be considered as so doing, and to compare them with those who have no pretensions to science, and who make none, the more I have been convinced that upon the whole the eulogium is the proper thing to give, and that it is not wise to be critical as to the true inwardness of all that we see or hear.

At least nine-tenths of the praises which have been heaped upon scientific men as a body are thoroughly well deserved. Among them are to be found a very large proportion of true gentlemen, larger, I think, than is to be found in any other class of men, — men characterized by modesty, unselfishness, scrupulous honesty, and truthfulness, and by the full performance of their family and social duties.

Even their foibles may be likable. A little vanity or thirst for publicity, zeal in claiming priority of discovery, or undue wrath over the other scientist's theory, does not and should not detract from the esteem in which we hold them. A very good way of viewing characteristics which we do not like is to bear in mind that different parts of the brain have different functions; that all of them cannot act at once, and that their tendencies are sometimes contradictory.

There are times when a scientific man does not think scientifically, when he does not want to so think, and possibly when it is best that he should not so think. There is wisdom in Sam. Lawson's remark that "folks that are always telling you what they don't believe are sort o' stringy and dry. There ain't no 'sorption got out o' not believing nothing." At one time the emotional, at another the intellectual, side of the scientific man has the ascendency, and one must appeal from one state to the other. Were scientific thinking rigorously carried out to practical results in everyday life, there would be some very remarkable social changes, and perhaps some very disagreeable ones.

That scientific pursuits give great pleasure without reference to their utility, or to the fame or profit to be derived from them, that they tend to make a man good company to himself and to bring him into pleasant associations, is certain; and that a man's own pleasure and happiness are things to be sought for in his work and companionship is also certain. If in this address I have ventured to hint that this may not be the only, nor even the most important, object in life, — that one may be a scientific man, or even a man of science, and yet not be worthy of special reverence because he may be at the same time an intensely selfish man, and even a vicious man, — I hope that it is clearly understood that it is with no intention of depreciating the glory of science, or the honor which is due to the large number of scientific gentlemen whom I see around me. A scientific gentleman! All praise to him who merits this title: it is the blue ribbon of our day.

We live in a fortunate time and place, — in the early manhood of a mighty nation, and in its capital city, which every year makes more beautiful, and richer in the treasures of science, literature, and art, which all the keels of the sea and the iron roads of the land are bringing to it. Life implies death; growth presages decay; but we have good reasons for hoping that for our country and our people the evil days are yet far off. Yet we may not rest and eat lotus; we may not devote our lives to our own pleasure, even though it be pleasure derived from scientific investigation. No man lives for himself alone: the scientific man should do so, least of all. There never was a time when the world had more need of him, and there never was a time when more care was needful lest his torch should prove a firebrand and destroy more than it illuminates.

The old creeds are quivering; shifting; changing like the colored flames on the surface of the Bessemer crucible. They are being analyzed, and accounted for, and toned down, and explained, until many are doubting whether there is any solid substratum beneath: but the instinct which gave those creeds their influence is unchanged.

The religions and philosophies of the orient seem to have little in common with modern science. The sage of the east did not try to climb the ladder of knowledge step by step. He sought a wisdom which he supposed far superior to all knowledge of earthly phenomena obtainable through the senses. The man of science of the west seeks knowledge by gradual accumulation, striving by comparison and experiment to eliminate the errors of individual observations, and doubting the possibility of attaining wisdom in any other way. The knowledge which he has, or seeks, is knowledge which may be acquired partly by individual effort and partly by co-operation, which requires material resources for its development, the search for which may be organized and pursued through the help of others, which is analogous in some respects to property which may be used for power or pleasure. The theologian and the poet claim that there is a wisdom which is not acquired, but attained to, which cannot be communicated or received at pleasure, which comes in a way vaguely expressed by the words 'intuition,' or 'inspiration,' which acts through and upon the emotional rather than the intellectual faculties, and which, thus acting, is sometimes of irresistible power in exciting and directing the actions of individuals and of communities.

The answer of the modern biologist to the old Hebrew question, viz., "Why are children born with their hands clinched, while men die with their hands wide open?" would not in the least resemble that given by the rabbis; yet this last it is well that the scientist should also remember: "Because on entering the world men would grasp every thing, but on leaving it all slips away." There exist in men certain mental phenomena, the study of which is included in what is known as ethics, and which are usually assumed to depend upon what is called moral law. Whether there is such a law, and whether, if it exists, it can be logically deduced from observed facts in nature or is only known as a special revelation, are questions upon which scientific men in their present stage of development are not agreed. There is not yet any satisfactory scientific basis for what is recognized as sound ethics and morality throughout the civilized world: these rest upon another foundation.

This procession, bearing its lights of all kinds, smoky torches, clear-burning lamps, farthing rush-lights, and sputtering brimstone matches, passes through the few centuries of which we have a record, illuminating an area which varies, but which has been growing steadily larger. The individual members of the procession come from, and pass into, shadow and darkness, but the light of the stream remains. Yet it does not seem so much darkness, an infinite night, whence we come and whither we go, as a fog which at a little distance obscures or hides all things, but which, nevertheless, gives the impression that there is light beyond and above it. In this fog we are living and groping, stumbling down blind alleys, only to find that there is no thoroughfare, getting lost and circling about on our own tracks as on a *jumbie* prairie; but slowly and irregularly we do seem to be getting on, and to be establishing some points in the survey of the continent of our own ignorance.

In some directions the man of science claims to lead the way; in others, the artist, the poet, the devotee. Far-reaching as the speculations of the man of science may be, ranging from the constitution and nature of a universal protyle, through the building of a universe to its resolution again into primal matter or modes of motion, he can frame no hypothesis which shall explain consciousness, nor has he any data for a formula which shall tell what becomes of the individual when he disappears in the all-surrounding mist. Does he go on seeking and learning in other ways or other worlds? The great mass of mankind think that they have some information bearing on these questions: but, if so, it is a part of the wisdom of the orient, and not of the physical or natural science of the occident. Whether after death there shall come increase of knowledge, with increase of desires and of means of satisfying them, or whether there shall be freedom from all desire, and an end of coming and going, we do not know; nor is there any reason to suppose that it is a part of the plan of the universe that we should know. We do know that the great majority of men think that there are such things as right and duty, — God and a future life, — and that to each man there comes the opportunity of doing something which he and others recognize to be his duty. The scientific explanation of a part of the process by which this has been brought about, as by natural selection, heredity, education, progressive changes in this or that particular mass of brain matter, has not much bearing on the practical question of 'What to do about it?' But it does, nevertheless, indicate that it is not a characteristic to be denounced, or opposed, or neglected, since, even in the 'struggle-for-existence' theory, it has been, and still is, of immense importance in human social development.

"Four men," says the Talmud, "entered Paradise. One beheld and died. One beheld and lost his senses. One destroyed the young plants. One only entered in peace and came out in peace." Many are the mystic and cabalistic interpretations which have been given of this saying; and if for 'Paradise' we read the 'world of knowledge,' each of you can no doubt best interpret the parable for himself. Speaking to a body of scientific men, each of whom has, I hope, also certain unscientific beliefs, desires, hopes, and longings, I will only say, 'Be strong and of a good courage.' As scientific men, let us try to increase and diffuse knowledge; as men and citizens, let us try to be useful; and, in each capacity, let us do the work that comes to us honestly and thoroughly, and fear not the unknown future.

When we examine that wonderful series of wave-marks which we call the spectrum, we find, as we go downwards, that the vibrations become slower, the dark bands wider, until at last we reach a point where there seems to be no more movement; the blackness is continuous, the ray seems dead. Yet within this year Langley has found that a very long way lower down the pulsations again appear, and form, as it were, another spectrum; they never really ceased, but only changed in rhythm, requiring new apparatus or new senses to appreciate them. And it may well be that our human life is only the lower spectrum, and that beyond and above the broad black band which we call death there are other modes of impulses, — another spectrum which registers the ceaseless beats of waves from the great central fountain of force, the heart of the universe, in modes of existence of which we can but dimly dream.

CLARK'S PHILOSOPHY OF WEALTH.

'A remarkable book!' Such is my involuntary exclamation as I finish reading Professor Clark's book, 'The philosophy of wealth.' In reviewing it I suffer in several ways under an 'embarrassment of riches.' There are so many excellent features of the work that it is difficult to select one or two for treatment, and there are so many passages in my copy marked for quotation that they would occupy far more space than can be given to the entire review. It seems, under the circumstances, best to abandon any idea of an exhaustive treatment of this admirable book, and simply attempt to notice a few of its characteristics in the hope that many may be induced to confer a benefit on themselves by its perusal.

The philosophy of wealth. By J. B. Clark. Boston, *Ginn*, 1886. 12°.

'The philosophy of wealth' is a treatment of fundamental principles in economics, in which every page is luminous with clear analysis and profound thought. Yet the entire work is most practical, and should attract the attention of all interested in the problems of the day; for nothing is more needed at the present time than deeper knowledge. People lose themselves in a maze of stock-phrases, and continue to move in the same weary circle because they fail to grasp primary principles.

Professor Clark very properly lays emphasis on this point in his first chapter. He says, "If obscurity still hangs over principles, the clear apprehension of which is essential to all reasoning on the subject, the removal of it, besides having an incalculable value in itself, will afford a welcome supplement to directly practical work. It will shed light on the pressing social questions of the day. In the present state of the public mind, for example, financial heresies and strange teachings concerning the rights of property find a ready circulation; and if these false doctrines connect themselves, even remotely, with fundamental errors of political economy, then the assault upon the practical fallacies can never be quite successful until the underlying errors be exposed and corrected. Questions on the solution of which the general prosperity depends cannot be solved without the clear apprehension of correct principles."

The scope of the work may most readily be gathered from the titles of the chapters, which are the following: Wealth; Labor and its relation to wealth; The basis of economic law; The elements of social service; The theory of value; The law of demand and supply; The law of distribution; Wages as affected by combinations; The ethics of trade; The principles of co-operation; Non-competitive economics; The economic function of the church.

One of the best examples of clear analysis of economic phenomena is found in the discussion of utilities. There is first a distinction between absolute and effective utility, which explains satisfactorily the apparent contradiction, found in old treatises, between high value in use and low value in exchange. Water is said to be useful, for example, but to have no value. The logical ambiguity lies in this: when we say water is more useful than diamonds, we think of water in the abstract; when we say water has no value, we think of a definite concrete amount of water, a glassful for example. But that has also very little use. If my glass is upset, I do not grieve: I have no special attachment to that particular concrete water, and I get some more without difficulty.

This is explained more clearly by Professor Clark than by any other writer in English.

Utilities are further subdivided, and a different law of costliness is found to govern elementary utilities from that which obtains with respect to form and place utilities. The law of diminishing returns holds only for elementary utilities. This has an important bearing on Malthusianism, for a predominance is demonstrated of those utilities which tend to cheapness. At the same time the essence of Malthusianism is recognized and admirably stated in these words : It "maintains that a retarding of the rate of increase of population is an ultimate necessity, if humanity is to fully enjoy the earth and to perfect itself." This is a great improvement on any thing which can be found in previous writers, and ought to modify the teaching of political economy. Other points which must especially interest the professional economist are the theory of non-competing groups and the treatment of non-competitive economics, which show conclusively the existence of narrower limits to the range of competitive action than is ordinarily supposed.

The chapter on non-competitive economics is in some respects as important as any in the book. It demonstrates the fact that the field of non-competitive economics is increasing ; that it ought, in the interest of humanity, to be still further widened ; and that even now the highest forms of rational wealth are disbursed non-competitively.

The book abounds in valuable practical suggestions ; but the man of affairs will be chiefly interested in the chapters on combinations, the ethics of trade, and the economic functions of the church. The last-named subject is discussed more profoundly than in any other book which has come under my notice, and the root of the matter is touched in the protest against the appeal in the forms of church activity to the spirit of caste. The author does not hesitate to call things by their proper names, and throughout he reveals a vigor of treatment equal to the strength of moral purpose everywhere displayed.

More, perhaps, might have been said about the nature of economic laws, which is to most economists even a dark field : and possibly the terms 'induction' and 'deduction' should have been more clearly defined. A great deal of current discussion on economic method leaves the painful impression of sad ignorance in the fundamental principles of logic as understood at present.

I cannot either express unqualified approval of what is said in regard to railways. I do not believe, as the result of my studies, that experience has so far pronounced in favor of government control rather than ownership of means of communication and transportation ; and, if that alternative be accepted, Professor Clark fails to show the possibility of an exercise of control over such powerful economic factors. Experience has never demonstrated it. However, this is a subject which needs much further discussion by non-partisans whose sole purpose is the public weal ; and I close this notice of Professor Clark's book with the unhesitating assertion that it is one of the most important contributions to economics ever made by an American. RICHARD T. ELY.

PLANT-DISSECTION.

Handbook of plant-dissection. By J. C. ARTHUR, C. R. BARNES, and J. M. COULTER. New York, *Holt*, 1886. 8°.

THIS book is a useful guide to the study of a dozen plants of common occurrence, ranging from the most simple forms to those of highest organization. It is modelled on Huxley and Martin's 'Elementary biology,' physiological details being, however, omitted. The introduction gives brief instructions as to the instruments and materials to be used, including the simple lens and compound microscope ; the chemical reagents employed ; section-cutting and the mounting and drawing of objects ; and a list of books of reference needed. The gross anatomy of the plant is first studied with the aid of a hand-lens only, and subsequently its minute anatomy explored with the compound microscope. Outlines are given for the complete study of the following forms : Protococcus viridis, Oscillaria (more usually written Oscillatoria) tenuis, Spirogyra quinina, Cystopus candidus, Microsphaera Friesii, Marchantia polymorpha, Atrichum undulatum, Adiantum pedatum, Pinus sylvestris, Avena sativa, Trillium recurvatum, and Capsella Bursa-pastoris. It would have been a little more convenient for the average student if one of our native pines had been selected instead of the Scotch pine, though this is quite commonly cultivated ; and Trillium recurvatum is of rare occurrence in the eastern states, though for any other purpose save the study of its gross anatomy, any other species of wake-robin will answer as well. A useful glossary of terms used, and an index, are appended.

A REVOLVING pneumatic cannon, devised by a Washington inventor, is one of the most recent additions to the list of destructive weapons. Another recently invented device of a similar nature is an accelerating projectile, which is so constructed that a series of charges, contained in chambers attached to the rear of the projectile, are exploded in succession, at distinct intervals, as the projectile passes along the tube of the cannon.

SCIENCE.

FRIDAY, DECEMBER 17, 1886.

COMMENT AND CRITICISM.

In a paper presented to the American philosophical society, Dr. Brinton of the University of Pennsylvania has developed some considerations concerning a form of writing intermediate between the iconographic and the alphabetic. This intermediate form of writing Dr. Brinton calls ikonomatic, since that to which the figure or picture refers is not the object represented, but the name of that object. In this ikonomatic writing, which Dr. Brinton finds in the Mexican and probably in the Maya hieroglyphics, he sees the explanation of the process by which the great advance was made from thought-writing to sound-writing. Thought-writing, we are told, is the oldest and simplest form, and is subdivided into iconographic and symbolic. In iconographic writing the object thought of is represented by a more or less skilfully drawn picture, while in symbolic writing a single characteristic serves to represent the object; as, for example, the track of an animal is represented instead of the animal itself.

Of course, the gap between this thought-writing and sound-writing is enormous, and endeavors have been made to explain how it was bridged by a study of the Egyptian and Chinese alphabets, each of which began as simple picture-writing, and developed into almost complete phoneticism. Dr. Brinton calls in ikonomatic writing to explain the transition. In this form of communication the picture or sign does not refer to a sound as the name of the object in question, but to the sound of the name of some other object or idea. The plan is that pursued by the constructors of rebuses, who, to use Dr. Brinton's illustration, can represent the infinitive 'to hide' by the figure 2 and a skin or hide. Of this system, Dr. Brinton finds several sets of instances, and says that there is little doubt that all the Egyptian syllabic and alphabetic writing was derived from this early phase of which the governing principle was that of the rebus. He finds evidence of this in mediaeval heraldry also.

One of the earliest stimuli to the development of phonetic writing was, Dr. Brinton thinks, the wish to record proper names, which, when we rise above the savage state, are not usually significant; and therefore, if recorded at all, they must be recorded phonetically. The Mexicans added to their ikonomatic system a feature peculiar to themselves in assigning a phonetic value to colors. The Egyptian sign-writing is also polychromatic, but the polychromes seem not to have had any phonetic value. So in heraldry, while colors have definite significations, these are seldom phonetic. But the Mexican writing offers many instances where the color of the object as pictured is an essential phonetic element of the sound which is intended to be conveyed. The Aztecs developed the ikonomatic system beyond proper names, and composed in it words, sentences, and treatises on various subjects. Outside of these races, Dr. Brinton finds evidence of but very slight progress toward a phonetic system made by natives of the American continent.

'Bovine tuberculosis' was the subject of a paper read by Dr. Blaine of Willard asylum, Ovid, N.Y., before the New York academy of medicine recently. In the paper and the remarks upon the same by Dr. Edson, of the New York health department, attention was called to the prevalence of consumption in cattle, and to the danger of human beings contracting the disease through the milk and meat of infected animals. As we have already repeatedly pointed out, there is but one way to prevent the sale and use of such meat and milk, and that is by a rigid inspection of the cows at the stables where they are kept, and of the carcasses at the slaughter-houses before the viscera are removed. Tuberculous milk cannot be distinguished from that which is non-tuberculous, and the most thorough expert examination of the meat of a tuberculous animal will not suffice to exclude such meat from the market unless the inspector can also examine the lungs and other internal organs in which the disease manifests itself. The cow-stable being situated, for the most part, in the country, the inspection of these should be performed by officers of the State board of health; while the slaughter-houses, being in the cities, should be rigidly watched by experienced veterinarians, who should be on duty continuously at these slaughter-houses, in order that no single animal can be sold for meat until it has been examined. A long experience in this matter has satisfied the writer that no confidence can be safely put in the slaughterers as a class. They will, without any compunction whatever, kill and sell the most diseased animals, and do not hesitate to put upon the market even the flesh of new-born calves, and of those that have died from disease. It will be an expensive matter, it is true, to station a competent veterinary surgeon at each of the slaughter-houses in these great cities; but the interests of the public health demand it, and they should be kept there continuously. The work will then not be done as efficiently as if public *abattoirs* were established on the river-front, and the slaughter-houses now scattered throughout the cities abandoned.

IT IS WELL KNOWN that the senses are subject to normal deceptions (*sinnes taüchungen*), which seem to be inborn in the structure of the nervous system and the sense-organs. In some respects the world that we piece together from our judgments and sensations proves to be somewhat different from the world to which we apply the foot-rule and plumb-line, which we weigh and measure by objective standards. The science whose business it is to discover the nature of these discrepancies is psychophysics. M. Sorel, in a recent article (*Revue philosophique*, October, 1886), calls attention to the wide practical bearing of this study, shows how it was taken into account by the Greek architects, and how it modifies our aesthetic conceptions. He looks forward to the time when all these deceptions will be quantitatively determined, and applied in every-day life. Not only will we have a real psychophysic law (or laws), but perhaps also the signs of practical consulting psychophysicists will grace our streets.

THE MEETING OF THE NATIONAL PRISON association at Atlanta this year seems to have been very successful. The opening addresses by ex-President Hayes and Mr. Henry W. Grady of the *Atlanta constitution* were very well received, the latter especially calling forth strong expressions of approval. The various discussions on prison architecture, prison diet, the prison physician, the paroling of prisoners, reformatories, and prison labor, were ably introduced and well conducted. The debate on prison labor seems to have excited most interest. Warden McClaughry of Joliet had the courage to defend the contract system, and regretted the action of the people of Illinois in adopting at the last election a constitutional amendment prohibiting it. Warden Brush of Sing Sing made an eminently sensible remark when he said that discussions about forms of prison labor were of little use just now, when a cyclone is sweeping over the country, and agitators are striving to put an end to all prison labor, whatever its form. It was in this discussion that Dr. Tucker created a sensation not only by defending the lessee system as practised at the south, but by pronouncing a panegyric on it. He claimed that the lessee system is the best possible, and made a number of extremely foolish and absurd remarks about the 'psychological repulsion' between races, and in closing demanded the utmost severity of punishment compatible with the convicts' physical health. He went so far as to declare that the chain-gang is the negro's paradise.

Dr. Sims of Chattanooga, who had two days before made an argument for the abolition of the lessee system, which is reported as being very cogent, made a brief answer to Dr. Tucker, and, while granting that the lessee system in Georgia is better managed than elsewhere, repeated the conclusions reached by his previous argument. Dr. Tucker had asserted, after telling his hearers that the penal features of the lessee system are too severe for whites and not severe enough for colored persons, that the death-rate of Georgia prisoners was 8.8 in the thousand. Warden Brush called attention to the official report of the state penitentiary, which showed a death-rate of 30 per thousand; but all the answer Dr. Tucker would vouchsafe was, 'My arithmetic is right.' The truth is, that the lessee system of convict labor is barbarous and inhuman; and the wonder is, that any self-respecting man could publicly defend it, especially before such a body as the National prison association.

Mr. Wines, writing in the *International record of charities and correction,* says that the tendency of thought in the prison association becomes more apparent each year. The keynote of all the discussions is that felons who pursue crime as a vocation, or are driven to it by an irresistible natural impulse, should be permanently incarcerated for the security of society. This implies a distinction between the incorrigible and the corrigible; and the possibility of reformation and establishment of reformatory discipline in prisons follow as matters of course. In Mr. Wines's own language, "Life sentences for recidivists, indeterminate sentences for first offenders, the mark system, the progressive classification of prisoners, conditional liberation, improved facilities for education in prison, the reformation of our system of prison labor, — all of these are parts of the sifting process by which we seek in the end to eliminate from the community the dangerous elements in society." This is an inspiring programme, and, when the reformers convince our legislatures of its practicability, undoubtedly much will be gained. But we do not hesitate to say, that, as a rule, we find, in the opinions of prison-reformers, too much theory and too little practicality. They are on the right road, but their progress is slower than it need be, on this very account.

THE DEBT WHICH the sciences of ethnology and linguistics owe to missionary labors has never been adequately acknowledged. The latest recognition of its value, though well meant and instructive, is still imperfect. Dr. R. N. Cust's monograph, 'Language as illustrated by Bible translations' (London, *Trübner*, 1886), displays the scholarship and research which would be expected from the author. He gives a classified list of versions, arranged according to the various families of languages, from which it appears, that since the establishment of the British and foreign Bible society, in 1803, the missionaries of that society and of similar associations in Great Britain, the United States, and other Protestant countries, have translated the Bible or portions of it into no less than two hundred and ninety languages and dialects. Of these, forty-nine belong to Europe, one hundred and one to Asia, sixty to Africa, thirty-eight to America, and forty-one to Oceania. Adding the older versions (some of which have been republished under missionary revision), we have a total of three hundred and twenty-four translations in the catalogue of Dr. Cust. This, however, by no means exhausts the list. His plan excludes reference to the Roman-Catholic versions, which are numerous—if not of the whole Bible, at least of portions of it. Eliot's Indian Bible, though mentioned (not quite accurately) in the text of the monograph, does not appear in the list. Nor is any thing said of the vast number of grammars, dictionaries, and vocabularies, or the versions of catechisms and similar works, — in many more languages than are included in his list, — which we owe to these zealous laborers, of almost every Christian denomination. In spite of these limitations, however, Dr. Cust's memoir will be a most useful manual of reference for philologists. It is to be hoped that he will supplement it, as he is probably better able to do than any one else, by an additional list, comprising these other missionary publications, which will be helpful to students. Prof. Max Müller has shown that the foundation of the science of comparative philology was laid in the great work of the Jesuit missionary Hervas, — his 'Catalogue of languages,' in six volumes, published in Spanish in the year 1800, and derived mainly from the results of missionary researches. The distinguished professor himself, and the other eminent philologists of our day, — a list which includes such names as F. Müller, Gerland, Latham, Farrar, Sayce, Hovelacque, Charencey, Whitney, Brinton, Trumbull, and many hardly less noted, — who have reared upon this basis such a noble superstructure, will be the first to admit that their work owes its extent and value chiefly to the materials supplied by the later efforts of these enlightened and indefatigable toilers.

A STRIKING PROOF of the growth of scientific studies at Harvard is given in the recent report of the Museum of comparative zoölogy. Although it is within three years that the latest addition to its building has been occupied, it has already become too crowded for the needs of the university. This addition completed the first wing of the great structure originally contemplated by Agassiz, and gave a massive building nearly three hundred feet long and five stories high, with about a hundred thousand square feet of flooring, or the equivalent of seventy rooms, thirty by forty-five feet in dimensions. The new portion, nearly a third of the whole, is entirely devoted to offices, library, and purposes of instruction; and yet the curator, Mr. Agassiz, in his recent report to the president and fellows, reports that "the unexpected demand for instruction is in excess of our accommodation. . . . It will be absolutely essential, in order to maintain the unity of organization on which so much care and money have been expended, to provide additional quarters for the accommodation of the increasing number of students, and the natural demands for expansion in the specialties of each department. At the present moment an additional section of the museum would barely meet our requirements." We understand that work will commence on this another season. Nor is the interest wholly confined to the students. Most of the exhibition-rooms having been thrown open to the public, the number of visitors has greatly increased, so that it has become necessary to begin the erection of a large portico-front to the main entrance on the middle of the south side, and to transfer to it the staircases, which are now wholly insufficient to accommodate the stream of visitors. At the same time it will greatly relieve the now somewhat barren façade of the building.

THE NOVEMBER IOWA WEATHER bulletin, by Dr. Gustavus Hinrichs, closes with an intimation of the character of the coming winter. "The probability is very high that the winter now begun will be a mild one in Iowa and the north-west. The very fact that the last two winters have been severe ones greatly increases the probability stated. It should, however, not be forgotten that even the mildest of Iowa winters has spells of severe weather and blizzards." We must not infer from this that Dr. Hinrichs has any intention of competing with such long-range weather prophets as Mr. Blake, editor of a self-complacent sheet called the *Future*, or others of that class. The prediction here quoted is probably based simply on the fact that the mean temperature of a region for a long term of years is essentially constant, and hence severe winters will generally be compensated by mild ones; but studies of this kind in Europe show that any rules thus based are very often broken. No one could safely order a smaller supply than usual of winter coal, or attempt to make a corner in ice, on such indications, especially as the term 'mild winter' is not considered incompatible with some spells of severe weather and blizzards. Severe winters may, on the other hand, have low mean temperatures, while they are relatively free from heavy snows, which form the chief element of severity in the mind of a railroad superintendent.

ISAAC LEA, LL.D.

DR. ISAAC LEA, the Nestor of American naturalists, died at his home in Philadelphia on the 8th instant. Dr. Lea was born in Wilmington, Del., March 4, 1792. He was of Quaker descent, his ancestors coming from Gloucestershire, England, with William Penn on his second visit. His taste for natural history exhibited itself at an early period, and was fostered by his mother, who was fond of botany, and by his association with Vanuxem, then a youth, who was devoted to mineralogy and geology, then hardly organized as sciences. Their studies were undirected, and only in 1815 did they become members of the Academy of natural sciences, then about three years old. Lea forfeited his birthright in the Society of friends by joining a company raised for the defence of the country, in 1814, though the organization was never called into service. Though engaged in learning mercantile business, young Lea became an active member of the academy, and published a mineralogical paper in its journal in 1817. This was followed by a very long series of contributions to mineralogy and conchology, recent and fossil, which have made his name familiar to naturalists all over the world. He married, in 1821, Miss Frances A. Carey, the daughter of Mathew Carey, the well-known economist, and became a member of the publishing-house of Carey & sons, from which he retired in 1851. Mr. Lea's married life was exceptionally long and happy, lasting fifty-two years, and blessed with two sons and a daughter, who still survive.

In 1825 began those studies of the fresh-water and land shells, especially the Unios, with which Dr. Lea's name will always be associated. In 1827 he published his first paper on the genus Unio. In 1836 he printed his first 'synopsis' of the genus, a thin octavo of fifty-nine pages. The fourth edition of this work appeared in 1870, when it had grown to two hundred and fourteen pages quarto.

Dr. Lea was a member of most American and many foreign scientific societies. He visited Europe, and studied his favorite mollusks at all the museums, where he made the acquaintance of Férussac, Brongniart, Gay, Kiener, and other distinguished men, whose names now sound like echoes of a past epoch.

In 1833 Dr. Lea published his 'Contributions to geology,' at that time the best illustrated paleontological work which had ever appeared in the United States, the text of which was remarkable for the care and judgment evinced in its preparation. Up to 1874 he continued ever busy; and the number of new forms, recent and fossil, made known by him, amounts to nearly two thousand. His activity continued almost unabated up to some ten years ago. Not content with figuring

ISAAC LEA, LL.D.

BORN MARCH 4, 1792; DIED DEC. 8, 1886.

and describing the shells alone, he figured the embryonic forms of thirty-eight species of Unio, and described the soft parts of more than two hundred. He also investigated physiological questions, such as the sensitiveness of these mollusks to sunlight and the differences due to sex. His 'Observations on the genus Unio' form thirteen quarto volumes magnificently illustrated.

Dr. Lea presided over the Academy of natural sciences for several terms, and was president of the American association for the advancement of science in 1860, beside filling various other positions of trust and honor. His scientific activity extended over a period of nearly sixty years. He received the degree of LL.D. from Harvard college in 1852. His faculties, and his interest in research, continued unabated up to the time of his death, and even to the very last such intercourse with him as his strength permitted was felt by all who approached him as a privilege. A full bibliography of Dr. Lea's writings, illustrated by an admirable etched portrait by Ferris, appeared about a year ago as Bulletin of the U. S. national museum, No. 23, and forms a volume of nearly three hundred pages.

ENGLISH WORKERS IN PSYCHICAL RESEARCH.

As requested by you, I will give the information respecting the English society for psychical research which I have been able to gather during a recent residence abroad. Both the English and American societies have been happy in securing the active support of the most able and widely known scientists, and under their guidance psychic research is assuming a definiteness and importance which claims full recognition in the commonwealth of science. It may be interesting to your readers to know something of the *personnel* of the English society. It was organized with the following officers: president, Prof. Henry Sidgwick; vice-presidents, Arthur J. Balfour, M.P., Prof. W. F. Barrett, Rt. Rev. the Bishop of Carlisle, John R. Holland, M.P., Richard H. Hutton (editor of the *Spectator*), the Rev. W. Stainton Moses, the Hon. Roden Noël, Prof. Lord Rayleigh, Prof. Balfour Stewart, and Hensleigh Wedgwood.

The president, a nephew of Lord Salisbury, is widely known by his philosophical works. Both his time and his most liberal purse are given without stint to the work of the society. Mrs. Sidgwick is one of the most effective contributors to the work of the society, not only in her independent investigations, but also by her writings and her able addresses at the public meetings. She is holding her own position ably against the urgent claims of supernaturalism on the part of the believers in mediumistic phenomena. Her brother, Lord Rayleigh, is well known to those who attended the meeting of the British association in 1884 at Montreal.

Prof. W. F. Barrett of Kings college, Dublin, first organized the movement, both in England and America, and is known personally, as well as by his scientific reputation, to many of your readers. Edmund Gurney, Esq., author of a large quarto volume on 'The power of sound,' has just completed two octavo volumes entitled 'Phantasms of the living,' the edition of which was burned last summer just as it was being put into the hands of the printer. The second printing is issued this month. Mr. Gurney possesses the highest abilities, and is in circumstances which enable him to devote his whole time to the work of the society. In close association with him is F. W. H. Myers, Esq., whose poems are household words with the younger generation of earnest thinkers. He is one of the able corps of government chief inspectors of public schools. A most valuable remainder of his time is devoted to the work of the society. Mr. Myers has communicated in the journals of the society, and in recent numbers [1] of the *Nineteenth century* and *Contemporary review*, some most brilliant and suggestive papers on psychology, deserving of the most careful attention of scientists. Prof. Balfour Stewart gives the weight of his counsel, and his presence in the chair at the public meetings held in the rooms of the Royal society of artists in water-colors, where are found many leaders in society, including some of the royal family, as well as scientific gentlemen.

Mr. Richard Hodgson of St. John's college, Cambridge, lately an able lecturer on the philosophy of Herbert Spencer, devotes his whole time to the work of the society. Mr. Hodgson went out to India in 1884 expressly to examine the claims of Madame Blavatski, Colonel Alcott of the Theosophical society, and of other impostors or dupes, to the possession of supernatural powers, acquired by the aid of a class of thaumaturgists in Persia called Mahatmas. Not a few earnest young men in the colleges of England and America, who had lost their faith in historical Christianity, had become fascinated by the claims of the Asiatic theosophists, especially as set forth in Mr. Sinnett's works, 'The occult world' and 'Esoteric Buddhism,' and were prepared to accept the occult philosophy, and with it the alleged miracles of theosophy. The results of Mr. Hodg-

[1] See *Nineteenth century*, May and July, 1884, and November, 1886; and *Contemporary review*, February and November, 1885.

son's investigations in India were issued by the society in a large octavo volume which has made the author's reputation as a patient, skilful, accurate observer and an able writer. The book is like the work of a first-class lawyer in the investigation of a criminal case. The effacement of every claim of Madame Blavatski to supernatural powers is complete and overwhelming. No such stupendous spiritual fraud has, in our generation, deluded so many educated persons. Had the society done nothing else, this work would have amply compensated for all its labor and outlay. Mr. Hodgson is now engaged, in connection with Professor Sidgwick and Mr. Myers, in some experiments on the subject of mind-transferrence, or the occasional communication of mental impressions independently of ordinary perceptions, under peculiar and rare nervous conditions. A series of experiments extending over several years seems to establish this as a scientific fact, but the idea is held tentatively until a much larger induction shall prove or disprove its reality. Malcolm Guthrie, Esq., of Liverpool, gave me two evenings with a subject in private life, who, while often wrong, gave such a preponderant number of successful answers as afforded an immense probability to the theory.

The members of the American society are so overworked in their own several specialties, that they are unable to give the close, continuous attention which the science requires. I wish that the services of some one who is as able and experienced an investigator as Mr. Hodgson, or Mr. Frank Podmore, could be secured for the secretaryship of the American society.

In regard to the results of the work of the society, it is too soon to expect any final verdict in a region of facts so elusive to the grasp, and so illusory in their character. The essential important result so far is, that, for the first time in the history of science, men of the highest reputation for successful investigation have collectively set themselves seriously, patiently, and without prejudgment of the results, to an investigation, by clear, cold, unemotional methods, of phenomena which in all the ages, and never more than now, have pressed themselves on the attention of the race. Long generations of impostors have taken advantage of these phenomena to intrude, by sacrilegious crimes, into the most holy of human susceptibilities, — the sacred love for departed friends. They have wickedly and falsely professed to speak authoritatively in the name of the dead, once dear to us in life, and to found on their imbecile, vagarious utterances a system of religion. It is hard to find terms sufficiently strong to characterize truly this wilful profanation of the innermost temple of our lives.

I do not prejudge the case, in the presence of so able a court as the Society for psychical investigation, by pronouncing that all spiritualistic phenomena are frauds; but I join with the more enlightened advocates in saying that evil spirits — human in my opinion, superhuman in theirs — are misleading multitudes to a fatal deterioration of character. No individuals could possibly have so completely extinguished the claims of the Blavatski fraud as could a society, authoritative in the character of its members, and permanent in its organization; and nothing but such an organization can deal with the ever-recurring claims, believed in, it is said, by millions of our countrymen, many of them of high social and even scientific reputation.

Whether, when all that is fraudulent has been eliminated, there will be any residuum of psychical phenomena on which impostors have traded, but which are real, is of course yet an open question. But it is to be remembered that smoke indicates fire, and counterfeits presuppose actual values somewhere. I do not hope that the inquiries will recover many who have fully yielded themselves to the guidance of paid mediums; but we may reasonably expect that the results of the investigations of a body of scientists of the first rank may in the future save tens of thousands of earnest men and women who are searching with intensity of purpose for what is true, before they have yielded themselves to the domination of mediums skilled in playing upon the emotions and credulity of their subjects. In this connection it may be well to say to the Siebert commission that we are waiting anxiously for the results of their investigations, and that we hope that they will be given to us in full detail, even though they may be negative in result.

The most practically important, possibly, of the investigations of the English society, is not yet in a state in which I can speak of it, but I confidently predict for it a world-wide and permanent position in the destruction of fraudulent error.

I commend 'The phantasms of the living,'[1] just issued. In it are given, for the judgment of the scientific public, the carefully sifted narratives of phenomena claimed to have been seen by reliable witnesses. It is unworthy of true science to ridicule or repudiate these until the evidence in their favor has been carefully and judiciously weighed. Candid scientists, whether believers or unbelievers in them, will welcome whatever authentically makes against, as well as for, their preconceptions.

R. P. S.

[1] *Phantasms of the living.* By EDMUND GURNEY, F. W. H. MYERS, and FRANK PODMORE. London and New York, *Trübner*, 1886. 8°.

DR. WALLACE ON THE DEVELOPMENT THEORY.

DR. ALFRED RUSSELL WALLACE, the distinguished evolutionist, delivered four lectures in the lecture course of the Peabody institute in Baltimore on Nov. 30, Dec. 2, 7, and 9. His general subject was 'The development theory and protective coloring.' The first lecture was devoted to a general outline of the Darwinian movement. The lecturer began by calling attention to a circumstance which he thought was too often neglected in evolutionary discussions; namely, the notions as regards species that existed before Darwin. At that time the fixity of species was regarded as an incontrovertible fact; and the origin of them, when explained at all, was referred to independent acts of creation. It is only by contrasting present zoölogical notions with the ones just mentioned that the immensity of Darwin's influence will be fully appreciated. It is true that before him a few writers had been bold enough to question the validity of the theory of the fixity of species. Foremost among them were Lamarck, Chambers, the author of the 'Vestiges of creation,' and others. But what was lacking in the speculations of these writers, and the reason why they were not as widely read as Darwin, was that they failed to produce any motive power sufficient to cause the transformation of species, and were not sufficiently acquainted with the facts that would suggest such a power. This was the distinctive work of Darwin, and through this the theory bears his name.

There are three main principles derived from the facts of nature from which the Darwinian theory and its consequences follow as an inference. The first of these is the high rate of multiplication of animal life, which makes it impossible for all the offspring to be sustained, and thus creates a necessary struggle for existence among themselves and with other animal forms. The intensity of this struggle depends on the rate of multiplication of the animal in question; and, when that is great, the life-period will be short, and the number who live to maturity correspondingly small. To appreciate how severe this struggle is, it may be mentioned that if a pair of partridges, a single species of birds, live for sixteen years, and breed, as they do, about eighteen young, and all these were to live and multiply at the same rate, then at the end of the sixteen years the whole surface of the earth, land and water, would not be sufficient to give all the partridges standing-room.

The second important principle is furnished by the variability of all parts of living tissue. It is difficult to appreciate the extent of this variation. Only by accurate measurements can it be realized that the variation within species is by no means as small or insignificant as is often supposed. The published writings of Darwin deal more with the evidences of artificial variation than of that in a state of nature. But evidences of the extreme variability of natural species are abundant. Diagrams representing the variation in the size of the chief parts of the body of specimens of several species of birds, of squirrels, and so on, were exhibited, and pictured not only the extent of this variation, but the independence of the variation in one part of that in another. Each part varies independently. It was shown, too, that while the ordinary probability curve represents the natural variation of an organ, the curve must be flat and long drawn out to express the extreme limits of variation and the comparatively slight tendency towards extreme crowding about the average form.

With these facts we pass to the third main principle, the hereditary character of these variations. The offspring of parents with similar variations will tend to preserve them: and the (though not the exclusive one, as Darwin knew) motive power which selects certain variations for preservation by hereditary transmission, and consigns the rest to oblivion, is natural selection. Those variations most in accord with the environment, best adapted to succeed in the struggle for existence, will survive as the fittest. To the objection that such favorable variations would be overshadowed by the other variations all with equal hereditary tendency, the answer was given that variation was sufficiently universal to insure the variation of many individuals in a similar direction, though in less degree, at any time. All variations are lying latent in the background, ready to assert themselves when the environment gives them an opportunity. The great rapidity of this change is shown in those cases where man makes artificial selections, and causes any part of a plant, for instance, which happens to be edible by him, to exhibit the greatest variability in size, nutrition, taste, and all else.

In conclusion, the lecturer expressed the view peculiar to himself, that the human mind is excluded from this evolution from more lowly forms, and that the belief in the gradual development of man's body is in no wise inconsistent with the belief that his soul springs from a higher source, and should yield to all those aspirations which religion is intended to satisfy.

In the second lecture, Dr. Wallace confined himself to the consideration of one of the devices by which animals rendered themselves the more fit to survive. This consists in adapting themselves to their environment by imitating it. The object of such imitation is primarily to escape observation from the animals that prey upon them, and to approach their own prey unobserved. The most striking characteristic of natural scenery is its color. Accordingly we find that protective coloring is the most widely distributed mode of mimicry, though the forms of natural objects are not infrequently imitated by animals. In a general way the animals in cold climates are more liable to be white, like the ice and snow among which they live, while those of tropical habitat present the wealth of color for which southern scenery is famous. The animals of the desert are quite generally of a sandy appearance, and many marine animals of a limpid, transparent tint. To account for this general correspondence between climate and color, the direct action of sunlight has been brought in as a sufficient cause. But apart from the fact that this cause has little explanatory power, it is inconsistent with the fact that many very tamely colored species abound near the equator, and attractive color is not infrequent in northern forms of animal life. Local influences are obviously of great importance. The theory that a direct photo-chemical action takes place, is in some instances undoubtedly true. Caterpillars, in passing into the chrysalis stage, have been observed to spin a dusky red cocoon when on a brick wall, a green one when on a twig, or a white one when on a white fence-paling. In these cases the change of color has been observed to take place within the few hours of spinning the cocoon, and is probably not analogous with the usual origin of protective coloring. In such unique cases as the chameleon, when the change of color is under voluntary control, the imitation of the environment is impossible if the creature be blinded. But, apart from these exceptional cases, the only sufficient explanation of color in the animal world is, that it must be a useful trait. In what way it is useful has already been stated. It is impossible to convey in a few words the cumulative effect of the instances of imitative coloring which Dr. Wallace presented. The stripes of the tiger, resembling the strong contrasts of light and shade caused by the shadow of dry grasses under a burning sun ; the remarkable list of caterpillars aping the tint of the petals, and the curl of the tendrils, of the flowers and plants on which they live ; and, more wonderful still, the leaf-butterfly of India, which even has the pink circles due to fungi on the leaves, which it imitates so closely that the lecturer had to point out on the screen which were leaves and which were butterflies, — these and many more give evidence of the great *rôle* that color plays in nature. And the evidence was still more remarkable, because it was largely taken from a work written many years before Darwinism and natural selection were much thought of.

Dr. Wallace next called attention to the facts that certain exceptions to this color-adaptation were apparent only, and that color had also other functions. The raven, for example, though living in the highest latitudes, is entirely black. But it is to be noted that there the raven is not preyed upon, and that its own prey is dead matter : hence it has no need of protection, and acquires no color-adaptation.

Again : color is sometimes assumed as a means of exciting terror in an attacking enemy. Certain harmless caterpillars have acquired the reputation of being deadly on account of such variegated appendages. Finally, Dr. Wallace pointed out the use of color as a means of recognition. The fact that a rabbit, when pursued, raises its tail, and shows its conspicuous white under surface, seems the opposite of a useful act. But by this means it is enabled to recognize its fellows, and run straight to its burrow, with the white tails of the others as a guide. And it often happens that defenceless animals, whose only defence is in flight, possess similar marks for recognizing one another.

In his third lecture, Dr. Wallace continued the discussion of color in the animal world with special reference to the facts of animal mimicry. Color is a normal feature of animal life. and it will be absent or subdued only when it is kept down by outside influences. For example : those insects that are strong, or protected by a sting, are very apt to be showy and conspicuous. They can afford to be so, because their hard shell (as in beetles) or the sting (as in bees and wasps) is a sufficient protection against attack.

A very peculiar and yet widely current mode of protection is by becoming distasteful and inedible to the attacking animal. A very large class, especially of tropical, butterflies have acquired an extremely disagreeable taste, so that birds and other insectivorous creatures soon learn to avoid them. And the remarkable point is, that such insects are almost invariably conspicuously marked (it is evidently well that they should be), and are usually slow of flight and without other protection. The direct experiment has been tried by Mr. Belt, of feeding birds with these insects, and they are invariably refused. In beetles the same phenomena occur. A great many species with a soft shell, that invites attack, are protected by their inedibility, and are usually lustrous and bright. A tame monkey refused one of these beetles at once, though greedily eating all others.

We see, then, that the acquisition of certain superficial forms and markings will be a protection to the animal acquiring them; and, after the birds have once learned that such and such insects are inedible, any insect, whether inedible or not, that gets itself mistaken for one of the inedible species, will enjoy a similar immunity from attack. This device is current in nature, and is termed 'animal mimicry.' Dr. Wallace showed many striking examples of this, — a moth closely resembling in form and marking a powerful wasp, or a wasp imitating an inedible beetle, and a host of edible butterflies and caterpillars imitating to a nicety quite different species that are inedible. A superficial observer would readily mistake one for the other, but the entomologist finds them structurally distinct in almost every particular. In fact, a South American species brightly marked and striped is really our common white cabbage butterfly transformed for purposes of mimicry. The crucial test of all such mimicry lies in the fact that invariably the mimicking and mimicked species inhabit identically the same territory, and are frequently found together. An excellent illustration of this was given. Two different authors had written up the descriptions, the one of hard-shell, the other of soft-shell beetles of a southern climate; and Dr. Wallace selected from one volume many cases mimicking the forms pictured in the other volume, and invariably found, on referring to the text, that the two species occupied the same area.

A curious and for a long time a very puzzling series of facts was that many inedible species imitated one another. The utility of this is not very evident, and, when the number of examples of it was small, it was regarded as accidental. The explanation has been given by the distinguished naturalist Fritz Müller. It is this: a certain number of the inedible butterflies must be sacrificed in order to teach the young birds that they are inedible. The young bird must experiment, try two or three of them, and then will reason from that sample to the whole class. Now, if two inedible species are closely alike, the bird will only have to use up two or three of both species, instead of two or three of each species, before learning that they must be let alone. And thus by clubbing together, the butterflies mutually protect one another against these experimental inroads. This is not an insignificant advantage when the number of birds is large, and, especially if the two species are unequal in the number of individuals they possess, the smaller species derives a great advantage. Examples of butterflies maimed by the bills of birds were shown.

In reptiles we find poisonous snakes imitated by harmless ones; and in birds the phenomena of sexual coloring are especially marked. Whenever the coloring of the two sexes differs, the female is dull, and the male bright; and this for the reason that the female is more open to attack, especially when taking care of the young and at other times. But when the nest is built in the hollow of a tree or in other not exposed places, it is found that the male and female are equally brightly colored. So, also, in some butterflies the female alone imitates an inedible species.

The last lecture was devoted to the consideration of color in the vegetable world. Here color is not so generally related to the economy of the organism. but is much more the normal product of chemical action. The chlorophyl of vegetable green forms one of the normal characteristics of plant-life. Protective coloring is also not usual. A small plant of the African desert very closely imitates the pebbles among which it takes root. Another African plant has tubers that might pass for small stones.

Many cases of apparent plant mimicry have been shown to be the result of similar conditions of existence; as, for example, the strong resemblances of many alpine as well as of marine plants to one another. But a few cases of true mimicry exist. There is a rare non-poisonous fungus which imitates a common poisonous fungus, and is always found along with the common species. There are instances, too, of higher plants imitating an orchis that grows in its vicinity; but these are rare.

When we consider fruits (in the botanical sense) in detail, the phenomena of color become highly important. These colors are largely for the purpose of attracting the visits of insects and other animals; the ulterior object being the dissemination of the seeds. The main agencies by which this is effected are mechanical ones, — the wind, and by the visits of animals. A few general facts of color are at once explained by this view. Unripe fruit is of a protective green color, and where it is disseminated by mechanical agencies along the ground, as in nuts, it takes on a dull brown color. Nuts are protected by hard shells, sometimes also by bitter or by prickly surfaces, and show very clearly that the seed within, though edible, was not meant to be eaten. Being sufficiently protected otherwise, it has not acquired the property of inedibility. On the other hand, what we popularly know as fruits are intended to be eaten: they are made attractive by a bright and juicy pulp, and the seeds are generally small and smooth, so as easily to be swallowed entire, and to pass through the body of the animal ready for fertilization. The seeds, too, may be bitter, or protected by a parchment-like covering, as in the crab-apple. We see, then, that fruits when ripe, and not before, offer attractive colors, generally red, so that the seeds contained in them may be swallowed by animals and then serve their normal function.

To understand the coloring of flowers, one must remember that the object is to have the pollen carried from the anther of one flower to the stigma of another, and thus to secure cross-fertilization. The well-known experiments of Darwin showed that self-fertilized flowers bear fewer and smaller seeds, and when these seeds are planted they develop into smaller, weaker plants, than those resulting from cross-fertilization. Dr. Wallace then described the familiar methods by which cross-fertilization is effected and self-fertilization avoided. The anther and the stigma ripening at different times, the mysterious self-sterility of some pollen, the bending-down of the stigma away from the anthers, and the separation of the stamens and pistils in two distinct flowers, are among the simple modes of avoiding self-fertilization. The more complex ways, such as varying the length of pistil and stamens in different flowers so that pollen from a short stamen will reach a long pistil, and *vice versa;* the innumerable kinds of springs and triggers and traps to retain insects and sprinkle their heads and backs with pollen. — all show the extreme harmony between the vegetable and the animal world. And if a still clearer demonstration of this is needed, we have it in the extreme specialization of some plants to particular insects. Such facts abound; and in the case of an alpine species the same flower, when growing in low regions, where bees abound, is adapted to them, and in high regions is adapted to the visits of butterflies.

Dr. Wallace then gave a brief explanation of the existence of self-fertilized plants. The object is not cross-fertilization, but a slight change in conditions. If the external conditions are rough and varied, self-fertilization is sufficient; but when the environment becomes equable and monotonous, then deterioration results, new blood is necessary, and the devices for cross-fertilization are evolved, and some may imagine that in the course of geological time, changes from the one to the other have gone on according as the desired variations could be best obtained. For example, if a self-fertilizing flower is tending to die out, it may adopt cross-fertilization; if the insects that visit it die out, it may return to self-fertilization.

In conclusion, Dr. Wallace expressed the view that insects had no aesthetic pleasure in color at all, but that this faculty was reserved for man alone, and served as a mark of his distinction.

Dr. Wallace also delivered a lecture on the 'Origin and characteristics of island life' before the students of Johns Hopkins university. The lectures were delivered in a clear and easy manner, and possessed that indefinable attractiveness which comes from many years of original research. It was a high privilege to listen to the words of one who had independently thought out the theory that bears Darwin's name, and has been intimate for years with Darwin himself.

NOTES AND NEWS.

THE December number of the *Political science quarterly* seems to us the strongest that we have yet seen. Economics are represented by Horace White's article on 'The future of banking' and Herbert L. Osgood's 'Scientific socialism;' law, by Professor Burgess's dissertation on von Holst's account of the public law of the United States — published in the *Handbuch des oeffentlichen rechts der gegenwart, in monographien*, under the editorial direction of Professor Marquardsen of Erlangen — and by Professor Goodnow's article on 'The executive and the courts;' history, by the conclusion of John E. Bowen's valuable sketch of the 'Conflict in Egypt;' while Prof. George B. Newcomb's article on 'Theories of property' is partly historical, partly legal, and partly economic. The most popular article is undoubtedly Mr. Osgood's 'Scientific socialism,' which is a pleasantly written account of the life and economic teachings of Rodbertus. Professor Goodnow's article is a valuable and scholarly essay in the field of administrative law, and Professor Burgess's able criticism of von Holst takes rank as the most valuable article of the number. We would call particular attention to the book-reviews, which seem to us, in point of discrimination, treatment, and literary style, the models of what attractive and valuable book reviews should be. There is no space wasted on valueless works or such as contribute nothing new in the way of thought or presentation to political science, no twisting and turning of isolated passages, and no attempt to write essays on the subjects of which the books selected for notice treat. The reviews are real reviews, straightforward scientific judgments well expressed. We would select as particularly good the notice of recent books on the railway problem by Dr. Seligman, that of Clark's 'Philosophy of wealth' by Prof. Henry C. Adams, and that of Ely's 'Labor movement in America' by Prof. Henry W. Farnam.

— Prof. Thorold Rogers has not finished investigating the early economic history of England. He has in preparation a work on the early history of the Bank of England, which will present much interesting information drawn from original sources.

— The value of American scholarship is now very generally and generously recognized abroad. The latest instance of this recognition, and a very important one, is the association of Professors Briggs and Brown of the Union theological seminary, New York City, with Canon Driver of Oxford in the editorship of a new critical Hebrew lexicon which is being prepared by the delegates of the Clarendon press.

— The article 'United States' in the new edition of the 'Encyclopaedia Britannica' will be written by Prof. J. D. Whitney.

— The fourth annual convention of the modern language association of America will be held at the Johns Hopkins university, Baltimore, on Dec. 28, 29, and 30. On the evening of the 28th an address of welcome will be given by Pres. D. C. Gilman of the Johns Hopkins university, after which will follow an address by the president of the association, Franklin Carter, president of Williams college. On the 29th the usual two sessions will take place, and in the evening a social entertainment will be tendered the convention ; on the 30th, session and excursion to Washington. Papers have been reported by several of the leading modern language professors both north and south. Reduced fares on several railways have been obtained, and orders for tickets are already in the hands of the secretary, Prof. A. M. Elliott, Johns Hopkins university, Baltimore, for distribution to all those who may wish to avail themselves of these lowered rates.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Electrical phenomena on a mountain.

I SEND you a brief account of some electric phenomena experienced by me last summer on Lone Mountain, a peak of the Gallatin range about thirty miles south-west of Bozeman, Montana.

In company with Mr. James Walsh, my assistant, I climbed this mountain on Aug. 7, 1886, for the purpose of making it a topographic station of my work in that vicinity. It is about eleven thousand feet above sea-level, and higher than any other peak within a radius of at least twenty miles. It stands alone, being separated from the other high points of the range by low saddles The mornings for two weeks previous had been bright and clear, but afternoon thunderstorms were of daily occurrence. The morning of Aug. 7 was clear as usual ; but about noon clouds had appeared in the west, and by 2 P.M. distant rumbles of thunder were heard, and dense black cloud-masses were sweeping towards us. About this time, as I was working at my plane-table, I heard a peculiar buzzing sound coming from the instrument, very much as if a large fly or wasp was imprisoned beneath one of the plane table sheets. Placing my hand on the table, I received quite a severe shock, and, starting back in surprise, felt another in my partly uplifted right arm. Immediately after the rocks about us began to hum and buzz in a peculiar manner, giving a sort of musical sound, and the hair of our heads, beards, and eyelashes to snap and crackle viciously. This phenomenon was felt with greater intensity in a small spot on the very tops of our heads, was accompanied by a tingling sensation, and at short intervals by slight shocks, which made us cringe involuntarily. On removing our hats, a tuft of hair stood upright over these spots. A shock was received whenever the hand came in contact with the head.

Placing the instruments in a horizontal position under cover, we descended the mountain about one hundred yards to a point perhaps fifty feet below the summit, and lay down flat. While in this situation, no unpleasant feelings were experienced, although the rocks still continued their musical hum; but the shocks and tingling sensations were immediately felt on raising any portion of our bodies to an upright position. The thunder-storm, accompanied by hail and rain, soon burst upon us, and continued for half an hour, after which the peculiar electric condition of the atmosphere passed away.

We noticed during the storm that at least eighty per cent of the lightning flashes passed between masses of clouds, and not between the clouds and earth, and that none of these flashes, as determined by the interval between sight and sound, were within a mile and a half of the peak we were on.

The summit of Lone Mountain is a loose mass of broken volcanic rock. There are no large bowlders or projecting points of any kind. M. F.

Washington, Nov. 24.

Archeological enigmas.

Professor Mason's article under the above heading in the last number of *Science* (viii p. 528) contains a report of remarks by myself which is in some respects inaccurate, and it appears to me that the subject is of sufficient importance to command the space necessary for a correction. The formation in which the hearth was found is a shore-deposit of a lake held in the Ontario basin during the final retreat of the ice-sheet. The ice-front then extended as far south as the Adirondack Mountains, and this prevented the water from escaping by the St. Lawrence valley. The local relations indicate that the hearth was made during the accumulation of the shore-deposits, so that its antiquity is somewhat less than that of the culmination of the last general glaciation of north-eastern America. Its antiquity is also sensibly identical with that of the Niagara River ; so that, whenever a satisfactory estimate has been made of the time consumed in the cutting of the Niagara gorge, the age of the hearth will have been determined in years. The estimate of seven thousand years is based upon the hypothesis that the rate of recession of the falls has been uniform throughout the period of the excavation of the gorge, — an hypothesis not yet sufficiently examined.

The phrases 'Mr. Gilbert's find' and 'the Gilbert hearth' are misleading. The hearth was discovered by Mr. Daniel Tomlinson of Gaines, N.Y., and our knowledge of it is based entirely upon his oral evidence. It was first communicated to the scientific world by Mr. George H. Harris, in the 'Semi-centennial history of the city of Rochester.' My own contribution to the subject was purely from the geologic side.

I may add, that the formation described by Mr. Murdoch is unquestionably littoral, and not greatly elevated above the present coast. What we know of recent oscillations of coasts in arctic regions, and of the rate of formation of littoral deposits, tends to the opinion that the Point Barrow goggles have an antiquity far less than that of the other finds.

G. K. GILBERT.

Washington, D.C., Dec. 11.

Polarization of resistance coils.

On p. 208 of *Science* (viii. No. 187) Professor Mendenhall's observation is noted. With my rheostat I fail to obtain any 'reverse' current properly so called. The secondary current obtained by us is in the same sense, whichever sense is given to the primary, charging current; and the secondary current is not in the same sense in all the coils.

This rheostat is constructed with brass mountings and German-silver coils: hence I infer that the main cause, at least of secondary current, is unequal heating of the junctions of coils with mountings.

Since we obtained galvanometer deflections of equal amount, as well as in the same sense, for both senses of primary current through the rheostat, we failed to observe any polarization effect by difference. It may be that thermo-electric effects at junctions of copper conductors with brass terminals happened to mask the polarization in this case, though we could not believe it probable.

If my explanation of secondary current be correct as far it goes, would it not be well to make rheostat coils and mountings of the same material?

F. C. VAN DYCK.

New Brunswick, N.J., Dec. 8.

Height of a meteor.

I have a very accurate map of the track of the large fireball which was seen near Philadelphia about 9.48 o'clock on the evening of Nov. 4. If any one can supply another, even if only approximate, so that the height may be computed, it would greatly oblige

ISAAC SHARPLESS.

Haverford coll., Penn.

Elliott's Alaska and the Seal Islands.

I beg permission to draw attention through the columns of *Science* to a glaring instance of plagiarism in Mr. Henry W. Elliott's lately published work entitled 'Our arctic province.' In this work the greater part of the third chapter (more particularly pp. 45 to 57) is quoted, or adopted with slight verbal alteration, and without the least acknowledgment, from my report on the Queen Charlotte Islands of British Columbia, published in the 'Annual report of the geological survey of Canada for 1878–79.' This in itself is perhaps a matter of small importance, though not calculated to lead the public to place unquestioning faith in the character of other parts of Mr. Elliott's volume, to which I do not here allude. The specially reprehensible feature to which I must direct attention is that Mr. Elliott has availed himself of the fact that a division of the Haida Indians inhabit the southern part of Prince of Wales Island (Alaska) to apply my specific observations on the Queen Charlotte Island Haidas and neighboring Ishmisians to the Indian population of the Sitkan archipelago generally, including ten tribes, which he enumerates. In some cases the transfer is made simply by substituting 'Prince of Wales Island' for 'Queen Charlotte Islands' of my notes; in other instances a more elaborate procedure is adopted: but in no case that I can find in chapter iii. is any part of my description credited to the Queen Charlotte Islands, nor is the name of that well-known group so much as mentioned in the chapter. Had Mr. Elliott confined himself to generalities, it would not have been so inexcusable; but he descends to details, and, as an instance, actually adopts the measurements given in my report for a house at Virago Sound, Queen Charlotte Islands, leaving it to be understood by the context that it was met with somewhere in the Sitkan archipelago, and measured by himself. I should add, that the measurements were made to the nearest inch, and that Mr. Elliott has followed six of the dimensions correctly, but misquotes two of them (p. 49).

As an example of the jaunty style which Mr. Elliott manages to impart to the original, I quote only the following, in which some evidence of originality certainly appears. Many pages occur in which the style of the original is considered satisfactory, and the incorporation made verbatim, or very nearly so.

Our arctic province (pp. 56–57).	*Report on Queen Charlotte Islands* (p. 111 B).
"But the 'loudest' feed of these savages consists of a box, just opened, of semi-rotten salmon-roe. Many of the Siwashes have a custom of collecting the ova, putting it into wooden boxes, and then burying it below high-water mark on the earthen flats above. When decomposition has taken place to a great extent, and the mass has a most penetrating and far-reaching 'funk,' then it is ready to be eaten and made merry over. The box is usually uncovered without removing it from its buried position; the eager savages all squat around it, and eat the contents with every indication on their hard faces of keen gastronomic delight — faugh!"	"Both the Haidas and Ishmisians have the custom of collecting salmon roe, putting it in boxes, and burying these below high-water mark on the beach. When decomposition has taken place to some extent, and the mass has a most noisome odor, it is ready to eat, and is considered a very great luxury. Sometimes a box is uncovered without removing it from the beach, and all sitting round eat the contents."

Mr. Elliott, in his introduction, refers to the great amount of literature which has appeared on Alaska, and adds, "In contemplation of this, viewed from the author's stand-point of extended personal experience, he announces his intention to divest himself of all individuality in the following chapters, to portray in word, or by brush and pencil, the life and country of Alaska as it is, so clearly and so truthfully that the reader may draw his or her own inference, just as though he or she stood upon the ground itself." Possibly wholesale unacknowledged appropriation is Mr. Elliott's idea of 'divesting himself of all individuality.' He has certainly succeeded in divesting most of the facts contained in his third chapter of all individuality, by applying them to a region and to tribes not intended by the writer. Why should Mr. Elliott leave the extensive tours on

Alaska, and the personal experience to which he refers, to avail himself of the observations of another in a different though adjoining region? We are of course aware that a considerable similarity exists as between the manners and customs of the various Indians of the north-west coast; but to transplant observations made in one specific district bodily to another is a proceeding utterly repugnant to any one with a regard for scientific precision — or truth.

GEORGE M. DAWSON.

Geological survey of Canada,
Ottawa, Nov. 27.

The best reply to make to a criticism like Mr. Dawson's is to let a few facts bearing on the case speak for themselves. Let me take the case of complaint cited by him, — the rotten fish and roe feast. In 1865-66, twelve and thirteen years before he knew any thing about the subject, I witnessed and smelled my boat's crew of Haida and Stickeen Indians open and eat rotten salmon and herring roe, and rancid fetid Aalachan fat, at a dozen different camping-places between Stickeen Mouth, Alaska, and Port Essington, B.C. My notes and drawings were made then, which appear in my recently published work. These notes and drawings were re-written and selected, and all in the hands of my publisher Feb. 26, 1886. I never saw Mr. Dawson's work, or even knew of it, until the middle of April, 1886; then my attention was called to it by Professor Mason, who has the only copy known to this establishment. He, at that time being at work on a collection just received from British Columbia, incidentally alluded to it, and, finding I had never seen it, asked me to read it.

'Our arctic province' was not written for the eye or ear of scientific specialists: were it so conceived, its covers could not be expanded wide enough to embrace the subject; and it would, if so written, be an utter failure as a popular and pleasant book to handle on the question. Hence all this detail, controversy, and citation has been justly eliminated from it.

HENRY W. ELLIOTT.

Smithsonian institution, Dec. 10.

Star rays.

In the oldest pictures in which the sun, or stars, or burning candles, are features, these objects are represented as surrounded with rays, or points, or brushes of light; and the coventional figure of a star is to-day a pentagon, with its sides extended to an intersection so as to form five pointed projections. It is evident that this manner of representing luminous bodies is due to the fact that such appendages have their counterparts, to a greater or less degree of correspondence, upon the retina of the eye, when such bodies are viewed. But it has never been supposed by any one that such points or rays were actual emanations of luminous matter from the objects, nor the converging of their light into these forms by the atmospheric medium through which they are viewed. Such impressions have always been considered so simple and constant as not to deserve any notice on the part of scientific inquirers, as far as I have ever heard; and it is because my curiosity has been excited to know their cause, that I appeal to the readers of *Science* for more light upon the subject.

In the case of the electric light, now so common in our streets, I have been able to account for the principal feature of their apparent radiations. The very long rays, which, if the carbon points were at the same distance as is the sun, would be many millions of miles long, I find are nothing more than the reflection of the light from my eyelashes; as is proved by the fact of their changing their position to correspond with every change I make in the position of my eyelashes, and of their total disappearance when I intercept the light by my fingers or other screen. But I cannot by any practical means thus get rid of the great body of minor rays which seem to interlace with each other, and which sparkle with the prismatic colors. The experiment with the longer ones, however, forces upon me the conclusion that these are due to some other part of my optic apparatus which is out of my reach.

I have also gazed upon the full moon, and, while doing so, have at different times, and with different conditions of the eyes, and with different positions of the eyelids, observed with great distinctness nearly every form that I have seen published, representing the solar corona as observed by the astronomers during an eclipse of the sun, and especially those rifts in the corona which extend to the very surface of the luminous orb, — features which, in the case of the sun, utterly disprove every hypothesis that has been advanced to account for the existence of the corona.

If the corona is an emanation from the general surface of the sun, or the illumination of a circumambient atmosphere of matter, how are we to account for these rifts, which imply immense long and narrow vistas, following great circles of the sphere, which constantly shift their position on its surface so as to coincide with the line of view of the observer on the earth, through all the movements of solar rotations and of the earth in its orbit?

Mr. Proctor suggests that the corona is the more highly illuminated centre of an hypothetical stratum of stellar substance, to which the orbits of the earth and other planets are confined, and which gives out the zodiacal light. If this were so, those immensely long projections should radiate from the equatorial zone of the sun. But the zone from which they project is always perpendicular to the line of view of the observer.

What quality can be assigned to a homogeneous atmosphere, either upon the moon or the earth, which is capable of perverting the light of the sun into such fantastic shapes as have been observed, and what can induce such changes in that quality to correspond to the manifold changes in the forms recorded?

Considering the complete failure of every hypothesis to account for the phenomenon, and during the pause which seems to have overtaken this inquiry, may it not be excusable for those who are ignorant to inquire whether sufficient attention has been given to the possible effects of the structure of the lenses and tubes of the telescopes through which the observations have been made, and whether it may not be possible to abolish the corona in the same way that the 'black drop' has been abolished? If reflections from my eyelashes and eyelids can produce such figures upon the retina, may not reflections from the tubes or other parts of the telescope produce them upon the photographic plate?

RD. RANDOLPH.

Baltimore, Md., Dec. 10.

SCIENCE.—SUPPLEMENT.

FRIDAY, DECEMBER 17, 1886.

THE PSYCHOLOGY OF SPIRITUALISM.

THE history of thought, says Dr. Bastian, has a double aspect. Its main object is to record the advance steps in the progress of civilization, to trace the normal, psychological growth of racial culture, and set forth the evolution of rationality. But it is hardly less instructive to regard the shadowy side of the picture, and study the mental movements of that ever-present and vast portion of mankind who by occult and mystic proceedings attempt to short-circuit the roads to knowledge and immortality. Weird notions and strange theories find a ready home in the disordered brains of such semi-morbid fanatics; and, when once they gain hold on the popular imagination and belief, such inhuman pages of history as those that record the horrors of witchcraft, the follies of alchemists and searchers for the philosopher's stone or the fountain of eternal youth, the wide-spread misery of mental epidemics or the bestial self-tortures of crazed ascetics, must be written. These deviations from the normal lines of progress — back-slidings, as the Hebrew prophets termed them — present close analogies in the mind of the evolutionist to atavistic reversions in some ways, and to useless rudimentary organs in others. They appear as reversions to more primitive modes of thought in the light of what anthropology has told us of the psychic life of savage tribes.

Hardly a page in the story of the vagaries that have turned aside the minds of our ancestors from the straight path of knowledge but can find its parallel in the fancies built up by untutored savages to satisfy their dearest longings and quiet their most constant fears. In brief, it is in the statistics of thought that our author finds the material for the complete study of intellectual evolution, and quite as much of those modes of thought that are reversions or survivals as of those that are in the direct line of advance. Modern science has decided to accept as its logic that system of principles most conveniently described as Baconian; but this process seems slow and insipid to those who have the final goal of all revealed to their ecstatic insight, and the logic on which they stake their faith is such as can only be fully appreciated when the eyes are calmed in dimly lit chambers, the brain flushed with excitement, and the judgment unsettled by intense expectancy.

In sachen des spiritismus und einer naturwissenschaftlichen psychologie. Von A. BASTIAN. Berlin, *Stricker*, 1886. 12°.

Spiritualism, theosophic lore, occult science, and all the mysteries that follow in their train, are simply the expression which this atavistic tendency of human thought has taken in our scientific century. When introspection, meditation, revelation, or dogma were the current modes of discovering truth, the occultists, mystics, and the rest claimed them as the foundations of their creed. To-day we experiment, observe with the senses, photograph, and so on; accordingly the 'vital influence' and 'telepathic impact' has been forced to leave its record in childish scribblings; our ghosts have been weighed and smelled and photographed; yes, even the methods of scientific psychology (reaction-times) have been employed to discover the most beneficial kind of 'smell-pills' and the clothing in which our soul can most conveniently disport itself. The Hipp chronoscope is pictured on the frontispiece of Jäger's 'Entdeckung der seele.' Every insane-asylum is a microcosmus of the world without. Formerly our paranoics heard voices in the air: now they hear them through the telephone. So, too, this morbid pseudo-scientific spirit apes the manners of the true goddess, and by such disguises sues the favor of the world.

It is in some such strain as this that Dr. Bastian as an anthropologist not alone familiar with the culture-history in which we form a link, but thoroughly at home in the mind-habits of 'natural' savage tribes not uncivilized but with a peculiar civilization of their own, calls up the procession of modern spiritualists, theosophists, and their like, and sits in judgment upon them. He shows them how they are simply repeating, with new costumes and improved scenic effects, the tragic comedy of former times, and falling back upon the play-tricks of the childish savages whom they profess to despise.

It would be a vain attempt to fill out, however roughly, this sketch of Dr. Bastian's point of view. For that, the reader must (though not without misgivings on the part of the reviewer) be referred to the original. The author is no stylist. There is no attempt at any classification or subdivision; no index; a preface that reads like part of the text; no chapters, simply 216 pages of tersely written paragraphs. Add to this, constant quotations from seven or eight languages (in one passage five languages occur in four lines) and a most puzzling and frequent use (one parenthesis to every two and a half lines) of the parenthesis, and some slight notion of the extreme Teutonic character of this valuable pamphlet will be obtained. JOSEPH JASTROW.

THE VENOMS OF POISONOUS SERPENTS.

THE experimental work which forms the basis for this valuable contribution to science was carried on in the physiological laboratory of the University of Pennsylvania. The reputation of its authors is such as to make it a standard work of reference. It brings our knowledge of the composition and effects of the venoms of serpents up to the present time, and we surmise that many years will elapse before the results recorded will be modified to any great degree. The subject is one, which, while it is full of interest to the reader, must nevertheless have been one involving no inconsiderable danger to the experimenters. To have handled two hundred living venomous serpents, one of them eight and a half feet long, weighing nineteen pounds, and furnishing one and a half drams of venom, cannot have been a very delightful task; and those who were willing to undertake it must have been enthusiastic investigators, as indeed we know they were. The serpents upon which the experiments were performed included rattlesnakes (Crotalus adamantus and C. durissus), moccasons (Ancistrodon piscivorus), ground rattlesnakes, copperheads, and coral-snakes. The venom of the cobra was obtained from India, while all efforts to obtain the poison of the Indian viper (Dabsia Russellii) were unsuccessful. The authors started with the theory, long held by Dr. Mitchell, that snake-venoms are not simple in composition, but are composed of two or more poisonous substances, and that in the qualities and quantities of these agents would be found an explanation of the differences between serpent-venoms as to power to kill and mode of causing death. All fresh serpent-venoms are more or less alike in appearance, being fluids varying from the palest amber tint to a deep yellow. When a drop of the fresh venom of the C. adamanteus was examined under the microscope with a $\frac{1}{12}$ Zeiss. homog. immersion lens (amplification, 800 diameters), in addition to oval nucleated red blood-corpuscles, leucocytes, and club-shaped epithelial cells, certain colorless particles are seen, some larger and of an albuminous character, others smaller. Some of these particles resemble bacteria, but are not: they do not multiply in cultures nor stain with the aniline dyes. In addition to these, there are, however, bacteria in fresh venom of a micrococcus form. Although careful search was made for ptomaines, none were found. An insoluble precipitate was obtained, which does not seem to have been recognized, and, when injected into pigeons, produced no toxic effect. Certain globulins were also obtained from the venom, to which the writers have affixed the names of water-venom-globulin, copper-venom-globulin, and dialysis-venom-globulin, from the method by which they were obtained. In addition to the globulins, peptones were also obtained. The differences in the proportions of the various globulins and peptones in different venoms are of immense importance in affording an explanation of the physiological peculiarities exhibited in poisoning by different species of snakes. The proportion of globulins in Crotalus is over three times the quantity in the Ancistrodon, and nearly fifteen times that in the cobra. The investigation, which has continued over a period of several years, included a study of the effects of various agents on venom, the effects of venom when applied to mucous and serous surfaces, their effects on the nervous system, and a comparison of globulins and peptones as regards their local poisonous activity. The action of venoms and their isolated globulins and peptones upon the pulse-rate, upon arterial pressure, and upon respiration, was thoroughly examined. Elaborate experiments were made with filtered venom, and with cultures for the study of the morphology of the bacteria contained in the venom. The anatomical changes produced in the animals experimented upon were carefully studied and recorded. The conclusions to which the authors arrive, as the result of their patient and laborious investigation, are, 1°, that venoms bear in some respects a strong resemblance to the saliva of other vertebrates; 2°, that the active principles of venom are contained in its liquid parts only; 3°, that venoms may be dried and preserved indefinitely with but little impairment of their toxicity; 4°, that there probably exist in all venoms representatives of two classes of proteids, globulins and peptones, which constitute their toxic elements; 5°, that potassic permanganate, ferric chloride in the form of the liquor or tincture, and tincture of iodine, seem to be the most active and promising of the generally available local antidotes. The fact that the active principles of venoms are proteids, and closely related chemically to elements normally existing in the blood, renders almost hopeless the search for a chemical antidote which can prove available after the poison has reached the circulation, since it is obvious that we cannot expect to discover any substance, which, when placed in the blood,

Researches upon the venoms of poisonous serpents. By S. WEIR MITCHELL and E. T. REICHERT. Washington, *Smithsonian inst.*, 1886.

will destroy the deadly principles of venom without inducing a similar destruction of vital components in the circulating fluid. The outlook, then, for an antidote for venom which may be available after the absorption of the poison, lies clearly in the direction of a physiological antagonist, or, in other words, of a substance which will oppose the actions of venom upon the most vulnerable parts of the system. The activities of venoms are, however, manifested in such diverse ways, and so profoundly and rapidly, that it does not seem probable that we shall ever discover an agent which will be capable at the same time of acting efficiently in counter-acting all the terrible energies of these poisons. The monograph closes with a complete bibliography of the subject, and a number of colored lithographs, which serve to illustrate in a most perfect manner the lesions caused by the venoms.

McLENNAN'S STUDIES IN ANCIENT HISTORY.

THE first edition of McLennan's 'Primitive marriage' was published in 1866. The novelty and striking character of the theories propounded in it, the accumulation of interesting facts, and the clear and attractive style, aroused attention, and led to much discussion. Many writers of note — Sir Henry Maine, Sir John Lubbock, Mr. L. H. Morgan, Professor Bachofen — took part in the controversy. Darwin himself entered the arena. Ten years later, to meet a pressing demand, the work was reprinted by the author, with additions, under the title of 'Studies in ancient history.' That the interest awakened in the subject has remained unabated is evident from the fact, that, since the author's lamented death, his brother has found it necessary to issue a new edition of this volume, with some notes of his own, designed to clear up doubtful points, and to indicate certain changes of view which the author had announced. The publication will be welcome to all who take an interest in the study of the primitive history of our race, and who have not had an opportunity of procuring the earlier editions. Few works on the subject can be read with greater satisfaction, even by those who do not yield assent to the author's views. The grace of diction, the profound scholarship, and the stimulating originality of thought, displayed in the work, combine to make it one of the classics of modern science.

Twenty years, however, have not sufficed to establish the views put forth with so much confidence, and maintained with so much ingenious reasoning. On the contrary, antagonistic theories have sprung up on every side. To some extent, indeed, the author, as his brother intimates, had changed his views; and it is not easy to determine what were the precise conclusions at which he had arrived on some important points. The view, for example, which represents the earliest tribes of men as living in a state of 'communal marriage,' or, in other words, of promiscuous intercourse, is maintained throughout his first publication. This view was subsequently adopted by Lubbock in his 'Origin of civilization,' and by Morgan in his 'Ancient society.' But it was contested with overwhelming power of argument by Darwin, in his 'Descent of man.' He showed that the nearest congeners of man, the anthropoid apes, are all pairing animals, and, like other pairing animals, fiercely jealous. That human beings, on their first appearance, should at once have sunk in the social scale below the apes, and even below the sparrows, and should only have emerged from this condition of more than brutal debasement by a long succession of struggles and experiences, is of all suppositions the most improbable.

This consideration seems to have impressed Mr. McLennan, and to have produced a remarkable change of opinion. One of his essays, added in this volume to the original treatise, comprises a severe and destructive criticism of Sir John Lubbock's scheme, which makes 'communal marriage' the starting-point of human society. With equal force of logic, the author disposes of Morgan's 'classificatory system' and Bachofen's 'mother-right,' both of which are founded on the same fanciful basis, thus demolished by him. Yet, strangely enough, he fails to see that his own theory of 'marriage by capture' rests on the same unsafe foundation, and must fall with the others. His view, as presented in his earliest publication, and not subsequently retracted, is that in the first stage of tribal society 'utter promiscuity' prevailed; that with this was connected the practice of female infanticide, the male children being preserved to add to the strength of the tribe, while females were regarded as a source of weakness; that the scarcity of females in a tribe led to the custom of capturing them from other tribes, and this custom finally became the law of the tribe. Thus marriage arose, at first exogamous (that is, restricted to women of other tribes or kindreds), and afterwards, as society advanced, either endogamous (that is, restricted to the clan) or general, as in civilized nations. As the author himself, in his later essays, has taken away the main substructure on which his ingenious theory was built, it is not necessary to refer at any length

Studies in ancient history, comprising a reprint of Primitive marriage. New ed. By the late JOHN FERGUSON McLENNAN. London and New York, *Macmillan*, 1886. 8°.

to the facts and arguments which have been brought forward in opposition to it. That among the greater number of tribes which have been found in the lowest stage of savagery, no trace of marriage by capture has been discovered; that among such tribes female infanticide is by no means a common practice; and that, on the contrary, female children are regarded by their parents as a source of wealth, through the price which they bring for wives, — these and similar facts seem to prove that the custom, of which the author has pointed out so many widely scattered traces, did not originate in any general law of social organization, but was, like polygamy, polyandry, the North American clan-system, the Australian class-system, the Hindoo caste-system, the Roman paternal autocracy, and the many other social arrangements which have been pressed into the argument, merely a casual and local custom, — one of those numberless diversities of tribal organization, which, like the diversities of language, indicate at once the variety of the human faculties and the unity of the species. The conclusion announced by Darwin, that all the races of men are descended from a common ancestry, and that all inherit the ordinary pairing instinct, — which, however perverted in occasional instances, manifests itself distinctly in the vast majority of communities, savage and civilized alike, — is one which will doubtless be generally accepted in the end. The theories which oppose this conclusion destroy one another; and the results of the profoundest science bring us back to the common belief which prevailed before the theorizers began their work. H. HALE.

STEPHENS'S HISTORY OF THE FRENCH REVOLUTION.

THE literature of the French revolution would in itself compose a library, and Mr. Morse Stephens naturally begins his preface with an excuse for adding another history to a list which includes such names as Thiers, Taine, and Carlyle. In a masterly survey of his authorities he shows, that, since Carlyle wrote, our sources of information have been materially increased; that a number of local records and personal memoirs have come to light; and he lays particular stress on a collection of pamphlets in the British museum which Carlyle found to be inaccessible. Briefly, Mr. Stephens has spent untiring labor on the subject for years past, 'to the exclusion of every thing else,' and he aims at embodying in this volume the results of specialist researches. He notes in this connection the influence of the German school of historians, — an influence, by the way, which is discernible in the increasing study of parochial and diocesan history in England, and in the rise of historical magazines and reviews such as the monthly *Révolution Française* and *Revue de la révolution*, which are entirely devoted to the history of the revolution.

A history of the French revolution. By H. MORSE STEPHENS. Vol. i. New York, *Scribner*, 1886. 12°.

Mr. Stephens introduces his work to the American public in a separate preface, in the course of which he remarks that the example of American independence was a more powerful ideal with the earlier revolutionists, the admirers of Lafayette and Franklin, while the later leaders sought inspiration from the republics of Greece and Rome. The Declaration of the rights of man he somewhat unfairly describes as a 'ridiculous fancy of the admirers of the American constitution,' foisted on the assembly by Lafayette. Surely the declaration breathes the spirit of Rousseau, and, far-fetched and extravagant as it may seem to us, it was the gospel of the French revolution.

While the conflict of king and subject was passing into the tyranny of the state, the questions raised were so varied and suggestive that the epoch forms a kaleidoscope which can always be viewed in a new aspect. Theorists had full sway, and many of those great modern movements directed against the constitution of society — movements which have lately received a new impetus — were inaugurated. Now that it is hinted that democracy does not imply liberty, and that a new school of 'physiocrats' is growing up in the stronghold of modern democracy, it will be useful to study the experiments made by land and labor reformers a century back.

The plan of Mr. Stephens's work is simple and effective. In the present volume he carries the narrative from the assembly of the notables to the dissolution of the constituent assembly, aptly introducing sketches of important departments of the subject, such as the court, the army, and the church. There is no 'Carlylese' or lurid color in his description; but if he does not write at high pressure, 'flamefully,' he tells his story in clear and straightforward English. Here and there occurs a slovenly phrase, such as, "the influence of the parlement and the affection has been noticed when discussing" — but the style generally is attractive by its simplicity and correctness. The fall of the Bastile is told unobtrusively. We notice that the celebrated speech, 'Paris has conquered her king,' is attributed to Lally Tollendal instead of to Bailly, presumably on the authority of the museum pamphlets. Bailly makes no mention of it in his 'Memoirs.'

Mr. Stephens is, we think, weakest in his estimate of character. Study of Mirabeau's correspondence with La Marck seems to have prejudiced him against the 'moral' characters of the revolution, — Necker, Bailly, and Lafayette, — whom he scarcely mentions without a sneer. The removal of the king and assembly to Paris is put down to "the extreme vanity of Lafayette, who wanted them there merely to increase his own honor and glory." The starvation "gave Lafayette an opportunity to pose as savior of the monarchy." In the matter of the suspensive veto, Necker "acted vainly and foolishly on the plan which Lafayette had vainly and foolishly invented." What was criminal in Lafayette at the Hotel de Castries, it becomes a virtue in Mirabeau to defend. In short, Mr. Stephens feels something of the rancor which Mirabeau felt when "every attempt of Mirabeau to unite himself to Necker and Lafayette had been spurned by those vain and conceited men." On the other hand, the double dealing of Mirabeau when he was in the pay of the court is put down as masterly statesmanship, and his want of principle is almost made a proof of his greatness. Nothing is said of the difficulties of Lafayette's position, which exposed him to attack from both sides; of his chivalrous loyalty to the court, yet sympathy with the popular cause; or of the high opinion entertained of him by the best contemporary critics.

There is much new and interesting matter in the account of the elections to the states-general, and of the local *cahiers* of grievances. Mr. Stephens is a lover of exact detail, perhaps at times overloading his history with biographical minutiae. There are also sketches of the economic and financial state of France in connection with the views of the foremost thinkers (to whom the evils of the internal *douanes* suggested the doctrine of free trade), showing the results of the issue of a paper currency and of the wasteful system of taxation. The theory (p. 176) that the burning of châteaux was due to the desire of the copyhold tenants to get possessionof their court-rolls seems a little strained to any one who has read contemporary accounts of the condition of the French peasantry. Points made very clear are the unpractical character of the constituent assembly, with its 'theory of irregular verbs,' — the reasons why it was left behind by the provinces in the march of ideas, — and the widening gulf between the *bourgeois* and lower classes, especially the *ouvriers*, who suffered from protective trade associations.

Enough has been said to show that Mr. Stephens has produced a work which promises to rank among the standard authorities on the period, and which will be of sterling historical value to the student of modern democracy.

VINES'S LECTURES ON THE PHYSIOLOGY OF PLANTS.

THERE has long been felt the need of a good text-book on vegetable physiology in the English language, and hence we heartily welcome the appearance of this excellent treatise. The investigation of the phenomena of plant-growth, nutrition, respiration, metabolism, reproduction, etc., has of recent years been almost entirely accomplished by the Germans, and the prominent part they have taken in these researches will be at once apparent to the reader of Professor Vines's work. As the title indicates, the volume is an expansion of the author's lectures on the subject, and these are twenty-three in number. Nearly ten years have elapsed since its preparation was begun, ill health and the pressure of official duties having retarded its publication.

Lecture I., as introductory, treats of the general features of the vegetable cell, its cell-wall, and its contents, Protococcus and yeast being used as examples with references to the tissue systems of multicellular plants. Then follow two chapters on the structure and properties of the cell, in which are discussed the growth, thickening, and lignification of the wall; its optical properties; and its incrusting mineral matters, — oxalate and carbonate of lime, and silica; the protoplasmic contents and the nucleus; the vacuole and the cell-sap. The molecular structure of organized bodies is then considered. An account is given of 'imbibition,' or capacity of organized matter for absorbing water. The rival theories of Naegeli and Strasburger are compared; and the latter appears to be favored by the author, though farther on in the book reference is made to Naegeli's *micellar* hypothesis. In this connection allusion is made to Hale's old experiment of putting peas to soak in an iron pot with a leaden cover on which was placed a weight of 184 pounds: the force generated by imbibition was sufficient to raise the cover and weight. Here we also find an instructive discussion of the osmotic properties of the cell, and it is pointed out that substances may be transferred from cell to cell by means of the connecting threads of protoplasm as well as by osmosis.

Lecture IV. is on the absorption of water by root-hairs and the epidermal cells of rootlets, and is full of important information for the agriculturist. The structure of soils, the action of acid cell-sap, which saturates the absorbing organs and brings salts insoluble in water alone into solution, are described, and numerous analyses of the ash of plants are given. The discussion of the absorp-

Lectures on the physiology of plants. By SYDNEY HOWARD VINES. Cambridge, *University press*, 1886. 8°.

tion of gases through stomata and lenticils is given in lecture V. It has long been known that under certain conditions some plants absorb oxygen: this is most markedly true of fungi; and Professor Vines states (p. 76) that it appears that the power of absorbing this gas is possessed by all plants, sustaining this conclusion by the experiments of Wolkoff and Mayer on seedlings, those of De Saussure, Oudemans, and others on germinating seeds, and of De Saussure on many flowers. It also appears, that, if roots are not supplied with oxygen, the plant soon becomes unhealthy, and ultimately dies. Portions of plants which contain chlorophyl abundantly, absorb oxygen in darkness, while this is given off during their exposure to sunlight. All green portions absorb carbonic acid in sunlight. Ammonia also is taken from the atmosphere, as has been shown by Ville; but free nitrogen is apparently not thence absorbed, the presence of this gas in the cell-sap being accounted for by its solubility in water.

Lecture VI. is on the movement of water in plants. A very clear account of this phenomenon is given, the circulation being regarded as passing mainly through the cell-walls of the lignified tissues. Transpiration, or the exhalation of watery vapor from the leaf surfaces, is treated of in the seventh lecture, and the food of plants in the eighth.

The next six chapters are devoted to the metabolism of plants, — the changes which materials undergo in the tissues under the influences of light, heat, chemical affinity, etc.; and these are perhaps the most valuable parts of the book. Here the discussion begins with the consideration of the formation of non-nitrogenous organic substances, principally starch; then that of nitrogenous substances, collectively termed 'amides,' and of the function of chlorophyl, which is concisely stated to "absorb certain rays of light, and thus enables the protoplasm with which it is intimately connected to avail itself of the radiant energy of the sun's rays for the construction of organic substance from carbonic acid and water." A summary of what is now known of the metabolic processes is admirably stated on pp. 325–328; and an instructive table, showing the income and expenditure of matter and energy, is given. The energy is entirely referable to the absorption of light by the chlorophyl, and to heat.

Lecture XV. is devoted to the phenomena of growth; and the following six chapters, to irritability, which is thus minutely described, and the forces inducing its manifestation fully discussed. In the last two chapters the subject of reproduction is treated; and here may be found a *résumé* of present knowledge of the development of spores and seeds in the various divisions of the vegetable kingdom, the phenomena of hybridization, of parthenogenesis, and of variation. The closing sentence is, "Evolution is no longer a matter of chance, but is the inevitable outcome of a fundamental property of living matter."

At the close of each chapter of this most valuable book, copious references to the bibliography of the subjects treated are given; but, for some reason not apparent, these are only to the works cited, and, except in a few instances, not to pages. Had these been added, it would have greatly facilitated the work of students who desire to pursue the study further. A very extensive index, arranged not only by subjects, but also by authors quoted, is appended.

CHALLENGER REPORTS.

THE Challenger cephalopods were at first placed in the hands of Professor Huxley, whose numerous engagements finally obliged him to decline the work, with the exception of a special investigation into the genus Spirula. Mr. William Evans Hoyle, who was intrusted with the work by Mr. John Murray, has devoted the report now under consideration chiefly to systematic work, but expresses his intention of preparing a supplementary article on the anatomy of those specimens which are available for this purpose. He alludes to the fact, that, since the return of the Challenger, marine explorations have been so energetically prosecuted, that no less than five genera, new when obtained by the Challenger, have since been described from the collections of the U. S. steamers Blake and Albatross, etc. Mr. Hoyle has been favored with the assistance and friendly advice of Professor Steenstrup, and has compared with the specimens of the fine collection at Copenhagen all the critical Challenger species, thus insuring a double authenticity for the determinations of the report. The latter commences with an excellent synopsis of the species of recent cephalopods, with references to the places where they are figured and described. The Challenger collection contains seventy-two species of thirty genera. Of these, thirty-two species and four genera were new to science. For one of these, Amphitritus, possessing the unique feature of having the mantle fused with the siphon in the median line, so as to form two openings into the branchial cavity, a new family has seemed necessary. None of the giant squids were obtained; as, indeed, the means for capturing such animals in their native haunts have not yet been devised,

Report of the scientific results of the exploring voyage of the Challenger. Vol. xvi.: Zoölogy. London, *Government*, 1886. 4°.

those observed or recorded by naturalists being without exception in an invalid condition or cast dead on the shores. With regard to the distribution of the species in depth, there are great difficulties in the way of deciding whether the specimens came from a given depth or not. Circumstances seem to indicate that Cirroteuthis, probably Bathyteuthis and Mastigoteuthis, and perhaps one or two species of Octopus, may be reckoned as abyssal forms. But no structural features appear to have been discovered by which a species may be definitely asserted to be a deep or a shallow water animal. This agrees well with the conclusions drawn by others from a study of the deep-sea mollusks of other classes. A full discussion of the geographical distribution of the class gives completeness to the report. In the discussion of genera and species, Mr. Hoyle has the courage of his opinions, and freely criticises where the circumstances seem to him to warrant it, but his tone is uniformly courteous. His report may be heartily commended.

The Stomatopoda are crustaceans related to the common Squilla of our southern and eastern coasts, and are restricted to shallow waters. Prof. W. K. Brooks remarks that when he examined the Challenger collection, consisting of only fifteen species, his first feeling was of disappointment, since the types seemed all familiar. But after a more thorough examination, this gave way to a lively interest, since it appeared that the material was such as to enable him to trace the ancestry and development of this small and compact order with great completeness. The Squillidae have a very long larval life, and are found at the surface of the sea, where the currents carry them vast distances; so that some of the species have a nearly world-wide distribution. The larvae are among the most elegant of the immature crustacea found in the tow-net, and naturally excite great interest among the naturalists who capture them. But the young stages do not thrive in confinement, the eggs seem dependent on the parent for suitable conditions up to the time of hatching, and so the connection of the isolated links in the chain of life of any given species has been a task of great difficulty. The very numerous larvae contained in the Challenger collection, and the indefatigable application of Professor Brooks to the problem, have enabled him to add materially to the knowledge of the group, and to smooth away many difficulties for subsequent students. According to the author, the Challenger collections "enable us to determine, with much greater certainty than before, the larval type which pertains to nearly every one of the genera of adult Stomatopoda, and also to give a pretty complete picture of the developmental history of each larval type."

The collection of reef corals made was a large and important one, there being representatives of two hundred and ninety-three species, referable to sixty-nine genera, and by series large enough in many cases to afford an instructive idea of the very considerable range of variation within a species. Of the whole number, about one-fourth were new. Of the seventy-three new species, seventy-one were obtained in the Pacific, and two in the Atlantic, which illustrates fairly well our comparative knowledge of the two chief coral regions. Of the sixty-nine genera, eight are new, all from the Pacific. The report is confined to a description of the hard parts, the material for anatomical purposes being otherwise disposed of by the authorities. In the generic grouping, Professor Verrill's revised list of Dana's zoöphytes, contained in the 'Corals and Coral Islands,' has been followed, with certain amendments as to species. Much use has been made of Professor Moseley's field notes as to the habitat and environment of the corals. A detailed list of the species from each locality has been given, which it is hoped may serve as a basis for a knowledge of the distribution of the reef corals. In classification, Mr. Quelch has mainly followed Duncan for the Madreporaria; but in the Rugosa the occurrence of Moseleya latistellata has led the author to apply a new treatment, which he anticipates will lead to some discussion. This remarkable species is directly and closely related to the most typical Cyathophyllidae, while at the same time it presents undeniable astraeid characters. It must be looked upon as one of the most remarkable types of structure brought to light by the Challenger. It occurred at Wednesday Island, Torres Strait, in eight fathoms. The discussion of distribution, areal and bathymetric, is very interesting. The Atlantic reef coral fauna is sharply separated from that of the Pacific and Indian Oceans. The distribution in depth is greater than formerly supposed, two species reaching to seventy fathoms, though it is tolerably certain that the zone of most active growth does not extend much below twenty fathoms. The thermal limit of 68° F., which is doubtless the limit of active reef-building, does not, as formerly was believed, confine the existence of the reef-building species. Manicina areolata was obtained at the Cape in water of the temperature of 65°, and Madrepora borealis is said to inhabit the cold waters of the White Sea near Archangel, Russia. On this point we confess to some scepticism, until at least a second specimen is obtained; that in the Paris museum, still unique, dating from

1829. Certain corals have been observed living in brackish or even nearly fresh water, others in the mud about the mangrove roots, and one species seemed to suffer little from exposure at low tide to the sun and air. The statement of Edwards and Haime, that a species of coral common in the Red Sea is found in the Dead Sea, is another matter which will bear renewed examination. The report supplements in a satisfactory manner the valuable work of Professor Moseley, and will add materially to the reputation of its author.

This valuable contribution to comparative osteology ('Report on the human crania and other bones of the skeleton,' part ii., by Sir William Turner) is largely devoted to the discussion of the pelvis. The characteristics of the black races differ among themselves as well as from those of the European type, which, as by far the best known, is adopted as a standard of comparison. In most of the negroids the conjugate diameter is long compared with the transverse, and the height increases. In the negroes and Tasmanians these characters are less pronounced compared with Europeans. In nearly all the black races the average length of the sacrum is greater than its average breadth, contrary to what occurs with white races, and, in so much, more like a tail. The lumbar curve in the black races, as derived from the vertebrae alone, is concave forward; the clavicle may be longer in proportion to the humerus than with the whites; the scapular index is apparently higher, except with the Bushmen and Australians, while in the Tasmanian it may have been distinctly lower; the radius and tibia are longer in relation to the humerus and femur; the shaft of the upper limb is proportionally shorter than that of the lower limb. In general, racial characteristics appear in the skeleton as well as in the skull. Among existing races osteological characters may be found similar to those of the most ancient known remains; and the differences which exist between the bones of primitive people are no more, in kind or degree, than are to be seen in corresponding parts of men of the present day.

AGRICULTURE IN MICHIGAN.

THE Michigan board of agriculture is likewise the governing body of the Michigan agricultural college, and considerably more than half of its twenty-fourth report relates to the latter institution. The general report of the secretary is followed by the inaugural address of the new president, Hon. Edwin Willitts, and the reports of the president and professors upon the work of their several departments. This, in most cases, is of a twofold character, — instructional and experimental. Of the instructional work it is hardly necessary to speak, further than to say that it follows the modern methods of teaching the physical sciences, and that, as is well known, ample facilities are provided in the way of laboratories, apparatus, farm, garden, park, etc.

The experimental work of such an institution is necessarily subordinated to the work of instruction; and, while valuable experiments have been made, the college by no means takes the same high rank as an experiment-station that it does as a college. In this connection we note that President Willitts, in his inaugural, speaks of the Hatch bill, now pending in congress, as a bill "to make all the agricultural colleges experiment-stations." If this is the intent of the bill, it were better left to slumber in committee of the whole. We certainly shall not look for great good from its passage, if the theory prevails that the professors of an agricultural college can successfully conduct an experiment-station in their leisure moments with an income of fifteen thousand dollars per annum.

Twenty-fourth annual report of the secretary of the state board of agriculture of the state of Michigan, 1884–85. Lansing, *State*, 1886. 8°.

AN ingenious gentleman of Evanston, Ill., has succeeded in applying the principle of the injector to a grain-elevator. The grain is run from the car to a revolving hopper, through an aperture in the bottom of which is forced a powerful blast of air, which carries the grain a certain distance up a horizontal tube. At intervals in this tube are bends, or horizontal curves, forming relays. These relays act as auxiliary hoppers, a fresh blast of air being admitted at each one, which carries the grain to the next higher relay. In this way the grain may be raised to any desired height. A modification of this device is arranged to raise grain from the hold of a ship or boat.

— A new method of manufacturing illuminating-gas from crude petroleum consists in conducting a stream of the petroleum to a moderately heated chamber, thereby producing vapor and liquid, and then separately conducting the vapor to decomposing-retorts heated to a certain temperature, and at the same time conducting the liquid portions to decomposing-retorts heated to a higher temperature, whereby the respective products are decomposed, and converted to permanent gas, without overheating either portion.

— An Austrian electrician named Marcus is supplying the German navy with a newly invented petroleum-engine for torpedo-boats. The engine is set in motion by electro-magnetism, and is more powerful than a steam-engine of the same size.

SCIENCE.

FRIDAY, DECEMBER 24, 1886.

COMMENT AND CRITICISM.

IT SEEMS A PITY that wealthy men who bequeath money to colleges cannot trust the authorities to expend the legacy in the way most beneficial to educational interests. Nearly every rich man who leaves any thing to a college seems to deem it essential that he indicate how it shall be expended, and the channels of expenditure selected are by no means always well chosen. While Mr. Greenleaf, the Boston hermit, who recently left nearly the whole of his large estate to Harvard college, made conditions that are more rational than usual, yet it is probably true that the president and fellows of Harvard could have used the five hundred thousand dollars — if it prove to be so much — with more benefit to education and in satisfaction of what are the more pressing wants of the college, had they been untrammelled by any testamentary conditions. The foundation of new chairs, the increase of the salaries of poorly paid instructors, the construction of some new laboratory, — all suggest themselves as being what Harvard probably needs most. The foundation by Mr. Greenleaf of ten undergraduate scholarships of an annual value of three hundred dollars each, is an excellent thing; and they will, beyond a question, be the means of affording a liberal education to young men who could not otherwise secure it. It may be that Mr. Greenleaf has left his money with fewer conditions than are now reported, but in our view it would have been better had he left his money without any conditions at all. The president, faculty, and trustees of a college are the proper persons to decide most intelligently what the institution needs most.

IT VERY FREQUENTLY occurs that among the advertisements in English educational and literary papers are to be found some calling for applications for vacant chairs in leading educational institutions. Owens college, Manchester, and the leading colonial universities, frequently advertise in this way. As with us this never happens, the practice of advertising being restricted to schools and small colleges, it seems odd to read these advertisements. We cannot help imagining the result that would ensue were it extensively advertised that applications were wanted for the chair of history at Harvard, of physics at Columbia, or of Latin at Yale. Without any advertisement, a vacancy in the faculty of a leading American college not long ago, called forth forty applications from this country and from England, many of them coming from men of eminence in the scholastic world. In selecting a professor from that number, the trustees were driven nearly crazy, and no one can predict the result had applications been solicited by advertisement. Which method is the better for the institution is the important question, and we have no hesitancy in saying that we believe nothing is lost by our habit of not advertising. In the case of all our principal colleges, it is undoubtedly the fact that the president and trustees keep their eyes continually open, and when a vacancy occurs they are pretty sure to know who is the best man for the place; or, in any event, they have made up, unconsciously, a short list from which the selection is to be made. It is to be urged, too, in favor of not advertising, that governing bodies thus escape the importunities of individuals in no way fitted for the position to be filled, but who put in an application in the hope of bettering their condition.

THE QUESTION AS TO the necessity or advisability of retaining corporal punishment in schools as a means of discipline is by no means settled. The majority of the authorities undoubtedly favor its abolition, but a strong minority are contending for its retention. At the last meeting of the German-Austrian teachers' union, a vigorous debate took place on this subject, being precipitated by the report of a special committee in favor of retaining corporal punishment as a last resort in cases of malicious wantonness, obstinate defiance, disobedience, falsehood or dishonesty. Dr. Dittes, a lifelong student of pedagogy, opposed the resolutions as embodying a great pedagogic error. He said that if, as claimed, its re-introduction into German schools was necessary, the logical conclusion must be that the German youth and nation rank, from a moral stand-point, below the French, in whose schools discipline was good, though no corporal punishment was allowed. Dr. Dittes insisted that the school must not be made a house of correction. The voting on the resolutions seems to have been attended with much confusion, as the result is disputed. The final figures given were, for the adoption of the resolutions contained in the committee's report, 181; against their adoption, 168. The Austrian papers condemn the teachers for adopting the resolutions; and the *Neue freie presse* of Vienna went so far as to say that this public confession by Austrian teachers, that they cannot accomplish their high task without the use of the rod, is proof that the main problem to be solved is not how to reform the education of children, but how to reform the training of teachers.

In New York City, Mayor Grace has followed up his excellent appointments to the school board by a letter addressed to that body on the subject of industrial education in the schools. Mayor Grace is of opinion that now is an exceptionally favorable time for the establishment and equipment of an industrial school for girls, because the normal college is in what may be termed a 'state of congestion;' hundreds of applicants who have demonstrated their fitness by obtaining the percentage required on examination, being turned away every year owing to lack of accommodation. Mayor Grace's idea is, that an industrial school can now be established in which young women may be taught such special branches as phonography, telegraphy, book-keeping, cooking, sewing, and type-writing. Admission to this school should be from the various grammar-schools throughout the city, and thus the overpressure at the normal college would be relieved. This school could be made to serve as an experiment, and upon its success would probably depend the future introduction of industrial education upon a more extended scale. By way of practical advice, the mayor recommends the board of education to apply to the board of estimate for an appropriation sufficient to start such a school, and promises his own vote and voice in favor of granting such an application if it is made.

The Germans have been forming a modern-language association similar to that in existence here, and of which the fourth annual session is to be held next week. About one hundred and fifty professors and teachers met at Hanover and organized as the Verband der deutschen neuphilologischen lehrschaft. The same conditions seem to prevail abroad as here, for we read in *Modern-language notes* that at the Hanover meeting pretty much the same wailings were heard about the defects of pedagogic methods, the preponderance of the classical element in the schools, and the necessity for organization, as went up from the assembly by which the American modern-language association was formed. But modern-language teachers seem to disagree widely among themselves as to method, as any one can learn by reading discussions on the subject, such as that lately printed in the *Academy*, the excellent journal published by the associated academic principals of the state of New York. If they are to carry on a vigorous attack against the methods of classical instruction, they must themselves present a united front, and come to a definite agreement as to how modern languages can be best and most expeditiously learned. We very frequently hear complaints from university professors that they are greatly crippled in teaching their subjects, because the men who come up to them in junior, senior, and graduate years, although they profess to have studied German and French, cannot use French and German authorities and books of reference. This certainly is wrong, and should not be suffered to continue; and it is our instructors in modern languages to whom we must look for a change. Our own firm conviction is, that, at the present stage of scientific and literary study, a student entering the junior year of his college or university course should be able to read French and German fluently, and understand them readily when spoken, if he is to gain the fullest benefit from the last two years of his course. And this knowledge will, we believe, be best secured by making the ability to read one of these two languages a condition of admission to the freshman class, and making the study of the other, with the express aim of learning to read it, compulsory during freshman and sophomore years.

At the Philadelphia meeting of teachers of preparatory schools, of which we print an account elsewhere, President Magill of Swarthmore college made an acute comment on Professor James's paper on the professional training of teachers. He said that chairs of pedagogy in the colleges would not be of much avail if women, who are generally excluded from the colleges, are to form as large a proportion of the teachers as heretofore. In 1880 the census showed that 154,375 of our 227,710 teachers were women, and the proportion has not been materially altered since. The problem is, how to train these female teachers, quite as much as how to train their colleagues of the male sex. And the training of female teachers is of especial importance, because they are very generally the teachers of primary schools and kindergartens: and their pupils, being at the most tender and impressionable age, require the most careful attention and training.

Of course, two ways for avoiding the difficulty indicated by President Magill suggest themselves. The first, and the one that he probably had in mind, is the opening of colleges to women on equal terms with men. The other is to provide all female colleges, training and normal schools, with competent instructors in the history, theory, and practice of education. The former method is the more likely to arouse opposition, while the latter requires the greater pecuniary outlay; for, if a professor is attached tc a college already, he can just as easily teach women as men. We fancy that President Magill's point is one that has escaped the attention of most of our educational reformers.

THE PRESENT STATUS of the gymnasium and realschule controversy in Prussia cannot remain long unchanged. The gymnasial students have too many unfair advantages; and because of this, and despite the excellent and practical character of the education given in the realschule, there are to-day in Prussia 257 gymnasia, as against 89 realschule and 14 higher realschule. The desire to limit the military service of boys holding certificates from these schools to one year, is the single point on which all the controversialists agree. Those who desire to equalize matters, and deprive the gymnasia of their privileges, point, and forcibly too, to the fact that only one-fifth of the pupils from the gymnasia pursue their studies any further, the rest falling back to inferior posts, or going into a business career. Moreover, until the re-organization of 1882, it was necessary that a boy's path in life should be chosen for him at the absurdly youthful age of nine; and now, since the first three years of the curricula in the gymnasium and real-gymnasium have been made identical, this choice is only postponed until the age of twelve, still far too early.

There are two ways of escape from the difficulty: more of the two courses may be made identical, or a new sort of school shall be devised to take their place. Prevalent opinion favors the latter alternative, the idea of an einheitsschule. Some of the teachers in the real-gymnasia have expressed themselves in favor of some such plan as this. The school-life should be unified by providing, that, after a preparatory course of three or four years, a six-years' course shall follow, made up of instruction in German, religion, drawing, arithmetic, geometry, history, geography, and, during the first three years, physiography and either English or French; in the second three years, mathematics, natural science, and a second modern language or Latin, according to circumstances. On completing such a course satisfactorily, the pupil should have the right to the one-year military service. Then, after all this, the plan provides for two parallel courses of three years, — one based on the classics, and one on modern languages and science. After all the absurd things that have been said in Prussia and elsewhere on this subject, it would be somewhat of a surprise to see so excellent a plan as the above adopted as the outcome of it all.

AMONG THE VARIOUS branches of technical instruction that are coming to occupy a very important place in our educational system, instruction in architecture is certain to claim for itself considerable attention. Architecture, affording as it does scope for the exercise of both speculative and practical temperaments, is very attractive to that numerous class of minds which combines imaginative power with constructive ability. Moreover, we must remember that certainly a quarter of a million of buildings are erected in this country every year, and the tendency is to obtain trained architects to design them and superintend their construction. For all of these reasons, information concerning instruction in architecture is of interest and value. There are only four schools of architecture in the United States, none of them long established, and therefore our sources of information concerning methods of instruction are limited. But in a recent number of the *Sanitary news*, Professor Ricker, of the chair of architecture in the University of Illinois, has a paper on architectural education which is very suggestive, because, instead of being a theoretical dissertation, it is a simple account of how he conducts the work of his own department. Professor Ricker finds that his work naturally subdivides itself into four classes.

The first of these classes comprises the university work proper, consisting of the methods employed and the instruction imparted in the technical classes. The second embraces the general supervision of the courses of instruction in shop practice, arrangement of course of study, problems, etc. The third covers the supervision of the commercial work of the university, comprising superintendence of work and contractors, the making of estimates, drawings, specifications, etc. The fourth is the supervision of the blue-printing laboratory. The course in shop practice offers some points of interest. It is arranged throughout on the Russian system, which Professor Ricker believes to be productive of better results than the Woodward system, which has been adopted in the training-schools of St. Louis and Chicago. At the University of Illinois no attempt is made to compel all the members of a class to do each part of the work in exactly the same time, for Professor Ricker holds that practice and competition will make a man rapid in execution soon enough, the first essential being to teach him how to work in the best manner, no matter how long it takes him. By adopting this system, each student is treated as an individual, and not as a member of a class; and bright and quick pupils are not kept back, nor are the slower ones urged on at the expense of thoroughness. Professor Ricker's equipment consists of benches and sets of tools for twenty-four students, the maximum number that he thinks an instructor can profitably take charge of.

DR. CUNNINGHAM, the successor of the lamented Principal Tulloch at St. Andrews, opened his classes in divinity with an address of great power and lucidity. After a glance at the past and a glowing panegyric upon his predecessor, Dr. Cunningham took up the subject of his chair and expounded with unusual clearness his conception of it. He said that at the outset he must answer the question, 'Is theology a science?' If it is a science, then it should be welcomed within every university, and taught with the care bestowed upon the other sciences; but if not, if it is a mere feeling or belief without any foundation in reason, without any capability of being reduced to logical forms, then it ought to be banished from every university as something alien to their spirit and design. Dr. Cunningham then proceeded to vindicate for theology the rank and title of a science. While it was largely dependent on metaphysics, on psychology, on moral philosophy, and on anthropology, yet it had facts of its own, gathered from both the material and mental worlds; which facts can be gathered into a system, and reasoned upon in a scientific way. This being true, it follows as a corollary, the speaker continued, that theology should be treated as a science, studied as a science, and taught as a science, freely and fully; not as a system of foregone conclusions, but as a subject capable of advancement, and therefore to be looked into, speculated upon, and brought into harmony with the widening knowledge and highest thinking of the age. If the chemist, astronomer, or physiologist were bound to teach his science according to the beliefs of the chemists, astronomers, or physiologists of a century, or two centuries, or ten centuries ago, his teaching would be a laughing-stock, and his chair driven from the university as unworthy of it. Similarly the professor of theology must be allowed free scope, and not tied down to theology as it was taught two hundred and fifty years ago. Dr. Cunningham's address was on a high plane, and, if it is a fair measure of the character of his university teaching, the latter cannot fail to be successful.

LONGEVITY OF PRESIDENTS OF THE UNITED STATES.

OF the men who have retired from the office of President of the United States, only one now lives. During the last year of Grant's administration, none at all were living; and hardly at any time within the memory of the younger generation have more than two or three lived at the same time. The inquiry naturally suggests itself, whether the men who have filled this office have really less viability than other men of their class, and especially whether a comparison with the tables of mortality justifies the conclusion that in recent years the mortality among them has been remarkable.

To furnish data for investigating this question, I have prepared the following table, showing the years of birth, accession, and death, of all the Presidents. The column following the year of death shows the age at which each President assumed his office. It is formed by subtracting the year of his birth from that of his accession, and is therefore liable to no error greater than a fraction of a year. Following this is the expectation of life at the epoch of accession as deduced from the 'combined experience' table of mortality. This expectation is taken in the usual way, as the number of years after which it would be an even chance whether the individual was living or dead. Although this is not a mathematically rigorous definition, yet in the case under consideration it differs from the rigorous one only by an amount too small to be worth consideration. Following this is given the number of years which the incumbent actually survived after entering upon the duties of his office.

	Born.	Became President.	Died.	Age at accession.	Years of life.	
					Expected	Actual.
Washington	1732	1789	1799	57	16	10
Adams, J.	1735	1797	1826	62	12	29
Jefferson	1743	1801	1826	58	15	25
Madison	1751	1809	1836	58	15	27
Monroe	1758	1817	1831	59	14	14
Adams, J. Q.	1767	1825	1848	58	15	23
Jackson	1767	1829	1845	62	12	16
Van Buren	1782	1837	1862	55	17	25
Harrison	1773	1841	1841	68	9	0
Tyler	1790	1841	1862	51	20	21
Polk	1795	1845	1849	50	21	4
Taylor	1784	1849	1850	65	11	1
Fillmore	1800	1850	1874	50	21	24
Pierce	1804	1853	1869	49	22	16
Buchanan	1791	1857	1868	66	10	11
Lincoln	1809	1861	1865	52	20	4
Johnson	1808	1865	1875	57	16	10
Grant	1822	1869	1885	47	23	16
Hayes	1822	1877	—	55	—	—
Garfield	1831	1881	1881	50	21	0
Arthur	1830	1881	1886	51	20	5

Omitting the only living ex-President, and taking the sums of the expected and of the actual years of life in the case of all the others, we find them to be: —

Total years to have been expected	331
Actual years of life	281

If we omit the two abnormal cases in which a President died by assassination, the result will stand : —

Years to have been expected	289
Actual years	277

If we reasoned from this general result alone, we should conclude that Presidents were not, as a class, less viable than the average of other men, since the difference of twelve years between the actual and expected sum total of life might well be the result of chance. But a more minute analysis of the table will show a feature which, taken in connection with the historical facts, prevents us from disposing of the subject in this summary way. Of the eight Presidents up to Van Buren inclusive, all but one lived out the full term of life allotted them by the tables, the single exception being Washington. On the other hand, of the thirteen men who have held the office since Van Buren, all but four have died before living out their allotted term. This fact raises the question whether we can attribute these premature deaths to the more arduous nature of the duties which the President is now called upon to perform. From this point of view, the dividing line would not be between Van Buren and Harrison, but rather between John Quincy Adams and Jackson, because it was under the latter that the change in question took place. Perhaps we ought to introduce a third epoch with the civil war. Making such a division, and omitting the cases of Lincoln and Garfield, the exhibit, which seems to show a total deficit of 53 years since Jackson, stands thus : —

	Expected years.	*Actual years.*
Washington to Adams	87	128
Jackson to Buchanan	143	118
Johnson to Arthur	59	31

Notwithstanding the color thus given to the view that the modern President is liable to be broken down by the duties of his office, it must be considered, that, taking these numbers as they stand, the number of cases is too small to sustain such a conclusion. There is, however, another circumstance to be considered. It is a well-known fact that the tabular expectation of life has been considerably exceeded in the general average of men who, during the present generation, have insured their lives. How great the increase is, cannot at present be exactly stated, but I do not think that it is less than one-fourth. It will also, I think, be conceded that all who have acceded to the presidency have been men with good insurable lives. If, now, we increase the expectation of life by one-fourth in the last two lines above, we shall have a decidedly greater discrepancy : namely, expected years, 252 ; actual years, 149. If it were allowable to include the cases of Lincoln and Garfield, which are omitted in this comparison, the discrepancy would be greatly increased.

While the danger of assassination has undoubtedly been greatly lessened by the deserved fate which the two assassins of Presidents met, I do not think we can consider it as a vanishing quantity. I think assassination should be regarded as a real danger to which a President is subject, and that a prudent life-insurance company would consider that fact in deciding upon an application for insurance.

Since, even when we admit the case of assassination, there is a large falling-off in the years of life, the question presents itself, whether this is due mainly or wholly to the arduous character of the duty which the President is called upon to perform. Of course it is impossible to answer this question from statistics: in fact, it must be admitted that the above summary does not prove the diminished viability of the class under consideration to any greater extent than to render it somewhat probable. Statistics can at the present stage do nothing more than disprove or substantiate *a priori* conclusions from physiological considerations. If we eliminate from the statistical results the probable effect of the lack of out-door recreation, as well as the lack of incentive to adopt that regimen best suited to a sedentary life, we shall probably find no such discrepancy as would justify the view that a President is liable to die from the arduous character of his duties. S. N.

THE SCHOOLMASTERS' CONVENTION AT PHILADELPHIA.

IN answer to a call issued by the heads of prominent preparatory schools in or near Philadelphia, more than one hundred teachers engaged in preparing boys for college assembled on Nov. 26 in the building of the University of Pennsylvania at Philadelphia. The address of welcome was given by Dr. Pepper, provost of the university, who laid great stress on the waste of time and energy caused by the sudden break between school and college. He said that to devise means to fill up this gap, and make the preparatory school an organic part of the education that ends in the college or university, was the object of the convention.

Professor James of the University of Pennsylvania made a strong plea for the technical education of teachers. The teacher's position should be considered as an end in itself, not as a stepping-stone to more permanent employment. In Germany this requirement was fully recognized. There, with few exceptions, the teachers have received a technical training, the result of which was to give them not only some information which they could impart to their pupils, but also some knowledge of how to impart it. They are acquainted with the history of education, know something of the long line of thought of which they form a link, are taught what their place in the existing educational system is and how they can best fill it. The one method and the best method of elevating the teaching in this country is to make teaching a real and an honorable profession. For this purpose the teachers must be trained to be teachers, and an essential part of this training is the study of educational history and systems.

Mr. MacAlister, superintendent of public schools of Philadelphia, warmly upheld Professor James's position, and testified as a man of practical experience to the value and efficiency of the study of pedagogy as a science.

At the session on Nov. 27, Professor West of Princeton college presented an admirable paper on the question, 'How to improve our classical training.' The classics have just survived a severe attack, and for the time being there is peace; but a second attack is sure to come, and the problem is to take such steps as will enable an effective answer to be made to it. To do this, we must improve the teaching of the classics. The classics are attacked because they are poorly taught. There is no method, or at least no rational one. In order to get a rational and elastic though definite method, it is necessary to consider the nature of classical study, the condition of the student, and the end to be gained. The problem of teaching the classics is a unique one: there is more in it than the language drill, more than the compliance with the requisites of a liberal education. It includes nothing less than the opening up of a new world: it is an embodiment not only of Greek and Roman history, but of the national history of Greek and Roman thought. The end of classical training is to enable the student to feel at home in this world, and to appreciate it. To do this, no doubt a certain amount of literature must be sacrificed and dissected in acquiring the technique. But that is simply preparatory: when it is over, then the real study of the classics begins. The main difficulty in realizing this method of teaching the classics is the lack of teachers who really know them. Teachers trained as teachers, and trained as classical scholars (not necessarily as philologians), would soon show the real educational value of classical study, and give the best possible answer to those who question its usefulness.

The next session was held at Haverford college, and was devoted to the discussion of the relation of the fitting schools to the colleges. The discussion was quite a general one, and included the questions of admitting to college on certificate from the heads of schools; the advisability of having a preliminary examination a year before entrance on elementary subjects; the uselessness of petty conditions, and the abuses of this method of admittance; and the necessity of recognizing the various interests of candidates in the entrance examinations. The discussion showed how generally the faults of our college system are felt by the schoolmasters, and how anxious they are for changes to be made.

A constitution was adopted by the teachers present, and it was decided to hold quarterly meetings. The Rev. Dr. Robins was elected president, and Mr. George F. Martin, secretary.

The meeting was eminently satisfactory, and the organization has come to fill a real want in our educational system.

PHYSICAL EDUCATION.

The American association for the advancement of physical education held its second annual meeting at the Adelphi academy, Brooklyn, on Nov. 26. This association was organized one year ago under the auspices of such well-known men as Professor Hitchcock of Amherst, Dr. D. A. Sargent of Harvard, Dr. Hartwell of Johns Hopkins, Mr. William Blaikie, and others. By the terms of its constitution, it consists of active members who are directly engaged in physical education, of associate members including all who are interested in the cause of physical education, and desire to be associated with the society, and of honorary members, who shall be well known as patrons of the cause of physical education. Its membership is nearly one hundred, and is constantly and largely increasing. The general interest which it has aroused is shown by the fact that delegations from various societies throughout the west, including St. Louis and Milwaukee, were present, and took an active part in the proceedings. At the opening of the session, Mr. Charles Pratt read an address of welcome, in which he said that the ten thousand teachers of New York and Brooklyn had one of the most magnificent promenades in the world, and that, if they would walk the length of the Brooklyn bridge both ways every day, their health would be much benefited. He would have every one sign a pledge that he would solemnly observe all the laws of health, and do what he could to lead others to do the same. He believes that if each individual should take proper care of himself, not only in matters of exercise, but in other respects, the work done in five hours would be of more value than that now done in ten. Prof. E. Hitchcock of Amherst college followed with a paper on 'The need of anthropometry in physical training.' From the earliest times an effort had been made to establish some foundation upon which observations could be scientifically made. Such an attempt could be traced back to India. The same was true of the Greeks. . Thus we have the various systems, some regarding one foot of the height as a standard, and others the length of the hand and the vertebrae. The basis of all must be a knowledge of the human body, what it can do, its various temperaments, and how it can be kept up to the most perfect condition. The largest men are not necessarily the men who can endure the most fatigue, or who best resist disease. Into the problem many things enter, — the pedigree, including parents and grand-parents; did they live to old age, and did they die of disease or accident? what is the condition of the individual's heart? of his lungs, his eyes, his ears? It is a very difficult matter to ascertain just what a typical or ideal man should be, and therefore it is difficult to select a standard of comparison. The author thinks, however, that the height of individuals is the best basis, and would suggest a centimetre or one-half inch as the unit for charts of anthropometry. At Amherst accurate measurements are taken of each student who enters college; and these are repeated occasionally, so that now there are records of one thousand students. It is the practice at this institution to examine each man with great care, and to advise him as to the exercise which he should take. Professor Hitchcock, in closing, said that every instructor should take such measurements, and be satisfied with simply recording them. The data which we have now are very crude and incomplete, and no deductions can be made from them. We must continue our observations as opportunity offers; and, though we may not live to obtain much that is practical from them, let us nevertheless do our work accurately and well, that succeeding generations may profit from what we have done. The next paper on the programme was 'The physiology of exercise,' by E. M. Hartwell of Johns Hopkins university. Dr. Hartwell laid great stress on the point that exercise had more in view than the simple development of muscle. While this was in a sense important, it was only half the truth. Proper exercise trains the nerve-centres, the brain and the spinal cord, as well as the muscles. And this is exceedingly important, and should never be lost sight of. The following papers were read at the afternoon session: Physical training of public school children, by W. C. Joslin of Staten Island academy; Educational gymnastics, by Prof. Carl Betz of Kansas City, Mo.; German system of training teachers at the Milwaukee normal school, by C. G. Rathmann, St. Louis, Mo.: and Physical training from a medical stand-point, by A. M. Starkloff, president N. A. Turnerbund, St. Louis, Mo. Very interesting exhibitions of gymnastics were given by classes from the Brooklyn normal school of physical training, the turnvereins of New York and Brooklyn, and the Adelphi academy.

GEOGRAPHICAL NEWS.

M. DE LESSEPS, on his arrival at Paris, reiterated the assertion that the Panama canal will be opened in 1889, "even if the most difficult part of the cutting is not then complete." He added, that the portion then navigable will demonstrate that the original calculations were well founded.

The latest rumors about the Kongo are, that the station at Stanley Falls (the highest station established by Stanley) has been abandoned, owing to the continued hostility of the Arab slave-traders.

English capitalists having definitely decided to have nothing to do with the proposed Kongo railway, it is stated that a committee has been formed in Brussels to proceed to the Kongo and decide upon the feasibility of the project on the spot.

There are so many travellers now exploring the central portion of Asia, that it is extremely difficult to keep track of them. Dr. Radde arrived at Sarakhs on the 22d of July, after a successful journey through the now familiar regions of Merv, Penjdeh, Meruchak, Zulfikar, Askabad. Thence he repaired to Tiflis, where he arrived in the early part of September. As might have been expected, he suffered severely from the heat.

Two Frenchmen, MM. Capus and Bonvalot, traversed a portion of the same ground, spending a whole month in Merv. They reported the moving sand-hills, or 'Barchaus,' to be great obstacles to the construction of the Transcaspian railway. Their intention, when last heard from, was to search for a route to Balkh *via* the Amu-Daria. Thence they would attempt to reach Kafiristan over the Hindu Kush, hoping to find a pass free from snow, notwithstanding the lateness of the season. They have since been captured by the Afghans, and are now in close confinement.

There is a clear and valuable account of the recent troubles in Afghanistan, from a Russian point of view, in the London *Times* for Nov. 1 and 12. This purports to be a translation of a synopsis of a Russian 'blue-book.' It appeared originally in the *Journal de St. Petersbourg*.

The officers in charge of the Indian survey have already surveyed Burma from Mandalay southward along the Irawaddy as far as Pagan. It is probable that a rough sketch-map of upper Burma on a quarter-inch scale will be published before long.

Among recent school-maps we note 'The British empire on a uniform scale of 107 geographical miles to an inch,' by William Shaw (London, *Philip & Son*). Naturally the most extensive limits have been assigned to the British possessions; and this in some cases, as in Africa, to the great injury of other colonial powers. Altogether, the map, though useful, reflects scant credit on its author.

A good statement of the present condition of the British colonies, from the side of the colonies themselves, is 'Her majesty's colonies: a series of original papers issued under the authority of the royal commission.' The introduction is by Seeley, whose 'Expansion of England' has introduced him to a host of readers.

Determined to be up with the times, the geographers of Australasia have formed a geographical society, which has flourished so luxuriantly that a branch society, restricted to South Australia, has already put forth its first volume of Proceedings.

THE TRAINING OF THE MEMORY.

SYSTEMS of mnemonics are exceedingly numerous, and the number of persons who have discovered "the quickest and best way to acquire a perfect memory" is legion. Every once in a while some new and absurd book on the training of the memory is foisted upon the public, and each has its dupes. The trouble with them all is the same, — ignorance of the physiological conditions of memory, and a very inaccurate acquaintance with psychology. Therefore we must plead guilty to the possession of a prejudice against any book on the education of the memory. It was with this prejudice that we took up Dr. Holbrook's little book;[1] but the perusal of the preface and the introductory sections alone proved that for once at least a prejudice against books on training the memory was unfounded. Dr. Holbrook writes with a physiological and psychological knowledge of his subject, and he treats it in a plain, straightforward, common-sense way. After showing the physiological basis of memory, he draws the practical conclusion that robust health, a well-nourished brain, and a healthy nervous system are the normal physiological conditions of a good memory. The psychological conditions are strict attention to sensory impressions, repetitions of them, and the formation of chains of association for them. The value of association may be tested by any one who is foolish enough to doubt it, by making the test given by Dr. Holbrook on p. 113, quoted from Dr. Pick's work on training the memory. We ourselves have tried it with several persons, and found it a most excellent and practical illustration. The practice of making notes of important matters is adverted to and commended, even if the notes are at once thrown away, because the process of writing the fact, name, or date down increases our attention to it,

[1] *How to strengthen the memory.* By M. L. HOLBROOK, M.D. New York, *Holbrook*, 1886. 12°.

and deepens the original sense-impression. Dr. Holbrook gives wholesome advice to persons of weak memories, and shows how such may be trained to become very retentive and accurate. A few judicious paragraphs are given on the art of forgetting, instruction in which is quite as necessary for that class of persons who insist on overloading their memories with all sorts of mental rubbish, as is instruction in remembering for those minds which seem to retain nothing.

LONDON LETTER.

An interesting discovery has very recently been made in the direct line between Pompeii and Nocera. The digging of a well in a vineyard revealed the existence of a street of tombs, about one thousand feet east of the amphitheatre of Pompeii. If the whole street is as closely lined with tombs as is the portion laid bare, it will be one of the most important discoveries lately made in that part of the world; but unfortunately money is wanting, so that the excavation is going on very slowly. Most of the tombs are covered with rude inscriptions painted in red, many of them being of the nature of advertisements, the tombs thus serving the purpose of a newspaper along the much-frequented road. The exact date has not yet been accurately ascertained, but they probably belong to the periods of Julius Caesar and Tiberius. A contrast may be drawn between the condition of Pompeii and that of Pergamon, which, although double the size of Pompeii, has, thanks to the energy of the Prussian government, been laid clear within eight years. In the latter, beautiful, finely painted statues, votive offerings to Athena, and belonging to the sixth century B.C., have been found buried in the earth, and literally forming the foundation of the houses above. Their style of art is one hitherto not supposed possible at so remote a period, and they cause Pompeii to appear quite modern.

The discovery of an aqueduct which probably dates back to the time of King Solomon is reported from Jerusalem, and it is confidently anticipated that the further excavation of it will bring to light some extremely interesting and valuable inscriptions.

The following particulars with regard to the Severn tunnel, which shortens the distance between the South Wales coal-field and the south and west of England, and which was opened yesterday for passenger traffic, may be of interest. The first sod was turned in March, 1873. The length of the tunnel is 7,664 yards, or 4¼ miles, of which 2¼ miles are under the river-bed, with a minimum 'cover' of 45 feet, and a maximum of 100; all this portion being bored through hard sandstone, conglomerate, and red marl, and costing roughly £100 per yard. The works have been flooded by land-springs four times, and the total cost is about two millions sterling. The tunnel is lined throughout with vitrified brick, set in about three feet thickness of cement.

It is announced to-day that Professor Rücker, F.R.S., has been appointed by the lord president of the council to the professorship of physics in the Normal school of science, and Royal school of mines, South Kensington, London, made vacant by the death of Professor Guthrie, F.R.S. The friends of the latter will regret to learn that his widow and family are but ill provided for, in consequence of the numerous family claims upon him during his life, and it is probable that the Physical society of London will start a fund on their behalf. Professor Rücker was, until recently, professor of physics at the Yorkshire college, Leeds, after which he unsuccessfully contested a parliamentary election for that city.

The reading and discussion of Mr. Gisbert Kapp's paper on the 'Predetermination of dynamo characteristics' have occupied three evenings (one a special and extra meeting) at the Society of telegraph engineers and electricians. The paper dealt with the construction beforehand of what may be called the 'idle' characteristic curve of dynamos; and the discussion turned in great part upon the questions of magnetic resistance, and especially of air resistance, as well as on the analogy between the electric and magnetic circuits. Before commencing his paper, Mr. Kapp stated that only two days previously he had found that many of his points had been anticipated in a paper on dynamo-electric machinery, by Dr. J. and Dr. E. Hopkinson, communicated to the Royal society in May last, but which had only just been published. It is greatly to be regretted that the routine of the Royal society prevents an earlier publication of important scientific papers which have a direct bearing upon industrial progress.

One result of the more extended adoption of the electric light in public buildings in London is a notable increase in the number of winter exhibitions of pictures. Nearly all artistic societies of any importance now hold their 'winter exhibitions' with as great regularity as the summer ones, which open in May. The electric lighting of the Grosvenor gallery, due chiefly to Sir Coutts Lindsay, first demonstrated the advantages which were thus obtainable.

The disinfection of articles of clothing, and of dwellings, after infectious ailments, is admittedly one of the most important duties which attends the work of preventing disease. A recent report of the medical officer of the local government board presents the entire question of the destruction of germ-life in a new aspect, including, as it does, a memoir on disinfection by heat, from the pen of Dr. Parsons. The degree of dry heat necessary to kill the germs of diseases well known to be infectious was first investigated. The bacilli of splenic-fever, for example, were killed by exposure for five minutes in a dry heat varying from 212° to 218° F. but their spores did not yield to two hours at 220°. One hour at 245°, and four hours at 220°, achieved the result. Some very remarkable practical instances are given of the difficulty with which dry heat penetrates such articles as bedding, blankets, and pillows. For example: a thermometer enveloped in a roll of flannel, placed in a hot-air bath at 212°, only registered 130° at the end of one hour! Dr. Parsons demonstrated by numerous experiments that steam at or above 212° possesses a very much greater power of penetration and disinfection than dry heat, and that, where actual steam cannot be employed, moistening the air of the heated chamber materially reduces the time required for efficient disinfection. Apparatus for thus treating the clothes, etc., of the sick poor ought to be a feature of the municipal arrangements of every city.

The sewage discussion (started by Dr. Meymolt Tidy's paper, alluded to in this correspondence in the summer) was continued, but not concluded, last night. Dr. Alfred Carpenter made a very strong speech in favor of irrigation, pointing out that the milk obtained from the sewage farm at Croydon was consumed with perfect safety. On the question of standards, a decided opinion was expressed, that these constant discussions of chemists would before long lead to a complicated formula, which would become a standard in a particular case.

A curious discussion, which attracts a good deal of attention, is now going on upon the use of boracic (or boric) acid for the curing of fish. It is being largely employed by the Norwegians; and the result is, that Scandinavian herrings are to some extent superseding the Scotch produce in the English market. Opinion is largely divided upon its toxic properties, in repeated small doses, and the whole matter is so new, that *experientia docet* will hardly avail. The first observation of the preservative power of alkaline borates is said to have been made in the case of a dead horse in southern California. W.

London, Dec. 2.

Hubert Herkomer, Slade professor of art at Oxford university, proposes to paint before his classes as a means of instruction.

NOTES AND NEWS.

In referring to the work of the appropriation committee recently on the floor of congress, Mr. Long from Massachusetts remarked that "it ought to be said in justice that the coast survey is in a condition of suspension, owing to the unaccountable, and, I think, culpable neglect of the President to appoint a man of scientific attainment at its head. The committee on appropriations have some reason for saying that they do not feel like giving full weight to the recommendation of a superintendent, unless that superintendent be a man of scientific acquirements. The gentleman who is at the head of it — an estimable man, who is doing the best he can, and is to be credited for what he has done — is not and does not pretend to be a man of any fitness or any training for the place. He would frankly say, I have no doubt, that he regards himself merely as a *locum tenens*, and is ready to give it up whenever the President will select the proper man. And yet for nearly two years the President of the United States, turning a deaf ear to the demands of science and commerce, refuses to fill this post, for which there is no lack of worthy material, and is making this coast survey the sport almost of public opinion."

— The recent death of Paul Bert, and the publication of a new edition (Philadelphia, *Lippincott*) of his 'First steps in scientific knowledge,' are amply sufficient reasons for calling further attention to that admirable little book. Its phenomenal sale in France, and the large sale of the English edition, apart from the intrinsic excellence of the book itself, warrant us in predicting the great success of the edition prepared for American schools by Prof. William H. Greene of Philadelphia. Though embracing the elementary facts of natural history, geology, physics, chemistry, anatomy, and physiology in some four hundred and fifty duodecimo pages, M. Bert's book is at once thorough, simple, and exact. It is a book which should find its way into every school in the country pretending to give a sound mental training; and the mastery of it, or its equivalent, should be required for admission to every high school and college in the land.

— Professor Heinrich von Treitschke of the University of Berlin has been appointed royal historiographer of Prussia, in succession to the late Leopold von Ranke.

— The steamer A. D. Bache, of the coast survey, will leave New York this week for the coast of Florida, where Assistant Hergesheimer is already at work. Assistant Perkins will commence work on the south coast of Florida about Jan. 1.

All the parties on the transcontinental geodetic work have now left the field on account of the winter season; all the parties on the Pacific coast also have been withdrawn from the field on account of the lateness of the season.

— The Saturday morning lectures given by Professor Boyesen and Dr. Butler at Columbia college last spring, proved so successful that arrangements are making for a number of similar lectures to be given during the winter and spring of 1887. The lectures will be open to the public, and tickets may be obtained free of charge by application to the registrar at Columbia college. Among the announcements definitely made are two lectures by Professor Munroe Smith on Bismarck, on March 12 and 19, and two on pedagogics by Dr. Nicholas Murray Butler on March 26 and April 2. It is also expected that Professors Boyesen and C. S. Smith, and Instructors Goodnow and Scribner will deliver lectures.

— Somebody has been figuring out the average salary paid to teachers in a selected list of leading cities in the United States, with the following results: —

San Francisco	$980.06	St. Louis	$607.01
Boston	933.08	Albany	606.58
Cincinnati	728.25	Brooklyn	606.22
New York	707.90	Kansas City	606.13
Chicago	705.66	Detroit	605.19
Dayton	698.28	Indianapolis	601.79
Columbus	672.71	St. Paul	599.87
Washington	671.65	Providence	505.77
Springfield	641.64	Louisville	595.41
Newark	638.01	Buffalo	588.49
Milwaukee	631 94	Baltimore	576.87
New Haven	614.00	Nashville	570.82
Minneapolis	607.40	Philadelphia	517.51

— We have received from Messrs. Macmillan a number of books in their Clarendon press series for schools. They are, as a matter of course, models of book-making, and it is a luxury to use them. Abbott's 'Greek reader' is novel, for it substitutes Aesop's 'Fables,' and stories from his life, for the traditional selections from the Anabasis. Miss Buchheim's new edition of Niebuhr's 'Griechische heroen-geschichten,' and Saintsbury's capital edition of Racine's 'Esther,' as well as his selections from Gautier, are doubly welcome, because they furnish material for placing elementary modern-language instruction on a higher plane. The meaningless sentences and the scraps of prose literature too often forced upon the young student of French and German, not only fail to give him a thorough and accurate knowledge of the grammar, — for which purpose they are presumably intended, — but they deaden his interest, and blunt his literary sense, at an age when both should be stimulated and encouraged. The use of some such books as these prepared by the Clarendon press is infinitely preferable. To Mr. Wickham's notes on selected odes of Horace, published in the same series, we have but one observation to make, and perhaps that should be addressed to the publisher; that is, that notes of this class and extent are needed within the same covers as the text itself, and nothing is gained, but much lost, in convenience, by binding the notes separately. We believe, however, that the publishers do have an edition in which both odes and notes are bound together.

— Copenhagen has, according to the census of this year, 285,700 inhabitants, an increase of 1.6 per cent in the last twelve months.

— According to Professor Heim of Zurich, there are 1,155 glaciers in the Alps, of which 249 are more than 7,500 metres in length. The glaciers are distributed as follows: in Switzerland, 471; in Austria, 462; in France, 144; and in Italy, 78. The largest glacier is the Aletsch, which stretches over 24 kilometres. The total surface of the glaciers is estimated at 4,000 square kilometres, of which the glaciers in Switzerland alone furnish 1,840 square kilometres.

— There are 510 kilometres of railway in Greece.

— The first Siberian university has recently been opened at Tomsk.

— Khartum, which is in ruins through the fortunes of war, has yielded its precedence as the principal town of the eastern Soudan to Omdurman on the White Nile.

— The correspondents in Switzerland and France, of the London *Journal of education*, report the following news, which is of general interest. In Switzerland the minister of instruction has taken in hand a revision of the law on higher education of 1879, on the following grounds. The present code is not based on sound psychological principles, and ignores almost entirely the natural development of the mind. Some subjects, eminently fitted for the earlier years of the intellectual development of the pupils, are reserved for the higher classes only, while the lower classes are chiefly occupied with very indigestible matter. The teaching of classics, as at present carried out, has a most pernicious influence in the school. It is commenced too early, too much time is given to it, and it is not apportioned on rational grounds. Latin and Greek stand in the way of many subjects of equal value with regard to mental training, and of far greater significance in actual life. The pupils, as a rule, take little interest in their classical studies. But this is hardly to be wondered at, seeing that the study of literature is not begun until the fourth year in most *gymnasia*, more than three years and a half being spent on a purely grammatical course. The proposed reform will chiefly consist in relegating the classics to the higher classes of the *pro-gymnasia* and to the *gymnasia*, and in giving a greater share of the time-table to modern languages. In France the study of modern languages, so long neglected, is being encouraged with great zeal, and at a considerable outlay of money. The minister of instruction, M. René Goblet, intends to send those students of the *Faculté des lettres* who have been recommended to him for industry and ability, to Germany and England after the first year of their university course. All their expenses are to be defrayed by the state. Their stay is to extend from July to December.

— Professor Alphonse Mongeol of the lycée at Aurillac writes in *L'université* as follows concerning the necessity for a knowledge of German: "The German language is spoken by more than eighty millions of persons in Germany itself, in Austria, Switzerland, Belgium, Holland, Russia, and America. On a recent journey from Constantinople to Paris by way of Buda-Pesth, Pressburg, Vienna, Linz, Salzburg, Augsburg, Ulm, Stuttgart, Carlsruhe, and Strasburg. I called the attention of my companions to the fact, that, although we stopped in a number of the finest cities of Europe, it was not until we reached Strasburg that the French language was of the slightest use to us. In all branches of science Germany stands at the top. I need not refer to the countless number of publications on scientific and literary subjects which appear annually in Germany, and which it were folly to think of translating into French. The rector of the school-district of Clermont lately told me that he would gladly exchange all that he knew of Greek and Latin for an equal knowledge of English and German. Who is there among our scholars, or how many can we count in our entire nation, who can deliver a scientific address in the German language as Dr. Koch lately spoke in French at Marseilles, and the archeologist Schliemann at Constantinople?"

— Dr. Percival, president of Trinity college, Oxford, has been appointed head master of Rugby school, and has accepted the appointment. Dr. Percival is an LL.D. of the University of St. Andrews.

— At the recent election for a lord-rector of St. Andrews university, Mr. A. J. Balfour, M.P., secretary for Scotland, was chosen by a majority of twenty votes over Sir John Lubbock, M.P.

— Principal Sir William Muir of the University of Edinburgh has announced that arrangements have been completed for conferring a special schoolmaster's diploma, and that regulations have been adopted for the granting of the same. The diploma shall be conferred only on graduates in arts of the University of Edinburgh, who have attended the education class of the university, and who have passed an examination in the theory, art, and history of education, to be conducted by the professor of education and an additional examiner. Each candidate must give evidence that he has attended a course of practical instruction in a training-college for teachers; or that he possesses the government qualification in the practice of teaching required of graduates, and provided in the Scottish code; or that he has taught publicly at least one year in a school, and holds a satisfactory certificate of practical skill from the head master of that school. As the first additional examiner of this scheme, the university court has appointed Mr. Maurice Paterson, B.A., rector of the Free church training-college, Moray House, Edinburgh. The subjects of examination in April, 1887, are, 'The class lectures of the professor of education;' Locke, 'On the conduct of the human understanding;' Milton, 'Tractate on education;' Comenius, 'Great didactic.'

— The Edinburgh association for the university education of women, founded in the winter of 1867–68, for the purpose of providing for women means of the higher education as nearly as possible equivalent to that provided for men in the Scottish universities, has opened, for the session 1886–87, classes in English literature, junior mathematics, senior Latin, and logic, conducted by university professors and assistants; and a class in physiology. Not only do students receive class certificates, signed by the professors and lecturers, but, by special regulations of the University of Edinburgh, students who have attended a certain number of the association classes, and have passed the local examinations of this or some other university, are admitted to examinations for further distinctions, in the form of ordinary and honor certificates in arts, granted by the university itself, and signed by the vice-chancellor. A sufficiently extensive course of study in the classes, thus stamped with the approval of the university, entitles to the full diploma of the association. At the end of last session, eight students gained ordinary, and four honor certificates, while two gained the full diploma of the association.

— At Oxford a new hall for women, called St. Hugh's, has been opened. It is intended for the benefit of members of the English church. The annual charge for board, residence, etc., is £45, and the tuition and lecture fees amount to £15 more.

— In the November issue of the *Revue internationale de l'enseignement*, M. Buisson concludes his account of the colleges and universities of the United States. In this last article he describes Yale, University of Michigan, Johns Hopkins university, the American school for classical studies at Athens, and colleges for the higher education of women.

— The new vice-chancellor of Cambridge university is Dr. Taylor, master of St. John's college.

— The various state teachers' associations take advantage of the Christmas vacation to hold their annual or semi-annual meetings. Among others, the New Jersey teachers are to meet at Trenton; the Iowa teachers, at Des Moines; the Michigan teachers, at Lansing; the Associated academic principals of New York state, at Syracuse.

— M. Goblet, the minister of public instruction in M. de Freycinet's cabinet, has become premier of France. The new minister of public instruction is M. Berthelot, who has been for some time an inspector of secondary schools.

— Dr. W. W. Ireland, the well-known alienist, publishes in the *Journal of mental science* (October, 1886) an admirable account of the insanity of King Louis II. of Bavaria. The influences of hereditary neuroses, the gratification of what were at first slight eccentricities, and the gradual evolution of the most serious symptoms of hopeless insanity, make this case almost a type of the influences most favorable to mental instability. The king was not only insane, but typically insane.

LETTERS TO THE EDITOR.

****Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Pleuro-pneumonia.

IN your issue of Nov. 26 you speak of the prevalence of pleuro-pneumonia in the counties of Harvard, Clinton, Newton, Jasper, and Benton.

1°. There is no Harvard county: presumably you mean *Howard*.

2°. Dr. Salmon and the officers of the state board of health declare the disease to be 'black leg,' and up to date about 400 head have died in this state. Dr. Salmon announces there is now no pleuro-pneumonia in the western states except at and near Chicago, Ill.

AMOS W. BUTLER.

Brookville, Ind., Nov. 29.

[The reports that contagious pleuro-pneumonia existed in Indiana are denied, and it is now stated that what was reported to be that disease is pronounced by Dr. Salmon and the officers of the state board of health to be 'black leg,' from which 400 head of cattle are said to have died. It is also stated that Dr. Salmon of the U. S. bureau of animal industry has announced that there is no contagious pleuro-pneumonia in the western states except at and near Chicago, Ill.

On this subject we quote from a letter just received from Dr. D. E. Salmon, chief of the bureau of animal industry: "In reference to the districts in which contagious pleuro-pneumonia exists in the United States, would say, that beginning with Long Island, New York, and Westchester counties, in the state of New York, we have found it to exist in various parts of New Jersey and the south-eastern part of Pennsylvania. The points of infection are continually changing in these states, and it is a very difficult thing to make a definite statement by counties. In Maryland there is a good deal of the disease in Baltimore and vicinity, but the remainder of the state appears to be nearly free. The District of Columbia has been infected for a long time, but I do not know of any herds here in which the disease exists now. Probably a vigorous inspection would discover some. In Virginia I do not know of any infected district except Norfolk. This is all there is east of the Alleghanies. In the Mississippi valley states there is but one outbreak at present, and that is in Cook county, Ill. The disease which I investigated in Indiana was 'verminous bronchitis,' or lung worms." — ED.]

Liberty's torch.

The noble statue of Bartholdi in New York harbor suffers a great injustice, so far as the idea of its conception goes, and the requisites for its most complete artistic presentation is concerned, in being made to hold a star in its hand instead of a wavering pile of flame. The blue orb of intense light shining from the uplifted hand poorly represents the lambent and rolling stalks of fire which the thought of a torch suggests, and fails to accentuate the statue with any dramatic or spectacular force.

The attempt should be made to burn a large volume of gas properly distributed over the present surface of the torch, and this would seem altogether feasible. A consumption of from a thousand to two thousand cubic feet of gas per hour might be required, but the result would be incomparably more striking and noteworthy. A series of one-inch pipes passing up into the torch, emerging at various points so as to completely invest it with the confluent flames issuing from their openings, would probably serve the purpose, the gas being permitted to burn under a pressure but slightly in excess of its own ascensional power. Two objections might be urged against this proposition, — first, the smokiness of the flame, producing an ugly and dirty appearance; second, the probability of its extinction in high gales. The first objection has not really much weight, as the tail of drifting smoke would hardly detract from the splendor of the pillar of flame, and in any case could be considerably overcome by an efferent tube with a perforated circular cap feeding air to the summit of the torch, somewhat on the plan of the central air-channel in the popular climax oil-lamp. The second objection is valid, but only in extreme cases; and, as the gas should be lit by electricity, the highest gales would only alter the constancy of the light, its extinction being succeeded by the renewed flame. Again by curving the extremities of the pipe, even these exceptional cases might be yet further reduced in number. The gas might be supplied from the mainland, or if that appears too expensive, or itself impracticable, naphtha or gasoline gas (enriched air) could be safely used, the precaution being taken of substituting for the large tubes bundles of smaller pipes.

The penetrative power of such a flame, and hence its beneficial uses in the foggy weather of our latitude, combined with its *photometric massiveness*, would compare, it would seem, very favorably with the incandescent point of light which now at night marks the watch-tower of Liberty on Bedloe's Island, and in fogs dimly shines through the mist in an apologetic and feeble way quite disappointing.

L. P. Gratacap.

New York, Dec. 15.

The relations of our colleges and preparatory schools.

In *Science* for Nov. 26 you comment editorially on the teachers' convention at Philadelphia, and close with the sentence, "It would be especially notable should it prove to be the first step in bringing our colleges and preparatory schools into frequent and close conference in some official manner."

Allow me to call your attention to the fact that in Michigan there now exists, and has existed since the year 1870, a relation between the university and the public high schools of the state, under which the graduates of schools, whose courses of study have received, after personal inspection by a committee sent for that purpose, the approval of the university faculty, are admitted to the university on the presentation of their high-school diplomas. The inspection of the schools is repeated at intervals, whenever it seems desirable to do so.

The privilege of admission on diploma, which was at first restricted to the public high schools of Michigan, has been gradually extended, and at the present time the University of Michigan holds this close official relation with thirty schools, public and private, in Michigan, and also with schools in New York, Illinois, Minnesota, and California.

Wm. H. Pettee.

[We were, of course, aware that in Michigan there is a system of co-ordination of university and high schools and academies, and we are now gratified to learn that this co-ordination embraces schools outside of the state of Michigan. It is to be regretted that this system is not adopted generally by our universities and colleges, and we renew our expression of hope that the late Philadelphia conference may emphasize the value of the Michigan system, and lead to its general adoption.—Ed.]

The Americanists.

There is a ludicrous slip of the pen in the account given in the last number of *Science*, of the Proceedings of the sixth congress of Americanists, held at Turin in September last. Supreme wisdom does not always seem to preside over the councils of this learned body; but it is hardly fair to Professor Grossi to represent him as having read a paper on the 'coins' of the old and new worlds before a society devoted to the study of prehistoric questions. What he had to say was about *momies*, and not *monnaies*, in the two continents, and was a sensible and learned discussion of the question. The same gentleman also presented a paper upon pyramids in the old and new worlds, and one upon the folk-lore of the primitive tribes of America.

Henry W. Haynes.

Boston, Dec. 13.

A new bat from Puget Sound.

Among the specimens collected in 1880 by Prof. D. S. Jordan, in the vicinity of Puget Sound, for the national museum, is a small bat, which, upon examination, proves to be different from any hitherto described. It resembles the common blunt-nosed bat, V. lucifugus, but differs from it in several important characters. Most noticeable of these is the great length of the tibia; and I have therefore thought it appropriate to name the species Vespertilio longicrus. It is the third species added to the fauna of the United States during the year. I subjoin a brief diagnosis.

Vespertilio longicrus: fur uniform, umber color above; the same below, but with the upper fourth dull Naples yellow; interfemoral membrane clothed above and below to a line joining the centre of the tibiae; ears shorter than the head; inner margin of the conch convex, that of the tragus concave; calcaneum reaching only to middle of hind margin of interfemoral membrane; teeth as in V. lucifugus, but first premolar not imbricate with canine; brain-case very high; length of head and body 47.5 mm., head 16; height of ear, 12.5, tragus 6.5, fore-arm 39, thumb 6, tibia 20, foot 7.5.

F. W. True.

U.S. nat. mus., Dec 17.

Preliminary description of a new pocket gopher from California.

Mr. F. Stephens, one of my Californian mammal-collectors, has sent me several specimens of a small pocket gopher, of the genus Thomomys (Thomomys talpoides perpallidus, sub-sp. nov.), which I do not find described. The sub-specific name 'perpallidus' refers to the very pale color of the animal. It may be distinguished at a glance from all its congeners, except T. clusius of Coues, by its color, which is very pale brownish-yellow above, and white underneath and on the sides and legs. It differs from T. clusius in the great length of its tail, which is half as long as the head and body, and in other characters which will be pointed out in a later paper on the animal. All the specimens were captured on the arid Colorado desert, in southern California, in March and April, 1886.

C. Hart Merriam.

Contents of foreign educational periodicals.

Zeitschrift für schul-geographie, October.—Bemerkungen zum geographischen unterricht an den gymnasien nach den neuen instructionen, Dr. Karl Lechner.—Ueber das verhältniss des land- und wasserareales auf der erdoberfläche.—Notizen, literatur, u s.w.

Zeitschrift für schul-geographie, November.—Einige bemerkungen über den zustand der geographie in Dänemark als schulfach, Prof. Dr. Löffler.—Die verbesserung des julianischen kalenders, Dr. Pein-Belgrad und seine umgebung, Prof. G. Jauss.—Die prairie, ein geographisches charakterbild.—Notizen, literatur, u s.w.

Zeitschrift für das realschulwesen, November.—Die pluralisation der substantivischen wortcomplexe im Französischen, Felix Zverina.—Der planimetrische und constructive unterricht in der unterrealschule, Joseph Bayala.—Schulnachrichten, notizen, anzeigen, u.s.w.

Bulletin mensuel de la ligue française de l'enseignement, November. — Les sociétés d'éducation civique et militaire, Jean Macé. — Cantines scolaires de Toulouse, Eugene Dubief. — Faits divers.

Canada educational monthly. — Annual convention of Queen's university. — A plea for our reading-circles. — The relation of higher education to religion, President William DeWitt Hyde. — Lord Derby on juvenile education — Children past and present. — Preserve the voice of the child. — Notes, correspondence, etc.

Pädagogisches archiv. — Die ersten sätze der stereo tomie. Dr. C. Lackemann. — Die verdeutschungsbestrebungen der gegenwart, Regierungs-rath Sarrazin. — Unterrichts minister Trefort über die schulreform. — Sprachsaal, anzeigen, nachrichten, u.s.w.

Educational times, December. — Folk-tales. — Meeting of the Council of the college of preceptors. — University and college intelligence. — Educational notes and summary. — The retirement of Mr. Matthew Arnold. — Education in India. — Dr. Percival's election to the mastership of Rugby. — The Bishop of London at the City of London college. — Reviews, notices, etc

Journal of education, December. — Occasional notes. — Practice *versus* theory, E. R. Wethey. — The training of elementary school teachers. — A fair field and no favor. — English literature and the classics. — Reviews. — Sonnenschein's cyclopaedia of education. — Sunday at school. Rev. J. Robertson; A lay brother's reply. — Correspondence. — History-teaching, a lesson from America. — Notices, etc. — The training of the faculties of judgment and reasoning, H. Courthope Bowen. — Education in Australia. — The teachers' guild of Great Britain and Ireland.

Revue internationale de l'enseignement, Nov. 15. — Ouverture des conférences à la faculté des lettres de Paris; Allocution de MM. Lavisse et Petit de Julleville. — Le Droit et le Latin, M. J. E. Labbé. — Universités et collèges d'enseignement supérieure aux Etats-Unis, M. E Buisson. — La nouvelle loi sur l'organisation de l'enseignement primaire, M. Carré. — Chronique, nouvelles, bibliographie.

Educational articles in miscellaneous periodicals.

Alcoolismo, sue conseguenze morali e sue cause. E. Morselli. *Rivista di filosofia scientifica*, October.
[A review of N. Colajanni's book of the same title.]

Anatomistes anciennes, les. M. A. Laboulbène. *Revue scientifique*, Nov. 20.

Application de la psychologie à la classification des races. G. Le Bon. *Revue philosophique*, December.

Bibliographie u. quellen-kunde der österreichischen literaturgeschichte. J. Minor. *Zeitschrift f. d. österreichischen gymnasien*, Oct. 14.

Breymann de l'étude des langues modernes. Anonymous. *Revue critique*, Nov. 1.
["L'étude de M. Breymann se divise en deux parties: dans la première, il recherche le but que poursuit l'enseignement des langues dans les universités allemandes; dans la seconde, il examine les moyens d'arriver à ce but"]

British school at Athens. Unsigued. *Macmillan's magazine*, December.

Dean Plumptre's 'Dante.' Bishop of Ripon. *Contemporary review*, December.

Educational methods. George Sand. *North American review*, December.

English literature at the universities. Unsigned. *Macmillan's magazine*, December.

Enseignement de la philosophie dans l'université de France, l'. M. Emile Beaussire. *Revue des deux mondes*, Nov. 1.

Enseignement des sciences; les femmes-médecins en Angleterre. Unsigned. *Revue scientifique*, Nov. 27.

Genève et la nouvelle loi scolaire. Ernest Stoehlin. *La nouvelle revue*, Nov. 1

Goethe and philosophy. Prof. Edward Caird. *Contemporary review*, December.

Hellinisme dans les ecrivains du moyen âge du VII^e au XII^e siècle, l'. A. Delboulle. *Revue critique*, Nov. 1.
[A review of Abbé Tongard's book of the same title.]

How I was educated. Pres. E. G. Robinson. *Forum*, December.

Hypnotisme et responsabilité. Mm. Binet et Féré. *Revue scientifique*, Nov. 13.
[An extract from the forthcoming work by these authors on animal magnetism]

Influence des femmes dans la littérature française, l'. F. Brunetière. *Revue des deux mondes*, Nov. 1.

Intellectual mission of the Saracens, the. Edward Hungerford. *Atlantic monthly*, December.

Life at the Scotch universities. J. Leys. *National review*, December.

Loi sur l'organisation de l'enseignement primaire. *Journal des economistes*, November.
[The full official text of the new French law regulating primary instruction.]

Master of Trinity, the late. Unsigned. *Temple Bar magazine*, December.

Miller manual labor school of Albemarle, Va., the. *Scientific American*, Dec. 11.

Modern philosophy: realism *vs.* idealism. R. S. Moffatt. *National review*, December.

Mouvements réfléchis de l'enfants, les. *Revue scientifique*, Nov 20.
[A chapter from the forthcoming French translation of Preyer's 'Die seele des kindes']

Mysticisme au XII^e siècle. M. Ch. Levèque. *Revue politique et littéraire*, Nov. 13.

Notes on Americanisms. R. A. Proctor. *Knowledge*, December.

Object of a university, the. Elisha Mulford. *Atlantic monthly*, December.

Open spaces and physical education. Lord Brabazon. *National review*, December.

Professeurs de littérature dans l'ancienne Rome et leur enseignement depuis l'origine jusqu'à la mort d'Auguste. Charles Cucuel. *Revue critique*, Nov. 1.
[A review of M. E. Juillen's book of the same title. "L'école, l'élève, la famille, le pedagogue, le professeur, l'enseignement (auteurs, grammaire, littérature), les devoirs, les études accessoires, M. Juillen examine successivement chacun de ces points avec une netteté jointe à une abondance de détails dont on ne sauvait trop se feliciter."]

Science and morals. Prof. T. H. Huxley. *Fortnightly review*, December.

Techner's und Sweet's vorschläge zur reform des unterrichts im englischen. H. Klinghardt. *Englische studien*, Sept. 15.

Thought-reader's experiences, a. Stuart C. Cumberland. *Nineteenth century*, December.

Uniforme des élèves de l'école normale, l'. M. Dionys Ordinaire. *Revue politique et littéraire*, Nov. 6.

Wiese's (L.) Lebenerinnerungen u. amts-erfahrungen. Friedrich Paulsen. *Berliner philologische wochenschrift*, Sept. 11, 1886.

[An excellent account by Professor Paulsen of Dr. Wiese's educational work and influence.]

Zwang-erziehung verwahrloster kinder in Hessen. Dr. Ludwig Fuld. *Jahrbücher f. national-ökonomie u. statistik*, Oct. 23.

Calendar of Societies.

Chemical society, Washington.

Dec. 9. — H. W. Wiley, Our sugar-supply.

Anthropological society, Washington.

Dec. 7. — H. C. Yarrow, Navajo treatment of ague; H. Ten Kate, Travels in Guiana and Venezuela; Cyrus Thomas, Mound - exploration work of the bureau of ethnology.

Biological society, Washington.

Dec. 11. — Theobald Smith, Parasitic bacteria and their relation to saprophytes; F. A. Lucas, On the osteology of the spotted Tinamou (Nothura maculosa); C. D. Walcott, Tracks found on strata of upper Cambrian (Potsdam) age; Frank Baker, The foramen of Magendie; C. Hart Merriam, Contributions to North American mammalogy of a new sub-species of pocket gopher.

Philosophical society, Washington.

Dec. 18, *election of officers for* 1887. — President, William Harkness; vice-presidents, C. E. Dutton, Garrick Mallory, J. R. Eastman, G. K. Gilbert; treasurer, Robert Fletcher; secretaries, Marcus Baker, J. H. Kidder; members at large of the general committee, H. H. Bates, F. W. Clarke, W. H. Dall, E. B. Elliott, G. B. Goode, H. M. Paul, C. V. Riley, W. C. Winlock, R. S. Woodward.

Engineers' club, Philadelphia.

Dec. 4. — Carl Hering, Analogies between electrical and mechanical units and phenomena; A. H. Howland, On the general subject of water-pipes; Rudolph Hering, Notes upon the present investigation of the drainage and water-supply of Chicago.

Academy of natural sciences, Philadelphia.

Nov. 30. — Miss Helen C. De S. Abbott, Haematoxylin; Professor Ryder, The transmission of morphological changes; G. A. Koenig, Boiler incrustation; On schorlemite as a variety of melanite.

Torrey botanical club, New York.

Dec. 14. — Julius Bisky, Additions to the flora of Queens county, N.Y.; Arthur Hollick, Revision of the species Cerastium arvense, L., and its varieties.

Institute of social science, New York.

Dec. 22. — Simon Sterne, Free trade.

Jan. 13. — A paper is expected on The economic heresies of Mr. Henry George.

Natural science association, Staten Island.

Dec. 11. — Mr. Henshaw, Azolla Caroliniana, Willd; W. T. Davis, Fasciated stems and branches from Rhus glabra and Ailanthus glandulosus; Mr. Hollick, Glaciation on the island.

Connecticut academy of arts and sciences.

Dec. 15. — J. H. Emerton, New England spiders of the family Ciniflonidae; J. T. Fewkes, Is the vast mass of oceanic water, between the surface and bottom, barren of life, or occupied by a peculiar fauna?

Society of arts, Boston.

Dec. 9. — Elihu Thomson, New art of electric welding.

Society of natural history, Boston.

Dec. 15. — Edward G. Gardiner, Recent researches on a third (rudimentary) eye in lizards; W. M. Davis, The mechanical origin of the triassic monoclinal in the Connecticut valley.

Brookville society of natural history, Brookville, Ind.

Dec. 7. — A. W. Butler, Some notes on the habits of turtles; C. F. Goodwin, Observations on the sense of vision in domestic animals; Joseph Lindsay, The manufacture of paper.

Publications received at Editor's Office, Dec. 6-18.

Agricultural science, proceedings of the society for the promotion of, 1886. Columbus, O., *Gazette pr. house*, 1886. 88 p. 8°.

Brown, G. Report on experiments in trap siphonage at the Museum of hygiene, U. S. navy department, Washington, D.C. Washington, *Judd & Detweiler, pr.*, 1886. 14 p., 2 pl. 8°.

Canada, annual report of geological and natural history survey of, 1885. Vol. i. Montreal *Dawson*, 1886. 791+24 p., maps, illustr. 8°.

Dagincourt, Dr. Annuaire géologique universel et guide du géologue. Paris, *Comptoir géologique de Paris*, 1886. 28+362+79 p., 1 pl. 12°.

Diller, J. S. Notes on the geology of northern California. (U. S. geol. surv., bull. 33.) Washington, *Government*, 1886. 23 p., illustr. 8°.

Gordon, J. C. Practical hints to parents concerning the preliminary home-training of young deaf children. Washington, *Gibson Bros., pr.*, 1886. 45 p., illustr. 8°.

Gurney, E., **Myers**, F. W. H., and **Podmore**, F. Phantasms of the living. Vols. i. and ii. London, *Trübner*, 1886. 84+573, 28+733 p., illustr. 8°. (New York, Stechert.)

Heilprin, A. Explorations of the west coast of Florida and in the Okeechobee wilderness. Philadelphia, *Wagner free inst.*, 1886. [63] p. 4°.

Hunt, T. S. Mineral physiology and physiography. Boston, *Cassino*, 1886. 18+710 p. 8°.

Linnean society of New South Wales, catalogue of the library of the. Sydney, *Cunninghame & Co.*, 1886. 74 p. 12°.

Low, J. G. and J. F. Plastic sketches. Boston, *Lee & Shepard*, 1887. 12 p., 47 pl. f°.

McCalley, H. On the Warrior coal field. (Geol. surv. Ala.) Montgomery, *State*, 1886. 16+571 p. 8°.

Ranke, J. Allgemeine naturkunde. Lief. 60, heft 1. Leipzig, *Bibliographische institut*, 1886. 48 p., 1 col. pl., illustr. 4°. (New York, Westermann.)

Ratzel, F. Allgemeine naturkunde. Lief. 51-59, hefte 9-17. Leipzig, *Bibliographische institut*, 1886. [431]+10 p., 9 col. pl., illustr. 4°. (New York, Westermann.)

Sanitary convention held at Ypsilanti, June 30 and July 1, 1885, proceedings of the. Lansing, *State*, 1886. 173 p., illustr. 8°.

Scudder, S. H. The cockroach of the past. London, *Reeve & Co.*, 1886. [16] p., illustr. 12°.

Shaw, A. Coöperation in a western city. Vol. i. No. 4. Baltimore, *Amer. econom. assoc.*, 1886. 106 p. 8°. 75 cents.

U. S. navy, annual report of the secretary of, for 1886. Washington, *Government*, 1886. 28 p. 8°.

Wyoming, historical and geological society, proceedings and collections of the. Vol. iii. Wilkesbarre, Penn., *Wyoming hist. geol. soc.*, 1886. 128 p., portr. 8°.

SCIENCE.—SUPPLEMENT.

FRIDAY, DECEMBER 24, 1886.

THE BASIS OF A GRADED SYSTEM OF SCHOOLS.

HERBERT SPENCER, in his treatise on education, says, "To prepare us for complete living is the function which education has to discharge, and the only rational mode of judging of an educational course is to judge in what degree it discharges such function." Froebel's doctrine, that "education is the complete unfolding of the whole being of man," indicates how we are to be prepared for complete living, since complete living can only be realized by one perfectly developed in all his powers. The value of an educational course, then, is to be measured by the degree in which it develops all the powers of the man. And thus Joseph Payne sums up his consideration of the purpose of education by defining it as "the cultivation of all the native powers of the child by exercising them in accordance with the laws of his being, with a view to development and growth."

Since the possibility of complete living necessitates the cultivation of all the native powers of the child, it is plain that a system of schools should be so constituted that all the appliances used and all the studies prescribed shall tend towards the development of power. The unfolding of the whole being necessarily comprehends the cultivation of the bodily, mental, and moral powers. A system that does less than this fails to discharge its highest function in preparing for complete living. It is not an impertinent question to ask educators whether our present educational system comes up to the requirements stated in the opening paragraph. A system may fail to realize its highest function, not by reason of its own defects, but because of unfavorable conditions. The buildings and appliances may be inadequate or defective; teachers may be hampered by boards whose transactions are controlled by selfish or political interests; or public sentiment may stand very much in the way of progress. Nevertheless it remains the educator's duty to plan his system with a view to the highest attainment, and to gather all possible forces under his control.

It is my wish to indicate how the public-school system should, and to some extent does, discharge its function. The usual school course covers the period between five and eighteen years of age. According to Currie,[1] school life is divided into three periods: viz., infancy, during the first six years; childhood, the next six or seven years; and youth, from that time to the eighteenth year. These periods are suggested, he says, "by so many distinct phases in the child's physical and rational being." During the first two periods, "animal enjoyment is the chief condition of life." "The period of youth unfolds itself when the mind begins to feel interest in its own exertions and to be somewhat self-sustaining in its operations." Subsequent to this, education takes on a professional or technical character, and is beyond the domain of the public school. By our laws it is the duty of the state to take in hand the education of infants, if we adopt the classification of children as suggested above. This law has been established not only by public sentiment and for public economy, but it is most necessary and right as viewed from an educational stand-point, though denied by some authorities. Children of the first two periods, from five to thirteen or fourteen, are enrolled in our elementary schools. Our youth are to be found in the high school: subsequent to that comes the normal and technical schools.

The function of a school system being to unfold all the powers of the child, the educator's first duty is to ascertain what are the powers of children in the various stages of their development; next, what are the means and materials appropriate to the proper exercise of those powers, and what mode or method should be used to apply those means and cause the activity of the child's powers.

The powers of children between the ages of five and thirteen, that should be operated upon by a system of education, are chiefly physical, and only the simple faculties of the mind are brought into requisition. For instance: the child's love of play and other manifestations of activity are his ruling passions, and the faculties used are those which depend mainly upon the activity of the senses. In the springtime of life the body and mind are undergoing the process of growth and formation, the body building up physical power, and the mind absorbing material for future use. The appropriate training for these years is that which stimulates natural physical growth of the body and all its parts, a wholesome use of all the senses, and a systematic exercise of the faculties

[1] Early and infant school education, p. 1, by James Currie.

of observation, imagination, and memory. By such a course the skilful teacher directs the will of the child, and cultivates all his moral characteristics.

The kindergarten is the only system which furnishes the means and the methods, and is systematically arranged to provide such a training as is suitable to children when they first enter the public schools; and the public-school system can never be complete until the kindergarten, the genuine Froebel system, is made the first step in the course. The natural exercise of the body is provided for in the games, the little hands and fingers are made skilful by the occupations, the senses are made acute by gifts, and all the faculties of the childish mind are set into activity; while at the same time a knowledge of number, form, color, symmetry, and language, is being naturally acquired.

During the later years of the elementary school, a similar course should be maintained, that would furnish all the facilities for the proper development of the physical, mental, and moral powers in their due proportion. The kindergarten work, and especially the true kindergarten spirit, should be made a part of the primary-school course. Drawing, paper-cutting, modelling, carving, sewing, etc., should occupy a fair portion of the time. It has been found that five hours of a day are too much for the intellectual labor of a child: the afternoon of school-work is of very small importance in the primary school, unless devoted to light occupations. The ordinary studies of the elementary school may be used to develop power, provided they are used according to the true principles of education. Reading, spelling, penmanship, and language are taught as one, by methods that cultivate the observation, the conceptive faculty, and the imagination. The early lessons in number, form, and drawing, tend towards the same end. Following these subjects comes geography, not to train the memory, but to further cultivate the observation and the imagination primarily. The outgrowth of this boundless study brings the child to a knowledge of other elementary sciences and of history, by all of which the faculties of the mind become exercised in the "complete unfolding of all the powers of the man."

The mistake made by the majority of teachers is in the method of presenting the subjects for study, and the methods are at fault because the purpose of study is lost sight of. The school curriculum is taught for the knowledge to be imparted instead of the power to be developed. The teacher is not alone to blame for this state of things: the examiner deserves the greater blame. He asks how much the child knows: consequently the teacher devotes her time to imparting knowledge, by oral teaching, by explaining all difficult examples, and, in short, by doing most of the pupil's work. Why? "Because it takes too much time to wait for the children to do for themselves," and because the pupils are not able to do for themselves, and need the teacher's help, and thus, as Spencer says, "Having by our methods induced helplessness, we make helplessness the reason for our methods." On the other hand, the teacher who teaches for the sake of the pupil and not for the sake of the subject, who employs methods that tend to develop mental power, creates self-activity, and furnishes her pupil with the means by which he can make himself his own teacher.

The elementary schools having served the purpose for which they were established, it becomes the province of the high school to make use of those powers of the mind, and acquirements in the further training of the intellectual faculties, in which, as Currie says, the mind 'begins to feel interest.' The work of the high school is designed for the cultivation of the higher faculties of the mind. The ideas already acquired are to be elaborated by generalization, judgment, and reasoning.

The unity of such a system lies in its purpose; namely, the development of power at each stage of the child's growth. Each grade or step furnishes the proper material and the proper studies for the exercise of his powers. There is an order of studies; but the order does not depend merely upon the relations of the subjects to each other, but upon their fitness for the work of development. The arrangement of studies from this standpoint differs much from old courses of study. For instance: penmanship is now taught from the beginning because it belongs with reading; lessons on hygiene and physiology begin as soon as the child is able to observe the parts of his body, and to understand their uses and need of care; and so other elementary sciences are used to cultivate the observation of our little children. History is also taught in the primary schools to cultivate the imagination, and to awaken a love for our country and its heroes. At the same time the primary arithmetics have been purged of much of the old-time puzzles and conundrums, while the rules of technical grammar have been deferred till a later day.

The normal school educates those who have an aptitude for teaching, a love for children, and a desire to learn to train young minds. Its methods tend to strengthen the judgment and administrative powers, and the ability to put to practical use the knowledge acquired, and are based upon the same principles of education that govern the methods of the earlier schools.

Such a system is consistent in all its methods and aims; it maintains a constant unity of purpose; while each department is distinct in its own individuality, and bears a proper relation to the whole. C. E. Meleney.

MR. MATTHEW ARNOLD'S REPORT ON ELEMENTARY EDUCATION ON THE CONTINENT.

Mr. Matthew Arnold has but lately resigned the office of her majesty's inspector of schools, a position which he has filled for many years with credit to himself, and with great benefit, we are sure, not only to such schools as have come under his immediate supervision, but also to English educational interests in general. One of his last official duties of any importance was to visit Germany, Switzerland, and France, and to write an official report on certain specified points connected with elementary education in those countries. Some portions of that report were used by Mr. Arnold in his address before the University of Pennsylvania, which was printed afterwards in the *Century* magazine. But the entire report is of the liveliest interest to American educators; for several of the points investigated by Mr. Arnold are those to which no little attention is being paid in this country, and all the information gathered by him is part of the material to be used by the comparative method in studying educational institutions and methods.

By the terms of Mr. Arnold's instructions, his attention was to be more particularly directed to Germany and Switzerland, and the points he was to study were four in number: 1°. Free education; 2°. Quality of education; 3°. Status, training, and pensioning of teachers; 4°. Compulsory attendance, and release from school. Only fourteen weeks were given to the inquiry; and of these, five were spent in Prussia, two in Saxony, two in Bavaria, two in Switzerland, and three in France. Mr. Arnold's latest mission, as he expressly states, differed from those of 1859 and 1865 in that he did not go now to study systems of education, but only to report on the four above-mentioned points. These points Mr. Arnold takes up in order.

Under the head of free education, he was instructed to ascertain whether gratuitous education is confined to elementary schools, or extends to other schools or colleges; what reasons induced the state to establish the gratuitous system; in what way (directly or indirectly) the lower classes of society are made to feel the weight of the expenditure on education; in what way the dirty and neglected children in large towns are dealt with, and especially whether all descriptions of children are mixed in the same schoolroom; whether there is a legal prohibition against charging fees in public schools, even if parents and children are willing to pay; whether the attendance of children has increased or diminished since the establishment of free schools. Mr. Arnold answers these questions first with the information gained by him in Prussia. In the Prussian constitution of 1850 is this provision: *In der öffentlichen volksschule wird der unterricht unentgeltlich ertheilt.* But this provision has generally remained inoperative, because the popular school is to be maintained by the *Gemeinde*, or commune, and the communers have not in general found themselves able to forego the income from school fees. And, on the other hand, the state has not been able or willing to provide gratuitous instruction in the communes. Some few communes, however, have been able to throw their popular schools open to all classes of the population, free of all charge. Düsseldorf has done so: so has Berlin. The Berlin schools have been free since 1870, and last year it cost more than 6,000,000 marks to support them. At the time of the introduction of free schooling, the municipality had 49 communal schools, with 31,752 scholars; in 1885 it had 146 such schools, with 132,889 scholars. These communal schools are the only body of schools in Berlin or throughout Prussia in which school fees are not paid. Herr von Gossler, minister of education, was found by Mr. Arnold to favor making the communal schools free everywhere, and Prince Bismarck is said to agree with him. But among the public generally, including the teachers themselves and the government officials, the weight of opinion is against such a course. Even where school fees are charged, they meet but a small portion of the total expense. On an average for the whole of Prussia, school fees furnish 20.58 per cent of the cost of teaching in the popular schools; endowments, 12.02 per cent; the communes, 55.26 per cent; and the state, 12.14 per cent. In some towns, Cologne for example, where the popular schools are not free, provision has been made for giving free instruction to poor children in schools by themselves. But in Berlin the children of the working and middle classes all attend school together. The only distinction made on the ground of poverty at Berlin is that school-books and school-material are supplied gratuitously whenever the teacher finds that the child cannot afford to buy them.

But throughout Germany, payment is the rule, free schooling the exception. The popular school is a municipal thing, and is paid for out of municipal taxes. No special school tax is levied.

In Switzerland there is also a constitutional provision determining free schooling. Article 27 of the Federal constitution of May 29, 1874, says, "Primary instruction is obligatory, and in the public schools gratuitous." So jealous are the cantons of their local independence, that there is no national department of education. Yet each canton has complied with the above article of the constitution. Mr. Arnold takes as examples canton Zurich, which is Protestant and industrial, and canton Lucerne, which is a mountain canton and Catholic. In Lucerne the child must come to school at seven years old, and may come at six: his day-school course lasts until he is fourteen; and he has then, unless he goes to some higher school, to attend a *fortbildungsschule* for two years more. In Zurich the child must come to school at six years old: his day-school course lasts until he is twelve; and he must then spend three years at an *ergänzungschule*, besides an hour a week at a singing-school. All these schools are free, and in canton Lucerne the higher schools are free also. Religious instruction is given in the popular schools in the several cantons according to the faith of the majority. Catholic instruction is given in Lucerne, Protestant in Zurich. There is, according to Mr. Arnold, no unfair dealing, no proselytizing, no complaint. In Switzerland there is no separate provision for dirty and neglected children, because there is no such class. Fifteen years ago there were 1,500 pupils attending the great town-school of Lucerne: now there are 3,300. "I regard free schooling, however," says Mr. Arnold, "rather as a part and sign of the movement of advance in popular education than as itself the cause of the movement."

In France, Mr. Arnold found that the payment of fees in public primary schools was abolished in 1881, and that attendance at school is obligatory for children of both sexes between the ages of six and thirteen. This is ascribed to no constitutional provision, as in Germany and Switzerland, but to *l'idée démocratique*, a moving cause at which Mr. Arnold sneers a little. No religious instruction is allowed in these schools, for democracy in France is at war with clericalism. The result is that there is much complaint, and rival schools, established by private effort, are numerous. The Catholics alone have raised for their schools in Paris over 15,000,000 francs in the last six years, and at the present time educate in their schools one-third of all the school-children of Paris. As to how these public primary schools are supported, the report summarizes thus: "The communes had formerly to maintain their primary schools out of their own resources, supplemented, if necessary, by an addition of four centimes to the four direct taxes for the commune; further supplemented, if still necessary, by an addition of four centimes to the four direct taxes for the department; supplemented finally, if still necessary, by a grant from the state. These eight centimes for the commune and department have now been made regular and fixed taxes paid to the state. Since 1882 the state has relieved of all further charge for their primary schools those communes which could not meet such charge out of their own resources. Only the five chief cities of France have undertaken so to meet it, — Paris, Lyons, Marseilles, Bordeaux, Lille. In all the other communes of France the cost of primary instruction is met out of the public taxes by the state. When, therefore, it is asked how the lower classes feel the weight of the expenditure on education, the answer must be, so far as they feel their share in the general taxation of the country to be increased by it. And this probably they do not feel at all."

Mr. Arnold found a very large increase, both in the outlay for primary schools and in the number of children attending them, since he last saw them in 1859. At present the state bears nine-tenths of the annual expense of primary instruction, and spends over 80,000,000 francs on it. The municipality of Paris had, in 1884, 361 primary schools, with accommodations for 121,798 scholars.

The second subject of inquiry related to the quality of the education given; and Mr. Arnold speedily found that the suggestion of his official instructions, that he determine this by having the teachers set papers in arithmetic and dictation on the model of those set in England, could not be carried out, because the whole spirit and course of teaching was opposed to setting in school-hours a number of sums, and leaving the children to do them by themselves. So Mr. Arnold determined to secure an answer to this question by seeing and hearing what the scholars did; and the popular schools of the free city of Hamburg he chose for the test. He concludes that in German schools, as a rule, the programme is fuller, the course longer, and the instruction better, than in England. The methods of teaching seemed more gradual, more natural, more rational, on the continent than in England. He wrote again and again in his notes, '*The children human.*' As to the school course at Hamburg, we read, "The fixed matters of the course are religion, German language, English language, object-lessons, history, geography, natural history, arithmetic and algebra, geometry, writing, drawing, singing, and gymnastics. English must be taught in the popular schools from the third class upwards, and French comes in as an optional matter (the only one), and to take it the consent of the *oberschulbehörde* is required. The two lower classes have each of them 26 hours of schooling a week, the class next above them has 28, the four higher classes have 32 each. Some of the popular schools in Hamburg, like those in Berlin, meet once a day only. In summer the schools meet at 8 in the morning, and the different classes go on till 12, 1, or 2 on different days in the week, so that each class shall make its proper number of weekly hours. In winter they meet at 9 and go on an hour later. No week-day is a holiday, like the Saturday with us and the Thursday with the French. Other schools have two daily meetings, from 8 to 11 or 12, and from 2 to 4, the proper number of hours for each class being again always made. Local convenience determines whether the school shall have two daily meetings or one. The pressure which the long attendance from 8 to 2 or from 9 to 3 would seem likely to exercise is remedied by an arrangement which I found general in German countries, and which works very well. At the end of each hour the class disperses to the corridors and playground, and the teachers to the teachers' meeting-room. In ten minutes a bell rings, and the classes and teachers re-assemble refreshed. How much the work of a long morning is lightened by this simple plan may be observed by any one of school experience who will pass a morning in a German or Swiss school."

In German grammar the children learn the declension of nouns, comparison of adjectives, and conjugation of verbs. In history, where the prescribed aim is to make the pupil acquainted with the prominent persons and points in the development of mankind in general, and of the German nation in particular, biographical notices form the principal subject-matter. In religion, parables and hymns are learned and said by heart, and instruction is given in the literary history and translation of the Bible. Everywhere in Germany Mr. Arnold thought the text-books used, good. The following passage merits quotation in full: "In the specially formative and humanizing parts of the school-work, I found in foreign schools a performance which surprised me, which would be pronounced good anywhere, and which I could not find in corresponding schools at home. I am thinking of literature and poetry and the lives of the poets, of recitation and reading, of history, of foreign languages. Sometimes in our schools one comes across a child with a gift, and a gift is always something unique and admirable. But in general in our elementary schools when one says that the reading is good, or the French, or the history, or the acquaintance with poetry, one makes the mental reservation, 'good, considering the class from which children and teachers are drawn.' But in the foreign schools lately visited by me I have found in all these matters a performance which would be pronounced good anywhere, and a performance, not of individuals, but of classes. At Trachenberg, near Dresden, I went with the inspector into a schoolroom where the head class were reading a ballad of Goethe, 'Der sänger.' The inspector took the book, asked the children questions about the life of Goethe, made them read the poem, asked them to compare it with a ballad of Schiller in the same volume, 'Der Graf von Habsburg,' drew from them the differences between the two ballads, what their charm was, where lay the interest of the middle age for us, and of chivalry, and so on. The performance was not a solo by a clever inspector: the part in it taken by the children was active and intelligent, such as would be called good if coming from children in an altogether higher class of school, and such as proved under what capable teaching they must have been. In Hamburg, again, in English, and at Zurich in French, I heard children read and translate a foreign language with a power and a pronunciation such as I have never found in an elementary school at home, and which I should call good if I found it in some high-class school for young ladies. At Zurich, I remember, we passed from reading and translating to grammar, and the children were questioned about the place of pronominal objects in a French sentence. Imagine a child in one of our popular schools knowing, or being asked, why we say *on me le rend*, but *on le lui rend*, and what is the rule on the subject!"

And the instruction is better in foreign schools, because the schools are better organized, and the teachers better trained, than those in England This brings us to the third general subject treated in the report, — the status, training, and pensioning of teachers.

To begin with, it may be safely said that teachers in Germany, France, and Switzerland, come from the same class of society as do teachers in England. For mention of all that is interesting and valuable in Mr. Arnold's report about the training of teachers, we have no space: but we give an abstract of the training in a typical instance, in Saxony.

The training-school course there lasts six years.

But a youth enters at the age of about 14, with the attainments required for passing an examination for the *entlassungs-zeugniss*, or certificate of discharge, from a *mittlere volksschule*, or popular school of the second grade, — a school which in Saxony must be organized in at least four classes, with a two-years' course for each. In the training-school, instruction and lodging are free; a small sum is paid for board, but a certain number of free boarders, 'gifted poor children,' are admitted. To the training-school is attached a practising school, organized as a *mittlere schule*, a middle school with four classes and 155 scholars. In this school the students see and learn the practice of teaching. Their own instruction they receive in small classes which may not have more than 25 scholars. Their hours in class may not exceed 36 a week, not counting the time given to music. The matters of instruction are religion, German language and literature, Latin, geography, history, natural science both descriptive and theoretical, arithmetic, geometry, pedagogy including psychology and logic, music, writing, drawing, and gymnastics. All of these matters are obligatory, but after the first year students of proved incapacity for music are no longer taught it. One-third of the teaching-staff of the training-school may be distinguished elementary teachers without university training, but this proportion is never to be exceeded. Each teacher, exclusive of the director, is bound to give 26 hours of teaching in the week. There are half-yearly examinations: the six years' term may be lengthened by one year for a student who is deemed not ripe for the leaving examination, which comes at the conclusion of the course. At the end of the course, when the student is about 20 years old, he undergoes the *schulamtskandidaten-prüfung*, or examination for office. The examination is both oral and in writing, and turns upon the work of the student's course in the training-school. The examining commission is composed of the Minister's commissary, a church commissary, and the whole staff of the training-college. The staff conduct the examination, the Minister's commissary presides and superintends. If the student passes, he receives his *reifezeugniss*, or certificate of ripeness, and is now qualified to serve as assistant in a public popular school, or as a private teacher where his work has not to go beyond the limits of popular school instruction. After two years of service as assistant, at the age of about 22, the young teacher returns to the training-school and presents himself for the *wahlfähigkeits-prüfung*, or examination for definitive posting. For this examination the commission is composed of the Minister's commissary, a church commissary, the director of the *seminar*, and either two of its upper teachers, or else other approved schoolmen named by the minister. This examination again is both written and oral. Mr. Arnold attended the oral part on two days, and heard and saw candidates examined in religion, music, German language and literature, the history of education, pedagogy, psychology, logic, and school law.

Training-schools for women are much less numerous in Germany than those for men, because women are much less used in teaching than men; the presumption being that women cannot teach satisfactorily certain matters of instruction in the upper classes of a popular school. The result is that in Prussia there are 115 training-schools for men, and 10 for women; in Saxony, 16 for men, 2 for women.

As to teachers' salaries and pensions, custom and law vary greatly. In Prussia in 1878 the average salary of a schoolmaster was £51 12s. per annum. In Berlin the average salary was £103 3s. In France the primary-school teachers must rise through a series of grades, to each of which a fixed salary is attached, varying from £36 to £48 for a man, and from £28 to £36 for a woman. If a school-mistress marries in Germany, she loses her situation. In all the countries visited by Mr. Arnold, teachers have retiring pensions, to establish which a deduction is made from their salary.

In respect to the fourth and last subject of inquiry, that as to compulsory attendance, Mr. Arnold quotes Saxon law as representative for all the countries visited by him. It is thus: "Every child has to attend, for eight years uninterruptedly, the common popular school in the school district where it resides; as a rule, from the completion of the sixth year of its age to the completion of its fourteenth. Children who by the end of their eighth school year do not attain due proficiency in the principal matters of instruction, that is to say, in religion, the German language, reading, writing, and arithmetic, have to attend school a year longer. The holidays for the popular schools in Saxony are fixed by law, and amount to 44 days in the year. In general the school meets for a minimum of three hours in the morning and of two hours in the afternoon. 'Parents and guardians are bound,' says the law, 'to keep children of school age to a regular attendance in school hours. As a general rule, only illness of the child, or serious illness in the child's family, is ground of excuse for its missing school.' Absences, with their causes, are entered daily by the teacher in the school registers. At the end of every month he hands a list of them to the managers, whose chairman has to bring, within eight days after the end of the month, all punishable absences to the notice of the magistrate, if he has not previously brought the parents to their duty by an admonition, or had the child fetched to school by the school beadle, to whom a small fee is due from the parent for his trouble. If, however, the matter goes before the magistrate, this functionary inflicts a fine, which may go as high as 30s., and if the fine is not paid the penalty is changed to one of imprisonment. In Saxony the law prescribes that the number of scholars in a class shall not exceed 60, and that the number of scholars to one teacher shall not exceed 120. In schools with from 60 to 120 children, therefore, if the commune is not rich enough to do more in the way of providing teachers than the law actually requires, two classes are formed, and a reduction of school time takes place for each, in order to allow the one master to conduct them separately."

The rural population greatly prefer the half-day school, as it is called, because they thus have the older children at their disposal for half the day.

Mr. Arnold concludes his valuable paper with three comments : 1. The retention of school fees is not a very important matter ; something can be said for and against it, but the weight is in favor of their retention ; 2. Keep improving our schools and studying the systems of other countries ; 3. Organize the secondary instruction not only in the interest of that instruction itself, but in the interest of popular instruction. This last remark applies with peculiar force to education in the United States.

Mr. Arnold's report is free from official dryness, and reads more like an essay than a government document.

THE EDUCATIONAL INSTITUTIONS OF PRUSSIA.

Despite all that has been said and written in this country during the past few years concerning the respective merits of the *gymnasium* and the *realschule*, there are very few educators who are able to describe accurately the character and relative status of the various educational institutions of Prussia. Therefore the following summary will be of value.

At the head of the education department in Prussia is the minister of education, whose duty it is to look after the administration of church matters as well. In each of the twelve provinces of Prussia is a *provinzial-schul-collegium*, having charge of the secondary schools. The elementary or primary schools are under the supervision of district boards, of which there are from two to five in each province. Every commune is compelled by law to build and support a number of elementary schools sufficient to provide primary instruction for all the children of the community. Where the means are not sufficient, a grant is allowed by the central government. The assistance of this sort given in the year 1885 amounted to nearly 21,500,000 marks. The inspection of these elementary schools is very thorough ; and every teacher, no matter what his grade, must have passed a government examination. In the towns a rector is placed over the teachers ; in the country a local school inspector, usually a clergyman, acts in the same capacity. These rectors and local inspectors are under the surveillance of district inspectors. Gradually laymen are superseding clergymen as incumbents of these district-inspectorships. The district inspectors report to the district boards, and these themselves not infrequently overlook the inspectors' work. In the eye of the law, all schools, no matter what they teach, that have no *berechtigung*, — a term used to express the privilege of preparing students for an examination the passing of which shall absolve from part of the full period of military service, — are elementary schools. All schools having *berechtigung* are classed as high schools, and are under the administration of the above-mentioned *provinzial-schul-collegien ;* and in this way the high schools are very closely connected with the military system. After 1812, military service was made compulsory for every Prussian. The period of service in the standing army is three years ; but those who have received a higher education have the privilege of serving one year only, if they apply to the authorities at the proper time. These are the so-called 'one-year volunteers' (*einjährige freiwilliger*). They receive no pay, and must keep themselves. In order to increase the intellectual standard of the army, and also to reduce expenses, the high schools have the right (*berechtigung*) to grant certificates for one-year volunteers.

These high schools are of various kinds, and include, 1°, the *gymnasien ;* 2°, the *pro-gymnasien ,* 3°, the *real-gymnasien* (formerly known as *realschulen* of the first class) ; 4°, the *real-pro-gymnasien ;* 5°, the *ober-realschulen ;* 6°, the *realschulen ;* 7°, the *higher-burgher schools*, and a few industrial and agricultural schools.

The *pro-gymnasium* is merely a *gymnasium* without the highest class, and the *real-pro-gymnasium* and the *realschule* stand in similar relation to the *real-gymnasium* and the *ober-realschule*. Those students who have satisfactorily attended for one year the second class of a *gymnasium*, *real-gymnasium*, or an *ober-realschule*, or the first class of a *pro-gymnasium*, a *real-pro-gymnasium*, or a *realschule*, are entitled to a one-year volunteer certificate. In the case of the *higher-burgher schools*, and such others, excepting the above named, as have the right to grant the certificate, its acquisition is made to depend on the final examination at the completion of the course.

The following table will show the various studies pursued in the several kinds of higher schools, and the proportion of time allotted to each. The figures represent the number of hours per week — taking all the classes together — given to the subjects named : —

	Religion.	German.	Latin.	Greek.	French.	History and geography.	Mathematics.	Description of nat. objects.	Physics.	Chemistry.	Natural history.	Writing.	Drawing.	English.
Gymnasium	19	21	77	40	21	28	34	10	8	—	—	4	6	—
Real-gymnasium	19	27	54	—	34	30	44	12	12	6	—	4	18	20
Ober-realschule	19	30	—	—	56	30	49	13	14	9	—	6	24	26
Higher-burgher school	13	21	—	—	40	22	29	13	—	—	8	8	12	13

Singing and gymnastics are taught in all these schools after the regular school-hours, which are from eight to twelve, and from two to four o'clock, and Hebrew is similarly taught at the *gymnasien* to future students of theology.

It will be observed that the *real-gymnasium* differs from the *gymnasium* in teaching no Greek, in adding English to the course, and in reducing the time given to Latin. The time thus taken from the classics is given to French, German, mathematics, physics, chemistry, and drawing. The *ober-realschule* omits Latin and Greek entirely, greatly increases the instruction in French, and adds to the courses in English, drawing and the sciences. The higher-burgher schools have only a six-year course instead of a nine-year, and the studies occupy the times shown in the table. Some of these secondary schools have *vorschulen* attached to them. Into the secondary schools, children do not enter before the completion of the ninth year; and they are required to possess an ability to read easily Latin and German text, a knowledge of the parts of speech, a legible handwriting, ability to write a dictation exercise without too many mistakes in spelling, an accuracy in using the four fundamental rules of arithmetic, and a general acquaintance with the historical events narrated in the Old and New Testaments.

Besides the *berechtigung* for one-year volunteers, which all these high schools possess under the conditions named above, certain other privileges as to positions in civil life are possessed by them, but these privileges are by no means the same for all.

The final examination certificate (*reifezeugniss*) entitles the holder to the following privileges : —

I. That of a *gymnasium*, 1°, to enter any university, and to compete in any examination for positions in the higher divisions of the civil service ; 2°, to enter the technical high schools for engineering at Berlin, Hanover, and Aix-la-Chapelle, and to admission to the government examinations for engineering in all its branches ; 3°, to enter the academies of mines at Berlin and Clausthal and the affiliated technical high school at Aix-la-Chapelle, and to admission to the examinations for the first-class certificates in the departments of mining and smelting : 4°, to enter the academies of woods and forests at Eberswalde and Munich, and to admission to the higher examinations in this department ; 5°, to admission to the first-class posts in the post-office, from postmaster-general downward.

II. That of a *real-gymnasium*, 1°, to attend lectures at a university with a view to matriculating in the philosophical faculty for the purpose of pursuing the study of mathematics, the natural sciences, or modern languages ; 2°, to admission to the examinations mentioned under I., 2°, 3°, 4°, 5°.

III. That of an *ober-realschule*, 1°, to admission to the examinations mentioned under I., 2° ; 2°, to admission to the same studies and examinations to which the certificate of a *real-gymnasium* entitles, on condition of passing a special examination in Latin.

IV. That of a *real-pro-gymnasium*, chiefly to unconditional admission to the highest class (*prima*) of a *real-gymnasium*.

V. That of a *realschule*, 1°, to nomination for civil-service posts in provincial administration and in the railways ; 2°, to nomination to clerkships in the department of mines and smelting ; 3°, to nomination as a land-surveyor ; 4°, to admission to examinations for apothecary, on condition that Latin has been an obligatory subject.

VI. That of a *pro-gymnasium*, 1°, to admission to the examination for apothecary ; 2°, to admission to industrial technical schools.

VII. That of a *higher-burgher school*, 1°, to attend an industrial or technical school ; 2°, to nomination for junior clerkships in the law courts ; 3°, to admission to the examinations for art teachers ; 4°, to admission to the high school for music in Berlin ; 5°, to nomination for junior posts in the post-office.

The high schools are supported by the state, by the commune, or by both. If supported by the state alone, they are known as royal high schools. In the budget for 1885–86 the state subsidy for the high schools amounted to 4,712,118 marks.

THE SOURCE OF THE MISSISSIPPI.

The readers of *Science* will recall our announcement a few weeks ago, of the despatch of an exploring party to the head waters of the Mississippi River to examine and locate all the streams and lakes tributary to Lake Itasca. Our explorers have now accomplished their task, and we have received from them a detailed report, and a map of the entire region, which includes the basin of Lake Itasca.

This map, which we have engraved on the scale of about one mile to the inch, divided into sections corresponding with the U. S. land-office surveys, is presented herewith. Other maps are also presented for the fuller explanation of the details of the report.

Preliminary to the report, it is proper that we should make some statement of the considerations which led to the despatch of this party. There have been a number of explorations and excursions to the head waters of the Mississippi during the present century. Of these, we have a more or less accurate record of the trip of Morrison in 1804 ; of Schoolcraft in 1832 ; of Nicollet in 1836 ; of Charles Lanman in 1846 ; of the Ayers in 1849 ; of William Bungo in 1865 ; of Julius Chambers in 1872 ; of A. H. Siegfried and his party in 1879 ; of W. E. Neal in 1880 and again in 1881 ; of Rev. J. B. Gilfillan and Professor Cooke in May, 1881 ; and of Captain Glazier in July, 1881. We also have the maps of the government surveyors who spent two weeks in this township in September and October, 1875, and the paper of Mr. O. E. Garrison, contributed by him to the tenth annual report of the State geological survey of Minnesota, for the year 1880.

Of these explorers, we know that Nicollet carefully explored all the feeders of Lake Itasca ; that Chambers explored Elk Lake, which he called Lake Dolly Varden ; and that Messrs. Gilfillan, Cooke, and Morrison, proceeding from the south, also visited the sources of the lake lying in that direction. Therefore. as to the general facts regarding the size and character of the basin of the lake, we did not hope to add any considerable amount of information to that already possessed. But of all these parties of explorers and surveyors, it is safe to say, that, with the exception of Nicollet and the government land-office surveyors, there has been little attempt at accurate investigation. Only these two have added any thing material to what Schoolcraft told the world in 1832. It is well, therefore, to note the difference in methods, of these two principal explorations of the Itasca basin.

"Nicollet was a trained scientist, but he worked under limitations ; and very sensibly, also, with a limited and definite purpose. His work was mainly done alone, and his chief instruments were the thermometer, the barometer, the sextant, and the compass. Hence he gives us details of temperature, elevation, latitude, longitude, and the general direction of the parts he visited. He rarely used the chain — if, indeed, he carried such a piece of property. His details of distance were either estimated — as in the case of a day's tramp or of an object within sight — or figured out by mathematical rules, as when he computed the length of a section of the river from the data of the latitude, longitude, and the direction from each other of a given number of points in its course. Hence his outline of the course of a river or creek, or of the form of a lake or pond, was only as accurate as might be expected from a trained explorer, whose eye was accustomed to take in and measure distance, direction, and form, on a large scale, and under a thousand varying conditions. In the matter of general relief forms, and the general trend and drainage of the country, he was, without doubt, the best equipped and most competent single explorer who has undertaken the study of our country ; and his work has been of inestimable value to hundreds of thousands who never heard of his name. So far as relates to the subdivision of areas, and the surveying and platting of the surface of the land, considered as a horizontal plane, his work did not profess to have any accuracy or value whatever.

"On the other hand, this last is the chief, if not the only, object of the government land surveyors. Their instructions are limited and specific. They take no note whatever of relief forms : they follow up and trace only the streams and ponds intercepted by the boundary-lines of sections. In the matter of horizontal area, in the meandering of lakes and navigable streams, and in the general platting of the land, they are proverbially reliable; but there is absolutely no account taken of elevation, and the drainage or trend of the land can only be inferred from the course and direction of the streams encountered in running the section lines.

"Nicollet's exploration was made in 1836, before a surveyor's stake had been set within the limits of Minnesota. The government surveyors of 1875 perhaps never heard of Nicollet, and certainly had no thought of supplementing or verifying his work."

In addition to the discrepancy noted above, another element of uncertainty has been introduced by the effort to maintain the claims of Captain Glazier as the discoverer of a new lake, unknown before his visit to the Itasca region in 1881. In order to maintain this claim, it is necessary to set aside entirely the map of Nicollet, to discredit the work of the government surveyors, and to ignore Garrison, Siegfried, Gilfillan, and every other explorer who has been to this region during the last half-century. With a dozen trustworthy parties on one side, maintaining the general accuracy of Nicollet and the government land-office map, and with Captain Glazier and his friends alone on the other side, it was not difficult to decide where the truth lay. But as no one had yet attempted to make an accurate survey of the topographical features of this region in the light of a government survey, and as Nicollet's work was simply topographical, without any attempt at accurate platting of areas, there was plenty of room for Captain Glazier, or any one else who chose, to come in and advance all sorts of claims. If, as was claimed by Mr. Pearce Giles on behalf of Captain Glazier, there was found three or four miles south of Lake Itasca another tributary lake, two miles long and a mile and a half wide. this certainly could not be Elk Lake, or any other lake laid down in the government survey. But if, as described by another of his friends, Captain Glazier's lake was less than half a mile south of Lake Itasca, it was undoubtedly Elk Lake, — the same that Nicollet shows, with its three feeders, on his map deposited in the office of engineers at Washington, — the same that Chambers visited and named Dolly Varden in 1872, — the same that the government surveyors accurately outlined and named Elk Lake in 1875, — the same that the Rev. Mr. Gilfillan and Professor Cooke explored and named Lake Breck in May, 1881.

But it was not simply to prove or disprove the truth of Captain Glazier's claim, that we made this effort at an accurate topographical survey of this region. Nicollet has furnished us with a map and a report of his explorations of the sources of the Mississippi, and these explorations have been a matter of history for fifty years. His maps have been public documents, accessible to everybody; and we believe, that, if his work is to be discredited, it should only be after the most careful and accurate survey. The government surveyors also were charged with having entirely overlooked a lake of more than a square mile in extent, lying several miles south of Lake Itasca. If these government officers are not to be relied upon to give us accurate maps and honest service, it is time that the people should know it; it is time that geographers and map-makers should know it; and we knew of no way so satisfactory as a careful review of the work, both of Nicollet and of the government surveyors. And this review afforded us an opportunity to correct the one by the other, in case they were each reasonably correct in their respective fields of work.

We are glad to be able to report that the most careful running of the lines of the government surveyors have proved the almost absolute accuracy of their work. Our explorers were also able to detect and to account for some interesting minor inaccuracies of the land-office plat of this township; but it was well worth the making of the error to discover the remarkable natural phenomenon whereby this was fully explained. We refer to the underground passage of the stream on the section line between sections 21 and 22, by which the government surveyors were deceived, and led into thinking that the stream did not pass out of section 22 at all, but kept north through the western part of that section.

It is also a cause of satisfaction to find the substantial accuracy of Nicollet's report and map of this region. There are, it is true, manifest discrepancies between his lines and those of the government survey. Lake Itasca is much broader, Elk Lake much smaller, proportionally on his map than on the map of the government survey, and the latter is found to be correct. A large share of this variation is due to the fact that Nicollet made his surveys by the eye entirely, and many of his drawings of the course of the streams and the contour of lakes were made upon birch-bark, and only transferred to paper afterwards. But beside this explanation, our explorers also found reason to believe that Itasca Lake was at one time several inches higher than it is now; and if, on the other hand, Elk Lake was once of a lower level than now, the two coming together would account for the difference in form they exhibited in 1836, as compared with their present outlines.

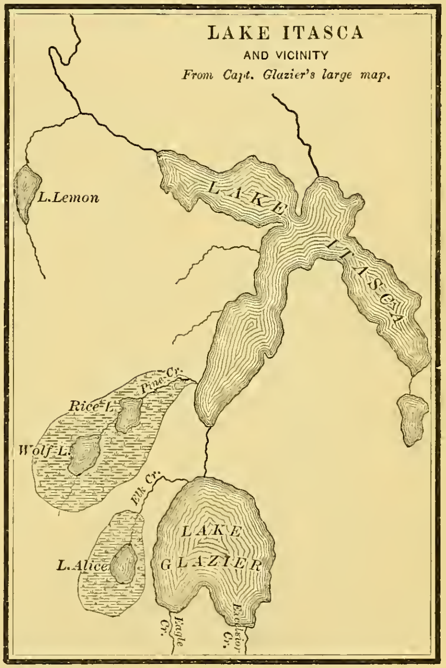
According to Mr. Gilfillan, the Indians called

Elk Lake, *Gabukegumag*, which means, 'water which juts off to one side' of another lake; that is, branches or projects out from it like a finger from a hand. This would indicate, that, when this name was given to it, Elk Lake was simply an arm or bay putting out from Lake Itasca, and that with the filling-up of the channel between the two, and the lowering of the level of Itasca, the difference in level, which amounts to only thirteen inches, contributed to make the one lake distinct from the other, and a feeder to it.

We may briefly sum up the results of this exploration to be: —

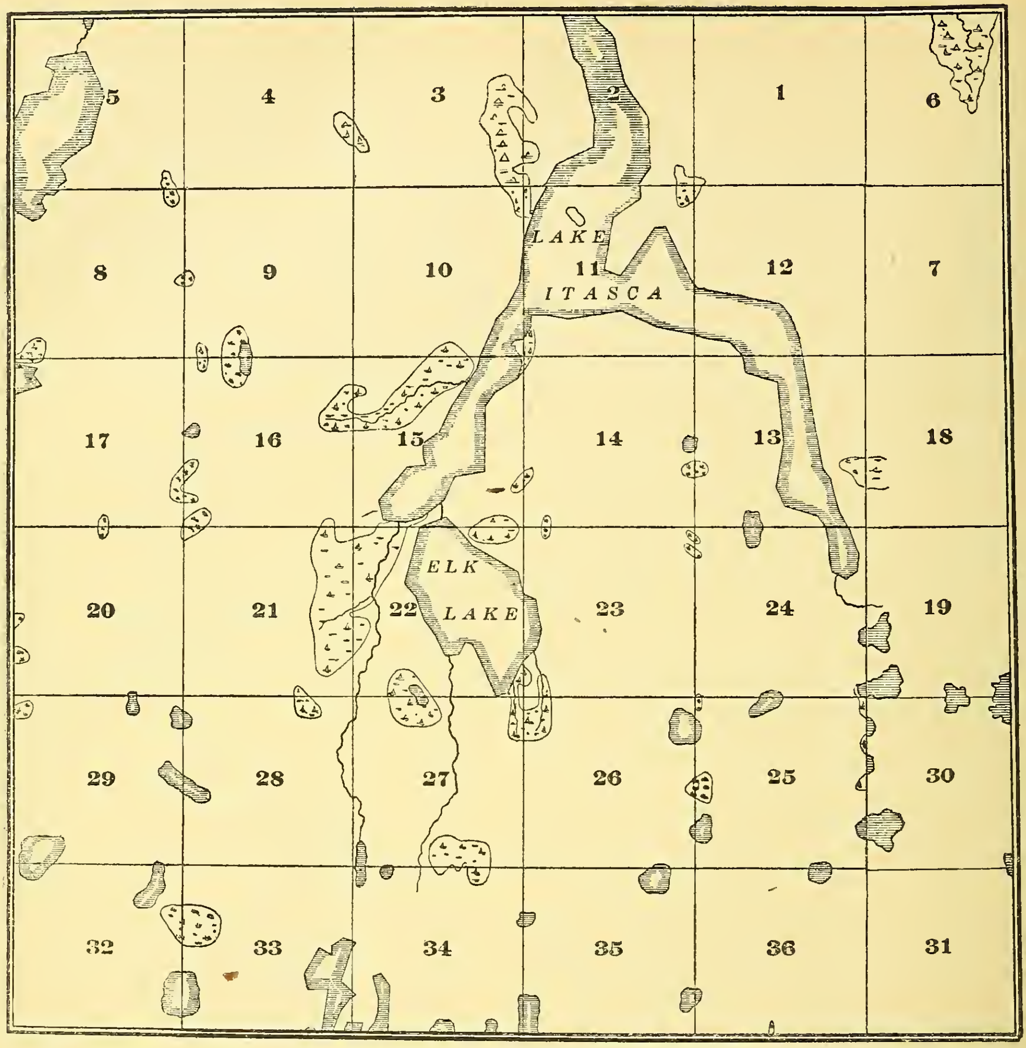
1. The confirming of the substantial accuracy of the government survey.
2. The proof of the general correctness of Nicollet's report and map.
3. Nicollet's creek is still by far the largest affluent of Itasca, contributing about three-fourths of the regular perennial inflow of water.
4. It can be traced beyond the point to which Nicollet followed it to the lake that heads in section 34, Tp. 143 N., R. 36 W. 5th meridian; and at this point it is 92 feet above the level of Lake Itasca.
5. Following its windings, it is also the longest tributary of Lake Itasca; and therefore,
6. As the largest and longest tributary stream, and the one most elevated in its source, it is entitled to be called the upper course of the Mississippi.
7. Considerable changes have taken place in the nature of the streams in this region since the exploration of Nicollet, but these are all easily accounted for by natural causes.
8. The principal tributaries of Lake Itasca are fed by springs, artesian in their character, which have their reservoirs in the strata of the hills, and in lakes and ponds probably miles to the south and west.
9. There is no large lake directly tributary to Lake Itasca, five, four, three, or two miles, or even one mile south of that lake; and Elk Lake, whose shore is only a stone's throw from Itasca (350 feet), is the only tributary lake within the Itasca basin which has an area of more than 40 acres.
10. Elk Lake, with its feeders, is clearly shown on Nicollet's map of 1836–37. Its position is more accurately given than on Glazier's map; its distance from Itasca is much nearer to truth; and as to its size, Nicollet has drawn it about as much too small as Glazier drew it too large.
11. Captain Glazier has added nothing to what Nicollet's map presents to us. On the other hand,
12. Glazier shows us nothing of Nicollet's creek which is the main tributary of Itasca; nothing of the eastern feeder of Elk Lake, which is the main source of its waters; nothing whatever that is not misleading and worse than worthless.

But what is the use of seriously going over this subject? Whatever of merit or accuracy there is in Captain Glazier's map is not in the slightest degree due to any thing done by him, or to any erudition possessed by his guide, Che-no-wa-ge-sic. His map, as he has published it, was drawn and engraved by Mr. G. Woolworth Colton of this city, and was made as near like the government surveys as Captain Glazier would permit.



The public will never be permitted to gaze upon the miserable travesty on geography and map-making which Glazier took to Mr. Colton to be doctored up and put in shape. But it will be interested to read Mr. Colton's account of how he became the innocent accessory of the Glazier fraud. The following is an extract from a published letter of Mr. Colton, to be found in the *American canoeist* for November, 1886: —

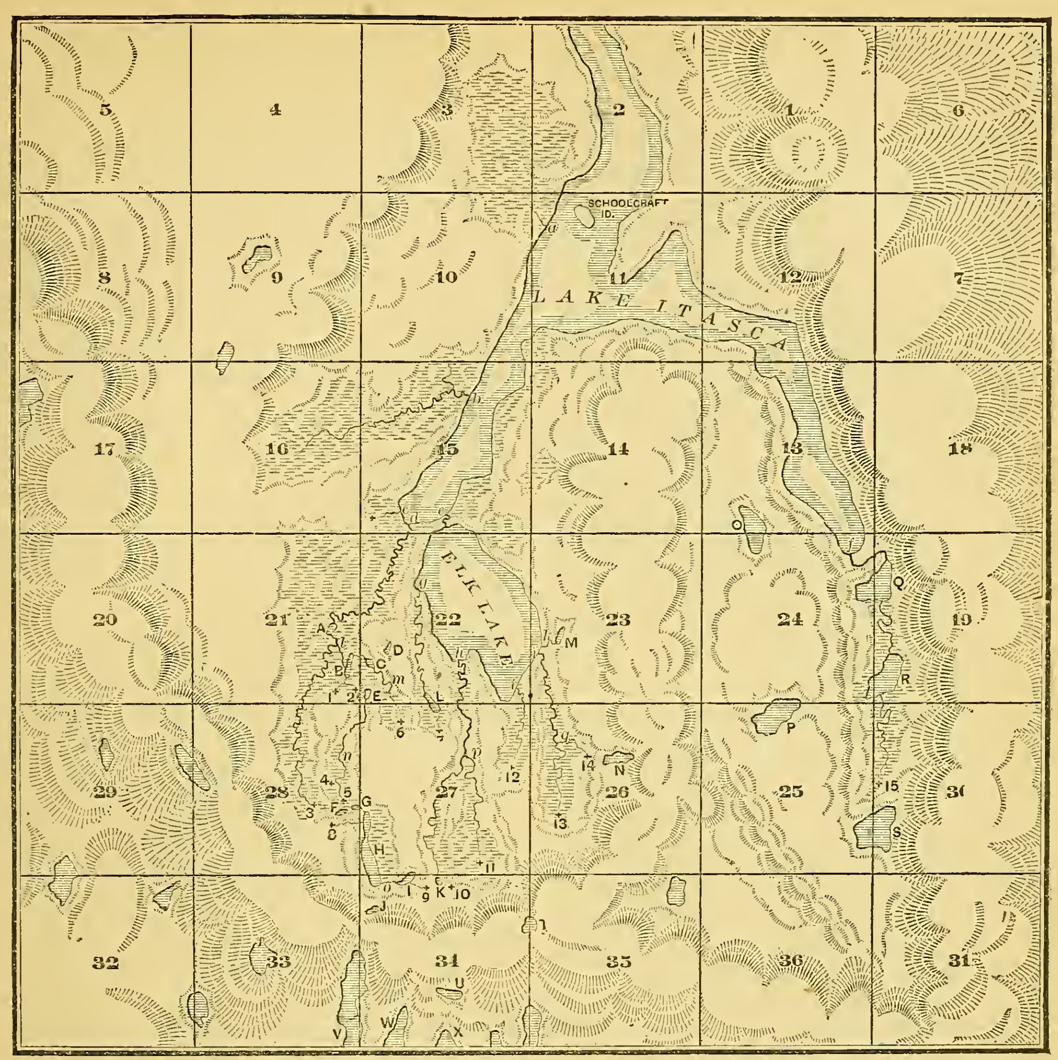
"When Glazier came to me in the fall of 1882 with his very rough map, to talk of his claim and to give us the geographical data for adding his streams and lake to our maps, I saw at once that



THE ITASCA LAKE REGION, REDUCED FROM THE OFFICIAL PLATS IN THE U. S. GENERAL LAND-OFFICE, WASHINGTON, D. C., AS SURVEYED IN SEPTEMBER–OCTOBER, 1875.

he was claiming what did not belong to him, *and so told him.* Then I referred to my copy of U. S. land surveys (of which I copy *every one* that enters the general land-office in Washington, on a scale of one mile to one inch, with my own hand), and showed him, under date of March 20, 1876, my copy of sectionized plats, covering not only the region referred to, Nos. 142 and 143, N. R., 36 W., 5th Pm. mer., but all the rest of the area covered by his route to and from the lake. He expressed surprise at the facts shown him, and said he regretted exceedingly that he had not known them before he went, for such maps would have helped him greatly in determining many questions of geography, etc. He concluded to have his maps engraved, and requested me to add some things and correct others, such as the form and proportion of lakes, etc., and to make more general resemblance to facts, only he insisted on having what he calls Lake Glazier much larger than the *meandered* exhibits on the L. O. plats. The result of my attempts to improve his draught was to make the resemblance to facts greater, and at the same time, as now appears, to give greater strength to his claim of exploration, and to accurate knowledge on the part of his guide."

And now, finally, to settle once for all the worth of Captain Glazier's claim, Mr. Bartlett Channing Paine comes into court, and, *as state's*



THE ITASCA LAKE REGION, AS SURVEYED BY HOPEWELL CLARKE, CHIEF OF THE I. B. T. & CO. EXPEDITION, OCTOBER, 1886.

evidence, gives the following testimony in a recent interview in the St. Paul *Pioneer press*: —

"I wanted to avoid this controversy, but I suppose I might as well tell you whatever I can. Yes, I accompanied Mr. Glazier on his journey at a stipulated salary per week. I went along to write up the incidents of the trip. I suppose Mr. Glazier's object in taking me along was to give a more extended notoriety through what matter I might furnish the press. When we left for the starting-point of our journey, our objective point was Lake Itasca. Glazier had no idea of exploring any lake beyond that point. The idea first entered his head when we were part way between Brainerd and Leech Lake. There we met an old man who told us that Itasca was not the farthest lake, and that there was another one a little beyond Itasca. Glazier then began inquiring among the Indians, and he finally found one who seemed to know all about this lake. He had, according to his story, grown potatoes on the bank of the lake. That settled it: so Captain Glazier decided to see this lake. We struck Lake Itasca about halfway up the south-east arm, and paddled to Schoolcraft's Island. Next day we made our camp a short distance from the end of the south-west arm to the lake that the Indians had told us about. Glazier was greatly delighted with the lake. We sailed around it till we came to the promontory shown in the map. There the captain made a great speech about the discovery of the source of the Mississippi. When he finished his speech, I, on a suggestion previously made by him, proposed that the lake be named 'Lake Glazier.' The third member joined in the suggestion, as did the Indians. That night we began our return journey, and when we reached St. Paul I went up and examined the charts in the surveyor-general's office to see if the lake was an actual discovery. I found it was on the government maps, but I did not tell Glazier. Why? Oh, well, I thought I would let him think he had made a discovery. I accompanied him to the Gulf of Mexico. He had no more claim to the discovery than you have. Mr. Glazier recently wrote to me, asking if I had any objections to his using my signature to a few communications to certain newspapers or magazines. I replied that I had. There has since appeared an article in the December number of *Outing* on the subject of this controversy. It had my name attached, but I don't know by whom it was written. I didn't write it. In Mr. Glazier's recent letter I see that he puts forth the statement that the lake was named 'Lake Glazier' contrary to his wishes, and that he desired the Indian name 'Pokegama.' That statement is not true. The captain was not only anxious, but extremely solicitous, that the lake should be named 'Lake Glazier.' Captain Glazier took no observations at Elk Lake. He had no instruments with him."

As to the name of Elk Lake, the former surveyor-general of Minnesota, who had charge of the government land-office at St. Paul, states, that, acting in accordance with his general instructions from the government, he called it Elk Lake, in order to retain the designation originally used by the Indians for the larger lake, which Schoolcraft named Itasca. We certainly think that the official designation should stand.

It will be noted that the map shows parts of two adjoining townships. The six eastern sections (square miles) are in township 143 N., range 35 W., and the other thirty sections are in township 143 N., range 36 W., 5th principal meridian.

It only remains for us to say that we can most thoroughly vouch for the care and accuracy with which this exploration has been made. Mr. Hopewell Clarke, the chief of the party, has long been one of the most experienced and capable land explorers of the N. P. R. R. Co. In this service he has spent years in inspecting the timber, and verifying the work of the government surveyors throughout the immense land-grant of that company. We placed at his disposal every instrument for an accurate determination of elevations, levels, and drainage, which could be desired for the most complete execution of his work. He had in his party two capable assistants; and we place the record of their exploration before the public, satisfied that it is the conscientious work of the very best men whom we could command for the important task which we undertook to accomplish.

IVISON, BLAKEMAN, TAYLOR, & CO.

THE REPORT.

MESSRS. IVISON, BLAKEMAN, TAYLOR, & CO.
753 Broadway, New York.

Gentlemen, — I herewith submit my report of the trip to the head waters of the Mississippi, undertaken in your interest in the month of October last. Among the causes of delay in forwarding this paper, were my sickness immediately after my return from Itasca; the great quantity of facts contained in my field notes, which I desired to condense as much as possible; some mishaps which always enter more or less into such undertakings; and a great pressure of regular work in the line of my daily duties consequent upon my absence and illness.

The route which I selected for my trip was by N. P. R. R. to Morley; thence by stage to Park Rapids; and the balance of the way by wagon conveyance to the south-eastern arm of Lake Itasca.

The company consisted of three persons,—one a trained land-explorer, a second to serve as driver and general assistant, and myself as the leader of the party. I had originally planned taking others with me; but I am satisfied, that, with the amount of work we had to do, it would have taken twice as long with help not accustomed to the woods, and I am afraid we would have killed a green man, travelling and working as we did. So, though at first I was disappointed at the loss of one or two whom I had expected to have with me, I am satisfied that the party would not have been better made up than as it was.

In the matter of equipment for measurements and for observations, we had the following: pocket-sextant, aneroid barometer, drainage-level, Locke's hand-level, thermometers, surveyor's compass and chain, levelling-rod, pocket-compasses.

We arrived at the south-eastern arm of Lake Itasca at noon on the 13th of October, and after taking dinner embarked at once for the south-western arm, which we proposed to make the centre of our operations. We approached this portion of the lake with considerable curiosity, and as we drew near our journey's end we stopped a few moments to admire the scene before us.

Directly in front, a small, bare, mound-like elevation or knoll rises from the edge of Lake Itasca near the centre of an open space of about ten acres between it and Elk Lake. The inlet of the principal stream flowing into Lake Itasca is seen on the right, and the outlet of Elk Lake comes in at the left, of the knoll. We are looking southward; and to the right the shore of the lake is lined with pine, while the left shore and all the upper (southern) end is bordered with tamarack, except the open space in front, which is bare except for a few bushes and some rice-grass. The Height of Land is in plain view two miles and a half to the south; and between these hills and the knoll there is a peculiar light familiar to woodsmen, which indicates an opening or water beyond. It is a striking scene. There is nothing like it anywhere else on the shores of Itasca. And while looking at it, our thoughts went back to the time Nicollet was there; and we could not but reflect that Francis Brunet, or Kegwedzissag, his Indian guide, would call his attention to it, and no doubt they landed and explored Elk Lake before they went in any other direction. The moment we saw this open country between the lakes, we were satisfied that no man accustomed to the wilderness, certainly no explorer of Nicollet's experience, no guide as trained as his Indian was, could go there on the business on which they were engaged, and miss seeing Elk Lake, unless he were blind.

As night was rapidly approaching, we landed, and selected a place for camp in the open space between the two lakes; and while one of my assistants was busy pitching camp, and the other prepared supper, I employed the time till dark unpacking and adjusting my instruments, and planning the work for the following days. In all, we spent five days exploring and surveying the basin of Itasca. Wherever there was especial care and detail required, we gave our best and most diligent efforts to the work, and I believe there is no material point regarding the sources of the feeders of Lake Itasca which is not covered by this report.

In presenting the results of our work during our stay at Lake Itasca, I shall not attempt to report the operations of each day, but rather state the general conclusions and facts obtained from the thorough exploration of every part of the basin of the lake.

In following the heights of land which form the southern boundary of the basin of Lake Itasca, the general trend of the crest is from north-west to south-east; but it takes a course almost directly east after striking the north-east quarter of section 33, as shown on the map. It also sends out spurs, one striking northward from section 35, and another, also northward, from section 31 in the eastern of the two townships shown. The spur striking north from section 35 divides the Itasca basin into two parts, the western furnishing the feeders of the south-western arm of the lake, and the eastern furnishing the single feeder of the south-eastern arm. It is not an unbroken ridge of hills, nor are these spurs perfectly defined; but they are, rather, groups and successions of hills, with the general direction given above. There is also a marked difference in the character of the springs of these two parts of the Itasca basin. The western bowl furnishes the feeders that are steady and constant during the year, and the largest feeder lies at the extreme western edge of this bowl. The eastern bowl furnishes a single feeder, which is probably nearly dry parts of the year. It is thus evident that the western streams are fed mainly by living springs, artesian in their character, being supplied by water which comes through the strata of the earth from ponds to the west and south, some of them, perhaps, miles away. The single stream of the south-eastern arm simply drains the bowl in which it flows, and while in the rainy season it may be quite a torrent, part of the year it is comparatively dry. I regard this as important in determining the ultimate sources of the waters of the upper Mississippi, it being evident that all the water which flows into the river from Lake Itasca is either surface drainage or comes from reservoirs and ponds which lie between the head waters of the Mississippi and the head waters of the Red River. To the north the elevation of the crest of the Height of Land varies from 150 to 250 feet above the level of Lake Itasca. In the western half of section 21 the height is about 200 feet; in sections 28 and 33 it rises to 225 and 250 feet; in section 34 it is 250 feet in the west part of the section, and 200 feet in the eastern; 175 feet in section 26. In section 23 the height is 100 feet, sloping gradually to 75 feet in section 14. The knoll in the western part of section 22 is 150 feet above the level of the lake. To the north, along the border of Elk Lake, the ridge is 90 feet high. Just south of the lake marked *D* the elevation is 120 feet, and just north of the lake marked *E* it is 100 feet. These data are sufficient to show the irregular and broken character of the land in this region.

One of the most interesting parts of our work was the survey and examination of the narrow strip of land between Lake Itasca and Elk Lake. We found it to be 350 feet wide at the narrowest point between the lakes, and 520 feet measuring along the crooked trail at the base of the knoll. The lakes run nearly parallel for 1,020 feet, and the strip of land contains in all about 10 acres.

The portion shown as hilly on the plat is a small mound-like elevation, nearly devoid of all timber, which rises with a gradual slope south from Lake Itasca to a height of 33 feet, and descends abruptly to the shore of Elk Lake. Its direction between the lakes is nearly east and west. Its height above Lake Itasca at its western base is 10 feet, where it is less than 100 feet wide; and thus, if each lake were a little higher in elevation, they would at this point be within 100 feet of each other. The highest point on the trail between the two lakes is 12 feet. The ridge extends to the outlet of Elk Lake, from which point Lake Itasca is in full view. Another hill rises to the east of the outlet, leaving an opening 12 feet wide, through which the stream flows with a rapid current, in a channel 6 feet wide and 6 inches deep. The balance of the land between the two lakes on either side of the creek, is a tamarack swamp. The outlet of Elk Lake flows nearly north-east 80 feet, and enters the tamarack swamp, where its general direction is north for 600 feet, until it reaches a point within 110 feet of Lake Itasca. It then curves back toward Elk Lake, and finally enters Lake Itasca, its whole course from Elk Lake measuring 1,084 feet. Where it debouches into Lake Itasca, it is 7 feet wide and 8 inches deep. We noted its width at numerous places in its course, and found it to vary from 6 to 12 feet, and its depth from 2 to 8 inches. It gains nothing from springs along its route, and its increased width and depth are caused by back water from Lake Itasca. It is a very pretty little stream, and has been cleared out by the Indians, who go there annually and place fish-traps to catch the fish that run between the two lakes. The difference in elevation between the two lakes is 1 foot and 1 inch. The stream between the two lakes falls 6 inches between Elk Lake and a point where it enters the tamarack swamp, in the first hundred feet of its course; the balance, 7 inches, measures the fall in its course through the tamarack swamp of nearly 1,000 feet.

Leaving this interesting part of the lake for a time, I will give some details in regard to the other feeders of the lake. The stream entering the south-east arm, as above remarked, is evidently quite variable in its character. At times, apparently, it is very shallow; but after heavy rains it is quite a torrent, and drains the lakes which form during the wet season, marked *Q*, *R*, and *S*. When the stream is at its best, it is fully 6 feet wide and a foot deep. The stream entering Lake Itasca at *a* is merely a sluggish creek, draining the marsh to the northward in sections 23 and

10. The stream entering at b rises in a swamp on section 16, and is joined by a branch in section 15, which rises in section 10. There are numerous springs along its course, and it is 8 feet wide and a foot deep, at its mouth discharging as much water into Lake Itasca as the outlet of Elk Lake does. The inlet at c is a small brook, 2 feet wide and a foot deep, that rises in a swamp less than a quarter of a mile from the lake.

This brings me to the largest feeder of the lake, the one entering at d. It is 16 feet wide and $2\frac{1}{2}$ feet deep at the place where it enters into Itasca, and is the stream mentioned by Nicollet, in his report of his explorations in 1836, as "the one remarkable above the others, inasmuch as its course is longer and its waters more abundant; so that, in obedience to the geographical rule that the sources of a river are those that are most distant from its mouth, this creek is truly the infant Mississippi; the others below, its feeders and tributaries." The exploration of this stream was the most complicated and difficult of our undertakings, and it was with considerable difficulty that we were able to identify the three lakes which Nicollet describes; but while on the ground, and after the most careful study of the problem, we came to the conclusion that Nicollet's three lakes were those marked on the map as A, B, and C. At first sight, it would seem, from Nicollet's description, that these could not be the ones he referred to; and I have given much study to the points involved, endeavoring to reconcile his descriptions with some other theory. We followed the stream to the first lake at the edge of the hills and through the swamps; and the course of the brook is two miles in length, and seemed like four. Distances on the ground double up very fast when one follows crooked streams, as you will remember when you compare the length of the stream between Elk Lake and Lake Itasca (1,040 feet) with the actual distance between the two lakes (350 feet). If we add to the actual length of the course of the stream from the lake A to its outlet at d, which is in reality 2 miles, the difficulties that Nicollet encountered in wading through the tamarack marsh, we can easily believe that this is the course which he describes as 'two or three miles' in length. His report makes the distance between the first and second lakes comparatively short, and that between the second and third lakes still shorter, so that there is no other lake which answers the description for the third or higher lake but the one marked C. This, however, is not the source, at the present time at least, from which Nicollet's stream draws its principal supply of water; and to find that source, after considerable exploration, we were obliged to go to a lake which has its head in the north-western quarter of section 34. This is the utmost source and fountain head of the water flowing north into Lake Itasca. The lake itself is fed by numerous springs along its borders, and its surface is 92 feet above the level of Lake Itasca. The small inlet from the lake marked I was dry when we visited it, but water runs through it in the wet season. The hills south rise from 20 to 160 feet high, and water has never flowed over them northward. It might be interesting to know how far it flows under them. It is certain that it does, but there is no way to trace its course or distance. All the streams in this part of the basin rise in springs in tamarack swamps, which undoubtedly are fed by water percolating under the hills from lakes and swamps beyond; and no doubt the group of lakes, U, V, W, and X, in the southern part of sections 33, 34, and 35, which spread out to a considerable extent in sections 3, 4, and 5 of the townships next south, are the reservoirs which feed a number of these springs. Beginning with the lake marked H, it spreads northward nearly half a mile. At its northern end the water flows out of this lake in a stream $1\frac{1}{2}$ feet wide and 1 foot deep, and, running west about 200 feet, empties into a small lake about 2 acres in extent, marked G. This lake connects with another of the same size about 20 feet to the west of it.

At the time we were there, both ponds were full of moss and bogs, and apparently almost dried up, the abundant inflow of water running out by underground passages as fast as it came in; but both lakes show that at some seasons of the year they contain 4 feet more of water, caused by the increased flow in the springtime and in the rainy season. At this time the underground passages are not large enough to carry the water off, and so it accumulates and the ponds fill up. Apparently they once had a surface outlet which is now closed by a beaver dam. The water flowing from the two lakes feeds the two springs numbered 3 and 5. Proceeding to the spring marked 5, we find the water bubbling up and flowing away in a rapid, lively stream, in a direction generally northward. It is fed by springs along its course until it reaches the extreme south-western corner of section 22, where it is $2\frac{1}{2}$ feet wide and 8 inches deep, and discharges into a small pond of about 5 acres in extent. This pond is the most remarkable one in the course of the stream; it has no surface outlet, and, from the formation of the land about it, apparently has never been any larger than it now is; but, with the large volume of water flowing into it, we perceive that it must, of course, have a steady and sufficient outlet underground. This we found to be toward the west, where it bursts forth in an immense spring or pool, marked 2, in the extreme south-eastern quarter of section 21. The lowest point on the hill between the pond and the spring is 12 feet above the level of the pond ; and the water, dropping underground, bubbles up in the swamp 200 feet away and 33 feet below that level. You will notice that the stream thus passes underground from section 22 into section 21, and is therefore invisible to one following up the course of the section line, — a fact which will be referred to again in a latter portion of this report. Proceeding from the spring marked 2, the water flows in a north-westerly direction, and empties into the lake marked *B*, — the second one of Nicollet's chain of lakes. The outlet of this lake is on the west side, a stream 3 feet wide and a foot deep, which is joined at a short distance by another from the south. Following up the stream, which joins the main one on section 21, we find it rises on section 28 at a spring marked 3, evidently fed by an underground passage from the pond *F*. These streams are re-enforced throughout their course by springs which ooze from the bases of the hills that line the tamarack swamps ; so that, when the creek leaves lake *A*, it flows with a brisk current 12 feet wide and 1 foot deep, which is further re-enforced by numerous springs all the way to Lake Itasca. At the point of its discharge into the lake, it is a broad, well-defined stream, 16 feet wide, and $2\frac{1}{2}$ feet deep at its deepest point. Lake *A* is ten feet above the level of Lake Itasca.

Recurring to the subject of Nicollet's three lakes, I recall the fact that Nicollet states, that, at a small distance from the heights where the head waters originate, they unite to form a small lake, from which the Mississippi issues with a breadth of $1\frac{1}{2}$ feet and a depth of 1 foot. "*At no great distance, however*," so Nicollet says, "*this rivulet uniting with other streamlets, supplies a second minor lake*," so we were obliged to look for the upper of the three lakes at a reasonably short distance from the lake *B*. If the spring, numbered 2, would fill the bill as a lakelet, it would meet all the other requirements of the case perfectly. The only alternative seemed to me to be the lake marked *C*. At present the outlet of this lake is obstructed by two beaver dams, and no water flows from it except what little may percolate under these obstructions. Its principal feeder, marked *m*, rises in a spring in section 27, and is also nearly dry, but there is a small amount of water flowing through its channel. I leave it to you, or to future explorers, to settle the question as between the spring 2 and the pond *C*.

There are four small streams flowing into Elk Lake. The first one rises in a spring, the outlet of which flows into a small pond 50 feet in diameter in the north-western quarter of section 34. It leaves this pond a brooklet 6 inches wide and 2 inches deep, and flows with a rapid current to the centre of section 37, where it is joined by another and larger branch coming from a tamarack swamp in the south-eastern quarter of section 27. At the point where it flows into Elk Lake it is 2 feet wide and 6 inches deep. The elevation of the source of this stream at the spring marked 10 is 88 feet above Elk Lake and 89 above Lake Itasca. The *largest* stream flowing into Elk Lake rises in the north-western quarter of section 26 in a spring marked 13. This is joined, at a short distance from its source, by another branch, which is supplied by a small lake in section 26, marked *N*. The outlet of this lake is by an underground current, it being closed by a beaver dam ; but water has flowed out by a surface outlet at some period, perhaps at the time of Nicollet's visit. Where the main stream enters Elk Lake it is 3 feet wide and a foot deep. This lakelet *N* in section 26, and its outlet, were to me among the most interesting things found in this region. To my mind they prove conclusively that Nicollet not only explored Elk Lake, but also its feeders. Referring to the copy of his larger map, which you sent me, I find just such a lake laid down at the head of a small stream flowing into Elk Lake from the south-east. This is the most important feeder of Elk Lake, just as Nicollet indicates it to be. The other two streams flowing into Elk Lake are quite small, and originate as shown on the map. We found a dry channel between the lake *M* and Elk Lake. No water was flowing from this lake, although it probably does discharge some water in the spring and when the water is high. In measuring the amount of water supplied by the various tributaries of Lake Itasca, we found the three streams discharging at *b*, *d*, and *e*, furnishing practically all the perennial water-supply of the south-western arm of the lake ; and of this I would estimate that Nicollet's creek furnishes $\frac{3}{4}$, and the other two, each about $\frac{1}{8}$.

THE WORK OF THE GOVERNMENT SURVEY.

It was an important part of our task to observe the posts and blazings left by the government surveyors, and we carefully ran the main lines with the view of detecting any errors that they might have made. In this part of their work, and also in meandering of the two lakes, our examination proved their work to be correct in every material point. A singular mistake, however, on the government plat, is easily accounted for. The course of the stream from lake *H* until it crosses the south line of section 22 is substantially correct as laid down on the government map: but, when they ran the line between sections 21 and 22, this stream was not crossed again, and they naturally supposed it ran due north through the western edge of section 22, and that the stream flowing out of section 21 into 22 was a branch running into the main stream; whereas this is the main stream, which, passing westward under their feet into section 21 by an outlet which they did not see because it was underground, takes its course through the eastern part of section 21, and crosses into section 22 again at the point where the government surveyors had indicated a feeder to the main stream. The two small lakes *C* and *D* on section 22, and the two *A* and *B* on section 21, would not be crossed by a section line: hence they were not indicated by the surveyors. At a point where the section line between sections 21 and 28 crosses the branch of the spring flowing out of section 28, the course of the stream is through a boggy swamp, and it would hardly be noticed as the stream without going a considerable distance north or south of the section line: hence it is not shown on the government maps, but in place of it is shown a marsh. In all other respects the work of the government surveyors is well done. Their business was to establish section corners, blaze lines between the sections, note all lakes intercepted by the section lines, meander lakes of more than 40 acres in extent, note streams crossed and indicate their apparent direction, etc. Trifling errors will creep into their work; but, when we take into consideration the difficulties they have to contend with, it is not to be wondered at.

Another part of the duty of the government surveyors is to indicate the names of streams and bodies of water, and, in case no modern name has been given to them, to retain the Indian name or its English translation. Following this rule, the name of Lake Itasca, being generally accepted, was retained.

With regard to the name of Elk Lake, Mr. Hall, who was the chief of the surveying party of 1875, recently told me that when he was surveying township 143 N., range 36, he met an Indian trapper at Lake Itasca, who had made this region his trapping-ground for years. He asked him the Indian name of Lake Itasca and Elk Lake, and the Indian gave him the name of 'Omushkos,' or 'Elk,' for the lake in section 22, and another name, which Mr. Hall has forgotten, for Itasca. As Lake Itasca had a name already, he simply recommended to the surveyor-general the name 'Elk Lake' for the other body. But the Indians are by no means agreed upon the designation for these lakes. They certainly gave Mr. Schoolcraft the name 'Omushkos' for Lake Itasca, and to Mr. Gilfillan, 'Gabukegumag' for Elk Lake. The latter term signifies 'water that juts off to one side' of another lake; that is, branches or projects out from it like the fingers from the hand.

Other travellers have found still other designations applied by the Indians to these lakes. Surveyor-general Baker, in fixing the name finally to be applied to the lake, considered, that, whether 'Omushkos' was the original designation of Elk Lake or of Lake Itasca, it was worth while, in the absence of any other fitting name, to retain that designation for the lake which was not yet named. I am certainly of the opinion that the name should stand.

NICOLLET'S MAP, ETC.

It is fitting to say a few words in regard to Nicollet's map and possible changes, past and future, in the Itascan region. Careful investigation along the shores of Lake Itasca shows plainly that some time in the past it has been 9 inches higher than it is at the present. This rise would be sufficient to overflow all that portion of the

ITASCA LAKE AND VICINITY. FACSIMILE COPY OF NICOLLET'S MAP DEPOSITED IN THE OFFICE OF ENGINEERS, U.S.A., 1836–37.

land shown as tamarack on the plat of land between Elk Lake and Lake Itasca, and back the water up to the narrow strip of high land on the outskirt of Elk Lake, thus bringing the lakes within 80 feet of each other. Whether this was the case when Nicollet was there, I will not attempt to answer. His map would seem to indicate that it was, by the fact that he shows the two lakes so closely connected, Elk Lake so much larger than it is, and the two arms of Lake Itasca so much out of proportion with their present outline. But this can readily be accounted for on other grounds. The shores of the south-eastern arm are abrupt and bluffy, while the shores of the south-western arm are low and swampy. This makes the south-western arm look wider than it is, and the south-eastern arm narrower than it is. The shores of Elk Lake are also abrupt and lined with bluffs, and to one looking south across it, it does not look half as large as it does to one standing on the hills south of it and looking north. Distances across water are always deceiving. The view from different points of Lake Itasca might be sketched by a dozen different parties, and no two sketches would look alike. My impression is, that Nicollet sketched the south-eastern arm of Lake Itasca from some point on its western shore and Elk Lake, and the south-western arm of Itasca from the knoll between the lakes; and when we take into consideration how insignificant is the distance between the two lakes, compared to the total length of both, it can readily be understood why he has shown them as though Elk Lake were a bay instead of a separate body of water. From the nature of the springs which feed the principal stream emptying into Lake Itasca, it is evident that very few changes have taken place in that part of the basin since Nicollet was there, and very few will take place in the next fifty years. The springs that feed it are supplied by underground currents and reservoirs from the lakes and the Height of Land, and, as they cannot be drained, no amount of settlement or clearing will change them. They are among the permanent features of the country. Lake Itasca of to-day is the same in its main features that it was when Nicollet was there, and for a hundred years before. Its level may have been a little higher, the surface of Elk Lake may have been a little lower, Itasca may have spread out over some acres more of marsh, Elk Lake may have been somewhat smaller in its surface extent; thus they may have come more nearly together, and nearer to being one continuous body of water. But the main features of this remarkable basin will remain the same for generations to come, and Lake Itasca will be then, as it is now, the first important reservoir of all the springs that feed the head waters of the Mississippi River.

Our meteorological observations were taken with an effort at system; but it is sufficient, perhaps, to say that the atmospheric temperature varied from 20 to 70 degrees during the five days that we were at Lake Itasca, and that we had the extremes of clear weather and invigorating atmosphere, and of desolate, soaking rain. The severest storm overtook us when we were within 5 miles of Lake Itasca, and we passed a most unenviable night in an improvised camp. We took the temperature of the water in Elk Lake and Lake Itasca when the temperature of the atmosphere was 51° F., the temperature of the water being 46°. The temperature of the water in the second lake on Nicollet's creek was 42°.

Among the mishaps which invariably attend such explorations, were two that are worthy of note, — the loss of my revolver, and the leaving behind, unaccountably, of my copy of the Nautical almanac. I had intended taking the latitude of the northern end of Elk Lake, and also establishing a meridian and noting the exact variation between the true and magnetic meridian; but when I got on the ground, of course this was impossible without my tables. Still worse luck followed the observations with the barometer. I had arranged with Sergeant Lyon, of the U.S. signal service at St. Paul, to take simultaneous readings of the barometer. The instruments were adjusted together when we set out for Itasca, but, when we got back to St. Paul, mine read 200 feet higher than his. As there was no way of determining when this change occurred, all that work was of no account. As our first observations were taken at 6 A.M., and the last at 10 P.M., they involved considerable sacrifice of rest, which I am sorry yielded so little result.

The figures given in the first part of this report for the elevation of the crest of the Height of Land are therefore necessarily only approximate, as the variation in my aneroid barometer destroyed the value of my observations, on which I largely depended for this part of my work. The heights noted for elevations between the lakes and for the springs and streams were obtained by the drainage-level, and these may be relied upon as practically correct.

I considered it very fortunate that our trip was made just at the end of a long spell of dry weather such as has hardly been known in Minnesota for years. This enabled us to judge of the sources of water-supply that are perennial in their flow, as distinguished from the surface drainage in the spring and in the rainy seasons. The rain of the night before we reached the lake was not enough materially to disturb these conditions.

The last thing we did before leaving our camp between the lakes was to erect on the top of the little knoll, in plain view from both lakes and from Schoolcraft Island on the north, a monument to the memory of Nicollet, on which was inscribed the following: "To the memory of J. N. Nicollet, who discovered the source of the Mississippi River, August 29, 1836." This was done after fully exploring the country for miles around; and our little party of three was fully satisfied that fifty years ago Nicollet had discovered all there was to discover of the sources of the Mississippi; and that if he had lived to complete his report on 'The sources of the Mississippi and the North Red rivers,' and to give to the world his unpublished map, there would have been no chance for any Glazier to confuse the geographical world, or to play tricks upon the learned societies of two continents. We found our work difficult enough, though we were only a day's ride from civilization and the railroad, and though the whole township had been marked off and blazed at every turn by the government surveyors. What, then, must have been the heroism of the invalid devotee of science, who buried himself for months in the unbroken wilderness, and gave his life to the exploration of the frontiers of his adopted country!

I have done my work without any prejudice or bias, and determined only upon finding out and stating the truth in regard to the sources of the great river of our continent whose exploration has commanded the service of so many worthy men in every period of our history.

As a preparation for the survey, I had read every thing I was able to gather on the subject, and I took with me tracings of all the maps of the region, either published or to be found in the government departments. The work has been done by actual survey, and in such a way that I believe it will bear investigation by any surveyor who wishes to check it.

HOPEWELL CLARKE.

Minneapolis, Minn., Dec. 7, 1886.

THE BRITISH SCHOOL AT ATHENS.

A WRITER in the *Athenaeum* states that the managing committee have now drawn up and will immediately issue a series of rules and regulations for this school. Its objects are declared to include, 1°, the study of Greek art and architecture in their remains of every period; 2°, the study of inscriptions; 3°, the exploration of ancient sites; 4°, the tracing of ancient roads and routes of traffic; and, further, the study of every period of Greek language and literature from the earliest age to the present day. The students of the school will fall under the following heads: 1°. Holders of travelling fellowships, studentships, or scholarships at any university of the United Kingdom or of the British colonies; 2°. Travelling students sent out by the Royal academy, the Royal institute of British architects, or other similar bodies; 3°. Other persons who shall satisfy the managing committee that they are duly qualified to be admitted to the privileges of the school. Students attached to the school will be expected to pursue some definite course of study or research in a department of Hellenic studies, and to write in each season a report upon their work. Such reports are to be submitted to the director, and may be published by the managing committee if and as they think proper. Intending students are required to apply to the secretary, Mr. George Macmillan, 29 Bedford Street, Covent Garden, London. No person will be enrolled as a student who does not intend to reside at least three months in Greek lands. Students will have a right to use the library of the school free of charge. So far as the accommodation of the house permits, they will (after the first year) be admitted to reside at the school building, paying at a fixed rate for board and lodging. The managing committee may from time to time elect as honorary members of the school any persons actively engaged in study or exploration in Greek lands.

The director is to deliver at least six free public lectures at Athens during the season, and at the end of each season he is to report to the managing committee upon the studies pursued during the season by himself and each student. A sub-committee has been appointed to purchase books for the library so far as funds will allow. Presents of books or pamphlets will be gratefully received and acknowledged by the honorable secretary.

THE 'NATURAL METHOD' OF LANGUAGE-TEACHING.

No single word has created so great a confusion of thought as the word 'natural.' Its bare etymological meaning is plain enough; but its application is confined by the bounds of no dictionary, and its sense is as mutable as the shifting sands of the seashore. No other word has so often been used by writers as the convenient vehicle of their own individuality. 'Natural' is often simply what one desires from his own particular view to be natural. It is necessary, accordingly, always carefully to scrutinize its use, and thus to discover from its special application the precise meaning it may bear.

Stripped of the mass of detail, a part of which, except by the sole right of assumption, does not specifically belong to it at all, the 'natural method' is, in ordinary phraseology, simply what its first advocate in this country called it, — the teaching of a language without grammar or dictionary, using the language to be taught as the medium of communication between teacher and pupil. Whatever its most enthusiastic votaries may claim for it, — and their claims are often even startling, — it is this, and no more. Since they were first formulated, the details of the system have grown by a not unnatural accretion, until they include a great mass of pedagogical material, some of which is about as much the especial property of the natural method as spectrum analysis is an individual prerogative of the pupils of Helmholtz. From one point of view, this is, perhaps, not to be deprecated; for, through the active proselytizing of its disciples, sound pedagogical principles have obtained a currency and found their way where otherwise they might not so easily have penetrated. On the other hand, it is, however, to be deplored as a categorical assumption of fact, to give plausibility to a theory which by no means finds universal acceptance. The name and claim of the method was in the first place, then, as it is given above. The substitution of the present name for the original title was, for its advocates, an extremely happy thought. In spite of some adverse testimony, there is something in a name; and a 'natural method' has attracted attention where 'language-teaching without grammar or dictionary' would have fallen unheeded.

Joseph Jacotot wrote, at a time when such sentiments as he expressed were somewhat revolutionary, what now might very properly be taken as a motto for the natural method: "Become a child, if you wish to make progress in studying a language; it is the quickest, the surest road to success." Whether Jacotot meant it literally or not, it is needless to question: certain it is that the formulators of the natural method not only cite it, but believe it, and incorporate it in their teaching.

There is no question as to the fact that a child readily learns a language from imitating, consciously or unconsciously, the speech of those about him. Every child with unimpaired faculties in this way acquires a vocabulary that steadily keeps pace with its increasing consciousness, — the vocabulary that can be used; the spoken vocabulary, of course, being always a little behind and in abeyance. It is a slow process at best, a matter of years, to learn a language in this way. Its slowness, however, is, no doubt, due to the fact that simple cognition is of slow growth: cognition and language are growing together, but the former must necessarily precede. A similar process may take place, to a limited extent, at any time through life, if we add a new idea and an accompanying expression to our knowledge; if, for instance, we study medicine, an applied science, or law. Now, it is manifest that it is possible to be a child, in its purely literal meaning, but once. No assumed childhood will serve to place one, with regard to idea and its expression, in the position here described. The natural method cannot, of course, mean to do this at all. It fulfils, then, no particular purpose to write or to speak in the first lessons such sentences as a little child would naturally use in its first faltering speech. It is only necessary to have simple, short sentences, that are easy to understand and convenient to remember. If the natural method does not mean to teach a language in the manner that a very young child learns it (and it manifestly does not), it must base its terminology elsewhere.

It is a well-known fact that children easily acquire a language in addition to the one they have unconsciously learned. It is only necessary to have a French or German nurse, and in a comparatively short time the child with whom she is intimately associated is in possession of a French or German vocabulary; good or bad, according to the time spent with the nurse, who is communicative or uncommunicative, and speaks her own language well or ill. Unfortunately for us of older growth who have neglected its opportunities, the period of childhood is one of peculiar facility of imitation and receptivity. It never comes again in like measure. Here, again, it is impossible to be a child, and no end of sentences embodying ideas that do not rise above the first simple formulations of a child can suffice to put one in the attitude of a child.

It is possible, of course, by going to a foreign land, to place ourselves somewhat, after all, in the position of the child towards its nurse. If we are utterly cut off from communication with those who speak our own familiar language, the situation is even improved. We are then forced out of our own speech and into another; we are fairly obliged to acquire the new vocabulary, the new constructions, and the new idioms. But those of us who have tried it know that under the most favorable circumstances, and with the best and most constant opportunities for communication, even this is a slow method: it depends upon the individual, and the time of life, as to how slow it is. A German laborer, — Hauschildt, — a man of some education and no end of general information, died a few weeks ago in one of the interior cities of the state. He had been in this country all of thirty years, but at the time of his death could scarcely make himself understood in English. His associations, however, had always been German: he had never cut himself loose from them, and even in a foreign land had still been a German among Germans.

The position last stated is plainly the one taken by the advocates of the natural method, and the one upon which is based their terminology. The pupil in the classroom is placed somewhat in the position of a stranger in a strange land. He is spoken to in a foreign language, and in the same language is expected to give his reply. Grammar and dictionary are unheeded, and upon this fact great stress is laid. It is a simple exchange of ideas, say its advocates, between teacher and pupil, resulting, in a surprisingly short time, in a complete mastery of the language the learner has been encouraged to use. By and by authors are read in the original. Curiously enough, in the last stages grammar is taken up, making thus its knowledge the capstone of the linguistic pyramid.

Now, there seems to be no reasonable doubt that instruction of this kind, if long enough continued, would ultimately result in giving to the pupil a certain knowledge of a language. He might learn, with limitations, to understand it, and he even might for a time speak it with some degree of fluency and correctness. This much must be granted. The pupil, however, has only arrived at this result by the expenditure of much valuable time that might have been better employed. The knowledge that he has acquired is inexact, and beyond a few parrot phrases it will improve the earliest opportunity to depart from him utterly.

The one great mistake of the natural system lies in its neglect to provide a suitable grammatical foundation for the superstructure it proposes to raise, — that it leaves for the top what it ought to have started with at the bottom. An argument is, however, in this way furnished in favor of the system, plausible, to be sure, but unreal and misleading. The teachers of the new method thus bring forward as an advantage that they do away with a text-book of grammar and its attendant drudgeries. One exponent of the principles of the system holds not only the supposed horrors of learning grammar, but of teaching it, hysterically up to the light, and exclaims, "Nothing can solace him (*the teacher*) for the *ennui* which grammars cause him : this is a suffering which kills, or at least shortens life, and takes from the mind all freshness and vigor."

There is no doubt but that there is some drudgery — call it that, if you please — connected with grammar. There is more or less of it in learning every thing else, — the alphabet, the multiplication-table, history, or any science. The natural method would here offer us a royal road to learning, and it is not strange that many will be found willing to traverse it. A foreigner, surrounded by people speaking a strange language, will indisputably learn to speak the language he constantly hears. If he hears it correctly, he will speak it correctly, without perhaps ever having heard that the language has a mass of inflections and syntactical agreements that some long-experienced scholar has carefully collected and summarized in a grammar. It is not, however, for a moment to be imagined that this supposititious person has learned his language either as rapidly or as well as if he had had a grammar to help him with its ready-made experience. The exertion of learning is not to be avoided, and has not been avoided ; and the result is the same whether the process be drawn out and diluted with great expense of time, and foolish repetition, or condensed and abbreviated with such aids as are at hand. There is, for example, no avoiding the fact that the majority of French nouns ending in *al* form their plurals in *aux*, whether we learn the whole truth at one effort from a grammar, or whether we attain it finally by induction from individual examples. The acquisition, in the one case, is, too, just as real as in the other ; the generalization learned from the grammar must also necessarily long precede its formulation by induction ; and, having been thus incorporated in one's knowledge, it can immediately be put to use. A grammar saves time by simply categorizing forms ; and it is not the rules themselves, it is their sure application, that is sought. All rules for language change can, of course, be established by induction after a sufficiently large accumulation of facts by experience ; but, after such a complete knowledge of a language has been attained as might enable one to formulate general laws, the need of a general law has passed away. A purely inductive method teaches the words of a language individually and separately, and does not abridge the labor by treating them in classes. Grammar, according to the foregoing, is, then, to be considered, in a modern language particularly, simply as a means to a definite end. It is not the end itself, and it is to be greatly doubted whether any teacher of a modern language regards it so. It would be a very foolish and incompetent instructor who would endeavor to teach a language solely from the grammar, to isolate it from conversation and from its literature. A language cannot be learned in this way. The writer previously quoted makes it a point that those who study grammar do nothing else. But surely no one contends that one can converse in French by knowing the rules for the use of, for instance, the demonstrative pronouns. What one does maintain, however, is, that, knowing the rules of grammar, one can converse correctly. You do not find, again, in a grammar, however complete it may be, the aesthetics of words ; neither, if you are wise, do you seek for it there. The same prominent advocate of the natural method exclaims warmly, "I defy any teacher to make us realize these shades, this use so delicate of the subjunctive, from the grammars : they know nothing of the niceties of language." As if for a moment it were a question of doubt! To make grammar an end, or, to put it differently, to make a language an affair of rules and phrases, is an error, as every teacher of even moderate intelligence will admit. To use grammar in its proper way, as an auxiliary, as an aid to classify and formulate facts necessary to be known, is an abbreviation of labor that neither a teacher nor a learner can afford to despise. By what has been said it is not meant that a person shall go about with a grammar under his arm to which he might refer, or that he should always be ready with his rules by paragraph and number. Grammar is thoroughly learned only when it can be applied accurately and with apparent intuitiveness in the course of conversation or of writing; and when it can be thus applied in the case of a modern language, that is usually studied for itself rather than for the mental discipline that its study involves, then its purpose has clearly been fulfilled. It matters little to one if, having acquired a thorough speaking knowledge of German, he is unable to assign his nouns to their proper classes of declension. In reality, he no more consciously assigns them at all. His knowledge of the inflectional processes of the language has been thoroughly digested and assimilated. The learner has, nevertheless, saved time by the original categorization. As he has had, in the process of learning, a well-known rule of grammar at hand to authorize a form of expression, confidence, too, has been given him as to the reality of his knowledge, instead of a feeling of uncertainty as to whether he is right or wrong; and his knowledge is in every way better founded and more lasting. There is still another point to be noticed connected with this knowledge, or want of knowledge, of grammar. Two languages co-existing corrupt each other. It is inevitable that when two languages are spoken side by side, except perhaps in that facile period of imitation in early childhood, one should influence the other. It depends upon circumstances which one is swayed the more, or, indeed, the process may be interactive. One has only to look for an illustration of this to the degeneracy of the German language as spoken by many Germans in America. It will be found, too, that those persons who are most influenced in this way are those who are most deficient in a knowledge of the constructive principles of their own language. If a foreign language is not a thing of constant daily habit, a learner will drift into error from precisely similar causes. Here, again, the rules of grammar, thoroughly learned, afford the only safe anchorage; and an early knowledge of them will conserve both time and labor.

In regard to the disuse of the dictionary by the advocates of the natural method, a word also may be said. By constant iteration on the part of the teacher, and endless repetition on the part of the pupil, a foreign vocabulary may unquestionably be acquired, but the result is by no means commensurate with the time or the energy expended. The only way to get a vocabulary is to learn it, whether by a series of repeated impressions extended over an indefinite time, or by a decisive exercise of memory that once for all grasps a classification. There is, it is to be willingly conceded, nothing quite so stupid or discouraging as to look out, at an early stage of the study of a language, every other word of a passage, in the dictionary. This difficulty may be obviated by furnishing a beginner's text with a special vocabulary, which, however, should be learned. It is an easy matter, as the study progresses, to select texts that shall only gradually increase in difficulty, and so keep pace with a continually widening vocabulary. There is, nevertheless, a distinct advantage to be gained from consulting the dictionary. It is an error, even in the case of a special idiom, to teach a word solely as the member of a phrase, or a few phrases, and not as a real entity that may be equally well used in other places. The dictionary here furnishes the proper corrective; and, as I have elsewhere written, the student will, by consulting it, "not merely exercise his faculty of discrimination in selecting, from among those nearly synonymous, the correct meaning demanded by the context, but he will unconsciously, at the same time, widen his vocabulary and his knowledge of the capabilities of the language."

As for the boasted advantage of the natural method, that instead of the intellectual barrenness produced by the use of grammar and dictionary it awakens interest by an immediate exchange of ideas, it is difficult to see what mental impetus can be given, or what superiority of ideas be embodied in such phrases as, "Here is the finger. Do you see the finger, madame? Yes, you see the finger, and I see the finger. Do you see the finger, monsieur?" etc. The whole vocabulary of simple words and their combinations, as given in 'Causeries avec mes Elèves' or 'Plaudereien,' it may be asserted without partiality, and as the result of careful computation, could be learned by a moderately energetic pupil in about one-half the time it would require him to read through these books. In other words, had the same amount of time and labor been bestowed upon a system with grammar and dictionary at its back, the direct results would have been as great again, and the utility of the acquired knowledge for its effect upon the future would, in accordance with what has been said, have been many times as great.

The natural system is not only not the ideal nor the best way of language-teaching, as its apostles desire us to believe; it is not even a good way, if the results it furnishes are considered with regard to the time spent in their acquisition. It is not meant that the system is throughout bad. Its great fallacy is, that it rejects as worthless the generalizations of grammars, preferring, instead of starting out on the journey with a well-filled wallet, to depend wholly upon what can be gained along a not always productive way. Its redeeming feature is, that it makes conversation, even if often trivial, such an important factor in instruction. Grammar is not a universal panacea for all linguistic ills, and surely no teacher of a modern language, in these times of pedagogical enlightenment, disputes for a moment the unmistakable advantage of abundant exercise in conversing and using the language taught, or of living as much as possible in its atmosphere. In learning a foreign language, one of the greatest difficulties to overcome is the tendency to translate bodily, word for word, idioms and all, from your own language into the new. Conversation here is clearly the only substantial corrective; for it would require a peculiarly observant mind to get these shades of usage from literature, even of the most conversational nature. The grammar of such speech as is here supposed might be faultless, but every sentence none the less unintelligible.

If the neglect of grammar at the outset is the hopelessly weak side of the natural method so called, and its practical use of conversation is its strong one, a combination of grammar — of the use of a text-book of grammar — with conversation in the language taught, would result in a method of study in every way more admirable and worthy of adoption. Other points, to be sure, in the elaboration of such a method, would also necessarily receive attention. The natural system promises too much return for the outlay made by the pupil; and just here may be sought the secret of its temporary popularity. It is, however, not real enough and not systematic enough. Learning a language is an affair of memory. To know it, one must remember the vocabulary and its correct combinations. It is a mistake to suppose that a person can imbibe knowledge without conscientious and continuous exertion. A royal road leading to the domain of language would be a good thing, but it has not yet been discovered. If instead of the natural method could be put a rational method embodying the principles already hinted at, results better, more real, and more lasting would indubitably be gained. Such a method would have a text-book of grammar as its cornerstone; it would not constitute it the whole fabric, for then its very purpose would be defeated. It would have extracts, furnished at the outset with a special vocabulary which would be learned, and later on it would inculcate a use of the dictionary. It would, above all, use the language taught at every possible opportunity, and make its practical acquisition the one end in view. Lastly, it would take wherever it find them all pedagogical methods of undoubted value, and incorporate them in its instruction. The grammar and dictionary are effete in modern language instruction if they are taught for themselves alone. Regard them as they should be regarded, as auxiliaries, and employ them in that way, and a rational method will give results that the natural method cannot hope to approach, either in breadth or in reality of actual knowledge.

"The castle which conservatism is set to defend," writes Emerson, "is the actual state of things, good and bad. The project of innovation is the best possible state of things." It is not, however, to be inferred from this that conservatism is always to be decried, or that all innovation is necessarily good. WM. H. CARPENTER.

OUR GOVERNMENT.

PROFESSOR MACY'S book is on the face of it a text-book. It is therefore to be judged by its adaptability to the purposes of the classroom. In a hundred and ninety-one pages, the author undertakes to answer three questions about our government, — how it grew, what it does, and how it does it. That an answer to each of these questions is essential to a satisfactory exposition of our governmental system, cannot be doubted; nor is it less certain that the difficulty of condensing the necessary matter within the limits of a convenient

Our government: how it grew, what it does, and how it does it. By JESSE MACY. Boston, *Ginn*, 1886.

classroom manual has thus far proved an insuperable obstacle to the production of a really excellent work of that sort. We are inclined to the opinion that Professor Macy has more clearly demonstrated the existence of this obstacle without successfully surmounting it.

The arrangement of topics adopted by the author is unusual. After a general introduction, in which is sketched the development of Germanic institutions, from the primitive tunscipa in Sleswick to the modern constitution of the United States, the reader is conducted through 'Matters chiefly local,' 'Administration of justice,' 'Federal executive business,' and 'Legislation,' to a final consideration of 'Constitutions.' The wisdom of thus reversing the customary order of presentation is doubtful. The moving cause in Professor Macy's mind was probably the idea of conforming to the order of historical development. Throughout the book, indeed, marked prominence is given to the origin and growth of the institutions described. But that the old Germanic township was the seed from which our higher governmental forms have sprung, seems to us no good reason why the modern local organizations should take precedence of the higher authorities that make and unmake them. It is likely to be misleading to the student to thus disarrange the order of political importance. The most logical method of presentation for the American reader is to begin with state institutions, and proceed down to the local and up to the national. Professor Macy himself recognizes this in a measure; for he recommends that the book be taken up in reverse order when a class is reviewing it.

Another feature of the book that will trouble the teacher is the very excellence of its answers to the question how our institutions grew. A text-book should be suggestive; but Professor Macy's sketches of the growth of various forms of governmental activity suggest too much. Nothing short of a complete course in the early history of institutions will enable a class of young students to appreciate, or even to understand, many of his chapters. His summaries are admirable, and could be made of service as the outline for a series of lectures; but, for class-work in an ordinary academic course, they are too sketchy.

In general, it is our opinion that the descriptive part of the work is subordinated too much to the historical. The chapter on juries, for example, contains eleven pages of matter relating to the development of the system in England, with descriptions of the customs of ordeal, compurgation, recognition, and trial by battle, and with a discussion of the relative weight of English and French influence in determining the final form of the institution. The only reference to 'our government' in the chapter is contained in two lines at the end, stating that "the jury system was established in America by Englishmen, and is found in nearly all the states" (p. 78). For a class of students not learned in the law, we submit that some description of the jury system as it now exists, with some notice of the methods of drawing jurors, would be quite as profitable; nor could it be said to be less pertinent to the subject of the book.

While exception may thus be taken to some features of Professor Macy's work (and it must be admitted that the faults seem to result rather from the aim than the execution of the book), too much praise cannot be bestowed upon the clear concise, and vigorous style of the author. As a practical book of reference for a teacher of civil government, it will be of great and permanent value. The 'suggestions' which are appended to each chapter show that the author himself is a teacher who understands his business, and they will be in many cases more useful than the text.

W. A. Dunning.

ECONOMICS FOR THE PEOPLE.

Economics for the people. By R. R. Bowker. New York, *Harper*, 1886. 16°.

Of Mr. Bowker's successful attempt "to set forth the principles of economics so as to make them plain and interesting to all readers, illustrating them from American facts, so that at the end of the book the reader will have a fair knowledge of the economic history and condition of our own country," little but what is good can be said. The book is certainly interesting, it is sufficiently full for its purpose, and it is unusually fair and temperate. Once or twice the author's personal opinions seem to come into collision with what most of our people consider established facts, but these are not stated in a way to attract very general attention. For example: on p. 70, while admitting in one sentence that under the protective tariff an enormous silk industry has been built up in the United States, and the price of the product greatly reduced, in the very next sentence Mr. Bowker says, that, "as silk is a luxury, no great hardship is worked by the increased price;" the fact being, of course, that there is no 'increased price.' The price has been greatly reduced.

In several passages Mr. Bowker appears to commit himself to the belief that the taxation of all land, unimproved on the same basis as improved, is likely to be the chief method of raising revenue in the future. Indeed, he expressly says this on p. 138. That this will really be the outcome of the study of the problems of taxation, we doubt very much. Mr. Bowker's clear distinction between time-wages and piece-wages (p. 161) should clear up a great many fallacies fondly cherished by some writers on the industrial situation. On the money question Mr. Bowker is explicit, but not as emphatic as we could wish in pointing out the evils attendant upon the continuance of the present silver-coinage policy of the United States. Perhaps, however, he did not feel justified in introducing too much polemical matter into an expository treatise. On p. 236 the author touches on a point which we believe to be of great importance, because it is an illusion which is very generally cherished; that is, the mistaking unproductive consumption for productive consumption. Nine persons out of ten seem to think that the people in general are benefited when a millionnaire spends large sums of money in flowers, laces, and so forth, arguing that in such ways more money is put in circulation. Mr. Bowker says truly that "the wealth thus wasted would, more wisely used, furnish capital to many more people in creating more wealth." But he should have fully illustrated this point, using examples similar to those of Mill and Fawcett in treating this same topic. A chapter on this head would not have been out of place; and then a large supply of marked copies of the book might have been 'productively consumed' by mailing them to our national and state legislators, and to a select list of popular orators on economic subjects. We like particularly the final chapter in this book, entitled 'The end of the whole matter,' in which the author makes plain the truths that wealth is not an end in itself, and that economics is subordinate to ethics. The following passage, too, is very clear, and puts the question as to the limits of state interference on what we conceive to be the proper basis: "When the social machinery grinds out injustice, abuses men, makes the rich richer and the poor poorer, the community practically will not accept the extreme *laissez faire* theory; it will not let *ill* enough alone, but will apply factory acts to right wrongs. The evils that society has done, society must undo. On the other hand, the common sense also rejects not only the impossible communism which would reduce the industrious and the idle to a common level, but also the socialism which would put the greater portion of the social work under control of the state, instead of leaving it to individuals. Between the two lies the actual working social system, varying among different peoples and at different times, but persistently in accord with the underlying economic laws, and never for any considerable time, in any stable state, against them. This is controlled always by public opinion, the aggregate of individual intelligences, in its turn directed by education and by the mastery of leadership. And thus the promotion of economic progress resolves itself into the work of political education" (pp. 262, 263).

It is well that Mr. Bowker has put in his sub-title, 'for use in business;' for it is a peculiar yet true fact that most business-men, though they use the terms 'capital,' 'price,' 'value,' 'money,' 'rent,' profits,' and so on, every hour of their working lives, have very confused ideas as to what they mean and imply.

A plain man's talk on the labor question. By SIMON NEWCOMB. New York, *Harper*, 1886. 16°.

Professor Newcomb's recently published talks also come under the head of economics for the people, though the subject treated is but one of the many touched on by Mr. Bowker. We should say that the chief fault to be found with this book is that the style is almost too conversational and too familiar for dignity. The talks were originally published in the *Independent*, and from their simplicity and directness attracted much attention. Advanced political economists and erudite writers on society and its phases may sneer at Professor Newcomb's bluntness and homely illustrations, but the ordinary reader will see their force. The illustration, for example, on pp. 44, 45, would be possibly unpleasant though profitable reading for 'walking delegates.' Chapter xv., entitled 'Another talk to a knight of labor,' is excellent, and can be safely recommended not only to members of that secret organization, but to others who find much to admire and little to criticise in its platform of principles. On p. 180 and the following pages Professor Newcomb disposes very neatly of the fallacy that waste creates wealth; but whether Mr. Powderly will break any fewer ginger-ale bottles in consequence of his perusal of it, remains to be seen.

CREMONA'S PROJECTIVE GEOMETRY.

PROFESSOR CREMONA'S new work on projective geometry makes an attractive appearance in its English dress. The characteristically English additions of the translator, together with the fact that the author himself has striven to imitate the English models, for which he professes great admiration, have had the effect to make the book quite indistinguishable, were it not for the title-page, from a book of purely English origin.

The volume before us has the common defect of not throwing sufficient illumination upon the great central points of the theory which it constructs, and of giving too much space (and too large type) to unimportant details. Another de-

The elements of projective geometry. By LUIGI CREMONA. Tr. by Charles Leudesdorf. Oxford, *Clarendon pr.*, 1885. 8°.

fect is that there are hardly any examples left for the student to do by himself. Half the advantage of a course of mathematical study is lost if some facility in doing work of the same kind has not been acquired: and facility cannot be acquired without long hours of practice, any more than one learns to play the piano by listening to another person's playing.

Professor Cremona objects to the rather more common name of 'modern geometry' for the subject he is treating, that it expresses merely a relative idea, and that although the methods may be regarded as modern, yet the matter is to a great extent old. Neither objection seems to us very forcible. The characteristic of the modern geometry *is* its method, and not its matter, and the distinction between an ancient and a modern world has not yet ceased to have a real significance.

In all essential respects the distinguished author has accomplished his self-appointed task in an admirable manner, and English-speaking students will be very grateful to him for his labors. The presentation of the subject is admirably lucid and clear, the order is well chosen, and there are many simplifications of the more laborious processes of Steiner and Von Staudt. It is a good plan to make use of M. Ed. Dewulf's proof of the proposition that lines joining corresponding points of two projective ranges envelop a conic, but it is a mistake to let the proof of the most important proposition in the whole book rest upon one of the few passages which are printed in smaller type. The extent to which the subject is developed may be gathered from the facts that the sheaf of conics through four points is not reached, and that the existence of sixty Pascal lines is only mentioned in a footnote.

ARROWSMITH'S EDITION OF KAEGI'S RIGVEDA.

Sanscrit scholars, and those who are familiar with the value of Professor Kaegi's 'Der Rigveda, die älteste literatur der Inder,' will be pleased at any attempt to throw the work into a form that will give it a larger circulation, and at the same time increase the interest in Vedic studies by bringing an introduction to them within the reach of general readers. As contributing to this end, Dr. Arrowsmith's translation of the German edition will be welcomed, since, to quote from the preface, it places "at the command of English readers interested in the study of the Veda a comprehensive and at the same time condensed manual of Vedic research."

The Rigveda: the oldest literature of the Indians. By Adolf Kaegi. Authorized translation, with additions to the notes, by R. Arrowsmith, Ph.D. Boston, *Ginn*, 1886.

This is the end which the translation has in view; and it is from a popular stand-point, as appealing to English readers, that this new piece of work must be judged. In preparing the translation, Dr. Arrowsmith has chosen to follow the author throughout; and no claim is made to originality of thought or treatment, or to the contribution of any specially new material for the elucidation of the Veda. Bearing this in mind, it must be said that the translation, as a rule, is excellently made; and it would perhaps be hypercritical to pick out the few passages in which the English is not as finished as it might be, or where we have, perhaps, too close an imitation of the German idiom or word order.

In the metrical quotations from the hymns themselves, the translator, although having the Sanscrit text constantly before him, has generally adhered, as he says, closely to Dr. Kaegi s renderings; and the design seems to have been to give a readable version in popular form, rather than always a strictly scientific translation of the Sanscrit. Such being the case, we cannot look to these renderings for any thing original; but they carry out well enough the plan proposed.

The additions to the notes consist chiefly in a number of references to the more recent literature on the subject, thus bringing the book up to date; and though by no means complete, nor even professing to be so, they will prove very welcome and useful. The introduction of the 'Frog song,' on p. 81, is a good idea, and makes an acceptable addition to the book. It may be noted, in passing, that an improvement has been made by inserting at the end of each metrical translation the numerical reference to the *mandala* and *sūkta* from which the various verses are taken, instead of reserving such references for the notes. This will prove much more convenient in a general reading of the book.

The form in which the book is presented is attractive; but it is to be regretted that numerous mistakes should have crept in, not only in the Greek and Latin quotations and in the transliteration from the Sanscrit, but even in the English portions of the work. These we shall hope to see corrected in a future edition in order that they may not mar what is otherwise admirable in form.

In conclusion, we may say that by others beside the student of Sanscrit this book will be found interesting and instructive; and, with the exception of the notes, even the general reader will be interested in its perusal. It will also, it is hoped, render somewhat more general a knowledge of the Veda, and at the same time increase the interest now taken in oriental studies.

A. V. Williams Jackson.

SCIENCE.

FRIDAY, DECEMBER 31, 1886.

COMMENT AND CRITICISM.

MR. EDWARD ATKINSON of Boston has for years ranked as one of the first statisticians in the world. To be a statistician implies a great deal. It implies more than a prodigious memory in retaining figures, and more than an untiring energy in gathering them together. The statistician must add to these qualities a graphic power of presentation and an insight into the real meaning of figures, which amount almost, if not quite, to genius. All of these qualities Mr. Atkinson possesses in a marked degree, and his two articles on 'The relative strength and weakness of nations,' contributed to the *Century magazine*, the first of which is published to-day, show them at their best. These articles are certain to be widely read and discussed, not only by the general reader, but by the economist, who will pay particular attention to Mr. Atkinson's methods and his interpretation of his results. Much of this first article reads like a chapter from 'Triumphant democracy,' and the ingenious illustrations used by the author add greatly to its force. Since 1865 we find that our population has increased 69 per cent; our hay-crop, 106 per cent; our cotton-crop, 194 per cent; our grain-crop, 256 per cent; our railway mileage, 280 per cent; our insurance against fire, 310 per cent; and our production of pig-iron, 386 per cent.

Mr. Atkinson's warning to the military powers of Europe is, 'Disarm or starve.' He holds that the annual product of a country is the source of wages, profits, and taxes. If one secure a larger proportion than now exists, the other two must supply it. Furthermore, Mr. Atkinson believes that wages, earnings, salaries, and the income of the small farm, are not the measure of the cost of production, but the results of the conditions, both material and mental, under which the work is done. From this it follows that the wages or earnings will be higher in that country which is not weighted down by the cost of a large standing army or the burden of a heavy war debt, and in which the work is done by the most intelligent people, under the most favorable conditions. The mental, material, and political influence of such a country will become the most potent factor in the world's commerce. This is the future Mr. Atkinson sees for the United States. The keynote of the argument for democracy against dynasties is commerce. Mr. Atkinson estimates the world's population at 1,400,000,000, of whom 400,000,000, are classed as machine-using. The other 1,000,000,000, being non-machine using, must depend almost wholly on the work of their hands for production. The control of the commerce of the world lies in the answer to the question, Which of the machine-using nations shall supply the need of the non-machine using nations? Mr. Atkinson sees that the nations of Europe cannot sustain themselves under their present conditions without commerce; but, if they hold to their present conditions, the United States, by virtue of its high wages and low cost of production, will take their commerce away from them. Therefore he says to the dynastic countries, 'Disarm or starve.'

The reasons for the vast gain in the conditions of material welfare in the United States, Mr. Atkinson finds to be seven. The first is the free purchase and sale of land, and the stability resulting from the large number of land-owners. The second is the absolute freedom of exchange between the states. The third is the extension of the common-school system. The fourth is the right of suffrage, with the consequent feeling of independence every voter possesses. The fifth is the conservation of local self-government in its strictest sense. The sixth is the existence of general state laws which preclude the possibility of any monopoly of the mechanism of exchange. The seventh is our habit of organization and self-government, which is so far developed, that "if any thousand persons were suddenly removed to some far-distant place, away from their fellow-men, the men of adult age would immediately organize an open meeting, choose a moderator, supervisor, or mayor, elect a board of selectmen, of assessors of taxes, and a school committee, appoint one or two constables, and then, adopting the principle of the English common law, would at once undertake their customary gainful occupations." These seven reasons may not be distinct, and we are inclined to believe that they are reducible to fewer; but, at all events, they form a comprehensive summary the value of which is not impaired by elaboration. Mr. Atkinson also negatives that foolish fallacy, now so widely held, that the "rich are growing richer, and the poor poorer." Its main force lies in the euphony of its expression.

Impressed, as we well may be, with the phenomenal development of the United States and the magnificent possibilities that lie before it, yet we must study development elsewhere as often as we can find it. That Great Britain has not been standing still for the past decade, Mr. Mulhall conclusively proves in the *Contemporary review*. Since 1875 the population of the United Kingdom has increased 12 per cent; wealth, 22 per cent; trade, 29 per cent; shipping, 67 per cent; and instruction, 68 per cent. During the ten years the natural increase of the population has been 1,200 daily, and the outflow to the United States and the colonies has averaged 600 daily. Besides this natural increase, there has been an immigration of 1,317,000 persons, consisting of returned colonists and foreign settlers: 65 per cent of the emigration came to the United States. Mr. Mulhall wants the medical association to investigate the fact, that, while the marriages have declined only 1.5 per cent, the births have fallen off 5.5 per cent. He considers that this furnishes ground for grave apprehensions of physical decadence. The condition of the people at large has materially improved in the ten years. Pauperism has declined (the rate per thousand of population being 27 in 1885, as against 41 in 1870, and 48 in 1850), savings-bank deposits have increased, and there has been increased consumption per capita of tea, sugar, meat, and grain. The criminal statistics show a large decrease in the number of committals, and the average number of children attending primary schools has risen 68 per cent in ten years. The bankruptcies are fewer than in 1875, and the consumption of alcoholic drinks has decreased.

Mr. Mulhall's conclusions from his study of the figures are very gratifying, the only two unfavorable items being the decline in the ratio of the number of births per marriage, and the lamentable condition of Ireland. The fall in the death-rate is ascribed to sanitary improvements and the increased consumption of wholesome food. The 24-per-cent decline in the consumption of liquor is especially to be noted, and considered in connection with the 82-per-cent increase in the savings of the working-classes, the larger amount of wheat and meat consumed, and the decrease of 36 per cent in crime and of 33 per cent in pauperism. Mr. Mulhall's figures are confirmatory of Mr. Atkinson's argument; for Great Britain is virtually a democracy, and, while subjected to a large annual expense for her army and navy, this is nothing like the drain upon her resources that the cost of their military establishments is to the great continental powers. Mr. Atkinson's further contributions to this discussion will be awaited with interest, and we shall expect some criticism of his fundamental tenets from economists.

Meanwhile Mr. Atkinson's position, that "high wages, either in money or in what money will buy, are the correlative or reflex of a low cost of production measured by labor or effort," receives an indorsement in some statistics that the United States consul at Tunstall has communicated to the department of state. He says in regard to silk, that, in a Macclesfield mill, 144 hands are employed in throwing 500 pounds of Canton silk, with average earnings of $2.25 a week; while in an American mill 80 hands throw from 1,000 to 1,200 pounds of Canton silk at an average wage of $5.50 per week. So American average earnings of $5.50 give far better results than the English average earnings of $2.25. This instance from the silk industry is supplemented by one from the boot and shoe industry; Frankfort-on-the-Main, and Lynn, Mass., furnishing the data. The price paid at a factory near Frankfort-on-the-Main for making uppers for ladies' high-top button gaiters is 21 cents a pair; while the cost of the same labor in Lynn, Mass., is 11 cents, or nearly 50 per cent less than in Germany. The whole boot, solid and finished, and laid in boxes, costs 33 cents in Lynn, which is far below what it is in Germany. The actual earnings in Germany, taken from the work accounts, are, on the average per hand employed, $3.38, while in Lynn they are not less than $9 per week.

The fallacy contained in the common saying that numbers cannot lie, is well shown in the recent discussion of the statistics of insanity by Dr. D. Hack Tuke. The statistics may be all right, but they must be taken in a certain way to warrant definite conclusions. From the facts that more cases of insanity are now treated, that we have more asylums, and that our age is called a neurotic one, the mournful conclusion is drawn that a greater proportion of civilized humanity is succumbing to the stringent requirements of modern life, and losing its mental equilibrium. Dr. Tuke shows, that, by such statistics, the insane of the past thirty years or so, whose lives our improved methods of treatment have succeeded in prolonging, are pushed upon our shoulders. The real test of the prevalence of insanity is the proportion of first attacks occurring within certain periods. On this basis, Dr. Tuke shows that since 1878 (the earliest date from which adequate statistics exist) there is no increase in *occurring* insanity in Great Britain. On the whole, there is a slight tendency to decrease; and this, too, though cases are now more apt than ever to be brought to notice. Of course, this should not lessen our vigilance in the matter, nor remove our attention from that large class on the borderland of insanity which is not recorded, and from which any sudden crisis chooses its victims.

THE PHYSIOLOGY OF DIGESTION has been so thoroughly investigated of late years, that it would seem that there could be very little opportunity for difference of opinion on most of its leading principles, and yet we find that authorities are on some points very much at variance. We are told that nothing can be more prejudicial than the habit of chewing gum, supposed to be so common among school-children. The salivary glands are unnaturally excited, and pour forth so much saliva in the act, that when food is masticated they are not able to respond as fully as is necessary for the proper insalivation of the food. We are also informed that food should not be eaten just before retiring; that thoroughly refreshing sleep requires perfect repose of all the organs; and that, if we go to sleep with a more or less full stomach, sleep will be disturbed and unsatisfactory. The authorities of Amherst college evidently do not agree with these views. In the instructions which they give to their students to guide them in their gymnastic exercises, after specifying the kind and amount of physical exercise, they recommend sleeping for half an hour after dinner and supper if possible, and, if sleepless at night from brain-work, to eat a few graham crackers before retiring, to draw the excess of blood from the brain to the stomach. In reference to the practice of chewing gum, this statement is made: chewing gum daily before eating and between meals increases the flow of saliva, and so aids the digestion of fat-making foods. It also indirectly stimulates the secretion of the digestive juices of the stomach. We have no means of knowing, but we presume that Professor Hitchcock of Amherst, who is himself a physician, is largely responsible for this advice, and have no doubt that he has given it after mature consideration. We fully agree with what is said in the instructions about the usefulness of food in cases of sleeplessness, and believe that many a person has been kept awake at night from a mistaken idea of the necessity of abstemiousness before retiring. This, of course, does not mean that late suppers are under all circumstances to be recommended; but a few graham crackers can never do harm, and will often do good. In regard to the chewing-gum, we do not feel so sure. Besides being a practice which is from an aesthetic point of view not to be encouraged, it is very doubtful whether, under the most favorable circumstances, it is really a benefit to digestion; and, until there is some guaranty as to the composition of what is called chewing-gum, we should hesitate before recommending it in such unqualified terms.

A FULL ACCOUNT of the Union Pacific railroad weather-service has been furnished to the newspapers in the west by Lieutenant Powell of the signal service, who is in charge of the new enterprise, and now engaged in bringing it into shape for practical work. There will be thirty-three stations in all. It is proposed to issue predictions twice a day, announcing the expected weather changes from twenty-four to forty-eight hours beforehand. This will give the railroad officials ample time before the trains start in the afternoon and morning to make any changes which the predicted weather may necessitate. The predictions will be couched in specific language, and not in meaningless general terms. For instance: one indication will predict in a certain division cold weather with snow, the wind being from the north and blowing at the rate of thirty miles an hour, followed by warmer weather, the wind changing to a southerly direction. Study of the road will determine where the worst snow-drifts most frequently occur, and from this it will be possible to tell pretty nearly where snow blockades are liable to form. An accurate and comprehensive weather-service will enable the Union Pacific to save thousands of dollars every week to its patrons. If storms can be accurately predicted beforehand, the stockmen can withhold their shipments and allow cattle to be sent through without danger of perishing by being caught in blockades or blizzards. One prominent cattleman recently said that such a system of predictions, if accurate, would be the means of saving him fifty thousand dollars every year. The practical working of this service will be watched with much interest by railroad men in all parts of the country.

In the prominent mention given just now to the meteorological enterprise of the Union Pacific railroad, it should not be forgotten that very considerable contributions towards increasing the value of the signal service are made by other roads. The display of weather-flags on many western and southern lines is no small matter, for one of the greatest difficulties that the service has to contend with is the delay in placing its indications in the hands of those who wish to know them. The predictions based on the seven A.M. observations, and issued about ten o'clock from Washington, are read by most persons only at five or six o'clock in the evening, or later, when the time covered by the prediction is already well advanced. Besides this, there is a large contribution of temperature, wind, and general weather observations made to the Pacific coast division of the service, at present in charge of Lieutenant Glassford, by the Southern Pacific railroad company. Observations are taken daily at seven A.M. at about a hundred and twenty stations on their wide-branching lines, making a valuable addition to the tri-daily reports from the twenty regular stations of the service on the Pacific slope.

THE FIRST PUBLISHED print of the topographical survey of Massachusetts, executed jointly by the U. S. geological survey and the state, was the map of the Greylock-Williamstown-North Adams district, issued last summer by the Appalachian mountain club on the scale of the original plane-table sheets (1 : 30,000), and of which mention has been made in *Science*. The same district is now published in its official form, on a scale of an inch to a mile (1 : 62,500), with brown contours every twenty feet, blue water-courses, and black roads, towns, and lettering. Old Greylock makes a fine centre for the sheet, and its sharply moulded form is well displayed in the crowded contours on its steeper slopes. The curious 'Hopper,' with its deep-cut outlet valley opening to the west, is one of the best-marked topographic forms in the state. There ought to be found here a nocturnal wind-stream as distinct as the water-stream that flows from so well-developed a drainage surface ; for on calm clear nights, as the air near the ground cools by conduction to the radiating earth, it becomes heavy, and, if resting on an inclined surface, tends to flow down it ; if a large surface lead downward to a narrow valley exit, like that from the Hopper, a distinct mountain breeze should be felt at the mouth. This should be studied and defined, so that our teachers need not go abroad to Switzerland, or even so far away as the Cordilleras of the west, to find illustration of phenomena that are doubtless distinct enough near home.

The deep valley separating Greylock from the Hoosac range is included in this sheet almost to the head of its stream, the Hoosic, a little south of the village of Berkshire. From the low pass that leads southward to the Housatonic valley, the Hoosic runs north before turning at North Adams westward to Williamstown, and therefore presents an example of that class of streams that suffered obstruction in the latter stages of the glacial period ; for, when the southern marginal remnants of the ice-sheet lay in the deeper valleys, they blockaded the streams that ran towards them, and flooded them into lakes that commonly rose until they overflowed backwards across their divides to the south. Glen Roy in Scotland, with its 'parallel roads,' is a famous example of the kind ; the Red River valley of Minnesota and Dakota is a very large illustration of essentially the same type ; the northward-flowing Contoocook in New Hampshire has been obstructed in the same way, according to Upham ; but not a single example of a valley thus modified has yet been described in Massachusetts. It is time that the many examples which undoubtedly exist should be brought to light, that they may contribute their share to the proper foundation of geographic study. Enough has been done in the broad, vague way of distant continental homologies : what is now needed is the local examination of minute topographic details, so that we may learn to see and appreciate the forms about us at home ; and nothing will lead sooner or surer to this long-delayed end than the publication of good topographic maps. The educational value of these maps will alone repay the people of Massachusetts over and over again for their share in the cost of making them.

WHENCE COME RACE CHARACTERS?

ONE is often led to speculate as to the origin of national peculiarities; and soon such speculations take one to the conclusion that a great deal of what characterizes a nation in the way of mental traits is not an intrinsic quality of the race, but akin rather to folk-lore, as to its origin at least. There are modes of the mind, and fashions of thought, which spread by propinquity. Such modes may give currency to superstitious tales of witchcraft, to foolish prejudices, or to great intellectual impulses. Every man's mind is a country inhabited by ideas, very few of which are autochthonous. His opinions are an immigrant populace; and, when a sturdy thought goes forth from the mind of its birth, it breeds abundant exact reproductions of itself in many other minds. Indeed, most thinking is repetitive. So, when a strong man appears, his example establishes a tendency in those about him; and, if he is highly endowed, he founds a school perhaps, of politics, art, or science, as the case may be. If many such men come in one epoch and in one nation, it may well happen that their conjoint impulses may lead a whole nation in a certain developmental direction, without the qualities which become prominent really being intrinsic race characters.

It is a legitimate question, and one possessed of deep meaning, Are the Germans more musical inherently than other peoples, or has the succession of splendid musical geniuses among them at once guided and accelerated the musical culture of the nation? The same alternative query arises concerning the pre-eminence of Italian painting or of English literature. Or we may make the complementary inquiry, Does the lack of certain qualities in a nation depend on the lack of the right leaders? To go back to the Germans, at whom indeed we are aiming all the while, do they lack American inventiveness because it is nowise in them, or merely because they have never been rightly impelled into the habit of invention by example-giving inventors? Probably for the latter reason, for German scientific men have done their share in inventing scientific apparatus, and the Germans who come to America learn to invent. The final interest of these considerations resides in the decision as to whether national defects of certain kinds cannot be remedied by tuition and right leadership. It must be left, however, for some powerful investigator to definitely solve these problems by rigid historical research. Let us, however, by an act of cheerful faith, accept the belief in possible betterment even unto thinking that the German people may acquire the literary instinct.

I have referred on several occasions in the columns of *Science* to the absence of the literary sense in German scientific men. It is one of the most flagrant arguments against the classical education, with its supposed results of literary culture, that the Germans, who have school doses of classics much larger and more concentrated than are administered in the rest of the world, themselves write more barbarously than any other civilized western people. German scientific articles are full of sentences like this, which refers to the bristles serving among arthropods as organs of touch: "Man darf für wahrscheinlich halten, dass die so sehr wechselnde gestalt und ausbildung der 'Tastborsten' nach der art des thieres und den körpergegenden noch bestimmten nebenzwecken zu dienen hat, ohne dass wir uns davon rechenschaft zu geben vermögen."[1] Now, the author of this sentence is one of the most distinguished and justly distinguished of German zoölogists, but his manner of writing is similar in quality to that of most scientific writers in Germany. The sentence is neither better nor worse than thousands upon thousands of others, perpetrated by his countrymen equally without literary feeling. The Germans need literary conscience to reprove them for all their awkward and involved phrases, that their souls may know how guilty they are in ignoring their readers' rights. The quoted sentence was evidently written without attention to the forms of expression. It never occurred to the author that aught was due the reader. His meaning cannot be had except by an effort. It is ill-mannered to give others so much trouble, when a little pains on one's own part might save it. A cultivated Frenchman would be incapable of such a rudeness. The pith of the evil is the indifference of the German author as to how he writes: he feels no inward necessity of having a good style, and is inclined to despise the French qualities of grace and lucidity.

Perhaps reiterated complaints will stimulate improvement. May it be brought about that the few good writers among German *savants* will have soon many imitators. It is, to be sure, more trouble to write well than to write ill. We all have facilities for bad logic, bungling rhetoric, and poor composition; but these undesirable gifts ought not to excuse us from striving after their

[1] *Zoologischer anzeiger*, ix. 288.

opposites. We cannot admit, therefore, that Germans are to be pardoned for not trying to present their many and valuable discoveries in articles well arranged and in language well chosen. It may be, however, that this will not come about until a set of leaders shall have established the 'folk-mode' of good writing. M.

THE HEALTH OF NEW YORK DURING NOVEMBER.

THE total number of deaths which occurred in New York City during the month was 3,076, an increase of 99 over the previous month: 1,290 of these deaths were of children under five years of age. The decline in the mortality due to diarrhoeal diseases is very marked, being but 87 as compared with 234 in October. The deadly influence of the oppressive heat of our midsummers is nowhere better illustrated than when we compare the deaths from these diseases in July and in November. In the former month no less than 1,382 persons are recorded as having died from this cause, while in the latter but 87 succumbed to affections of the bowels. From consumption 459 persons died, an increase of 27 over October. Diphtheria, which began in October to figure more prominently as a mortality factor, has not yet relaxed its hold, and is chargeable with 188 deaths, 23 more than in the previous month. The deaths from scarlet-fever were only 23, practically the same as in October, the difference being but 5. Measles is now very prevalent in New York, and is assuming such proportions as a cause of death, that we shall in the future include it in our chart. Small-pox is still absent from the city, — a fact which reflects great credit upon the health department, for, with its prevalence in Brooklyn, it seemed almost impossible for New York to escape without becoming infected to a slight degree at least.

The meteorology of the month has not been characterized by any great variations from the normal or average, either as to temperature or rainfall. The maximum temperature was 71° F., at 3 P.M. of the 2d, the average for ten years being 67.9° F.: the minimum was 27° F., at 5 A.M. of the 27th, somewhat above the average of the past decade, which was 22.2° F. The rainfall for the month was 4.42 inches, 0.25 of an inch more than in October. The November average for ten years is 3.19 inches.

THE *Fortnightly review* is to begin in its January issue the publication of a series of unsigned articles on 'The present political situation in Europe.' It is expected that these articles will be very important, and attract much attention.

A SKETCH OF THE GREAT SERPENT MOUND.

ACCEPTING an invitation from Dr. Cyrus Thomas to accompany him on a visit to a number of the ancient monuments of southern Ohio, I had the long-wished-for opportunity of examining the great Serpent Mound. This work is situated in the northern part of Adams county, somewhat remote from frequented routes of travel, and hence rarely visited by people from a distance. Several accounts have been published, however, the first in the classic work of Squier and Davis, and subsequent ones by McLean, Putnam, Allen, and others. The map given in the first-mentioned work conveys, as far as it goes, a fair idea of the extraordinary structure, but is characterized by remarkable omissions. Some of the more decided shortcomings have been pointed out by recent writers, who have, in their turn, fallen into the opposite error of over-elaboration. I venture to present a few notes and observations which will assist in enabling those who cannot visit the locality, in gaining a clear conception of the work and its surroundings. The valley of Brush Creek is bordered by an extremely rugged country, abounding in high hills which reach an elevation of perhaps six hundred feet above the bed of the creek. Entering from the north, we skirt the eastern rim of the valley, and descend at Lovett's farm upon the subordinate levels that border the stream. Leaving the road and crossing the fields, with the Lovett dwelling on the right and a small circular mound on the left, we reach the brink of a steep cliff which descends about one hundred feet to the stream bed. Turning our faces up stream, we find ourselves at the insertion of a long, narrow spur, described as 'crescent-shaped,' which holds its level to the extreme point, and slopes abruptly to the brink of the cliffs at the left, and rounds off more gently into the deep gulch at the right. This spur narrows up farther on, and terminates in an abrupt promontory, around the base of which a small branch from the gulch at the right turns, and crosses the strip of alluvial bottom to the creek. Along the rounded grassy crest of this ridge we can detect the obscure serpentine coils of the earthwork, and descending a little to the left, and almost to the brink of the cliff, we reach the tail of the serpent. Beginning with a small pit at the terminal point, we follow the unfolding coil for two full turns, and then advance along the body to its highest point upon the ridge. The curves are strong and even, and the body increases gradually in height and width as we advance. Upon the crest of the ridge we find ourselves at the beginning of three great double folds. Following these, we descend

Weekly Mortality	679	718	714	715	
Weekly mean Thermometer	54.7°F	40.9°F	42.5°F	41.3°F	
Weekly mean Barometer	29.903	29.841	29.893	29.880	

into a slight sag in the ridge, caused by the encroachment of opposing drainage, and ascend again slightly to a point where the body straightens out along the ridge. Beyond this we reach the curious enlargement with its triangular and oval enclosures. Here the body embankment is divided into two parts, which respectively pass to the right and left of the enclosures. At the sides they descend slightly upon the slopes of the ridge, and at the widest part of the oval are somewhat obscure on account either of original conformation or of subsequent erosion. Beyond these breaks they continue, closing entirely around the body of the serpent, and the peculiar features of the enlarged portion, are all distinctly traceable, as shown approximately in the accompanying map, and leave no doubt in the mind as to their artificial character. The work was carefully laid out and neatly executed, and, reduced as it now is, it is of a most stable nature. The earth employed is extremely compact ; and the elevation of the body is so slight, as compared with its width, that time, unassisted by the plough, produces but little change. The height rarely reaches three feet, and the width at the base is in many parts fifteen feet or more.

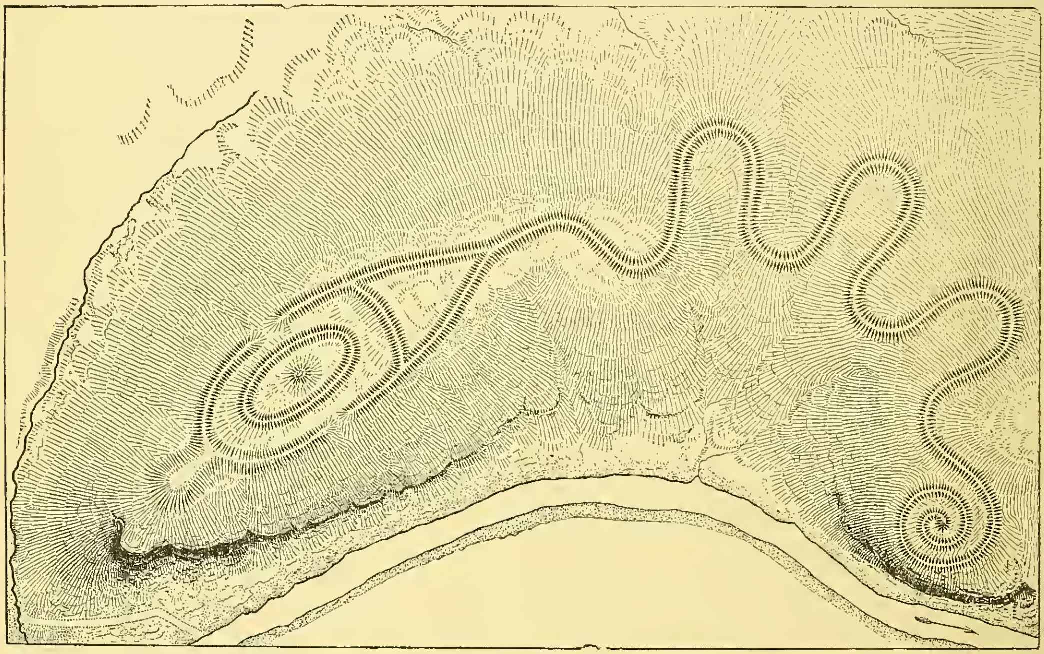


Fig. 1. — Sketch-map of the great serpent.

oval embankment within. From the point of junction the body continues for a short distance, perhaps forty feet, and then terminates in a rounded and slightly widened point. This terminal elevation is entirely omitted by Squier and Davis, but is noticed by more recent writers ; and, on account of the supposed presence of obscure auxiliary ridges of earth extending down the slopes to the right and left, it is likened to the body of a frog by Mr. McLean. These auxiliary ridges, and the minor appended features recognized by Squier and Davis and by some recent visitors, are too obscure to be identified with absolute certainty, and I consider it unsafe to introduce them into my illustration ; but the entire

The topography of the outer end of the promontory is somewhat peculiar, and needs to be briefly described. The extreme point is about thirty feet beyond the end of the artificial embankment, and is slightly cleft in the middle. The right-hand portion has no exposure of rock, and descends in a narrow, rounded spur to the rivulet at its exit from the gulch. The left-hand point is a naked shelf of rock a little to the left of the direct continuation of the earthwork, and some ten feet below its terminal point. It is rounded at the margin, and perhaps twenty-five feet wide.

Descending upon this rock, we are upon the brink of a slightly overhanging ledge composed of rather compact, nearly horizontal beds of limestone. The outline is curved, and presents a number of encircling ledges marking the thickness of the firmer strata. The rock immediately beneath is massive and coarse-grained, and, from rapid disintegration, has receded a number of feet, and exhibits a tendency to weather into caves. The entire exposure of rock at the point is perhaps forty feet in height. Beneath this a talus slope some thirty or forty feet in height, and covered with bushes, extends to the creek bottom. Descending the bluff at the left of the point, and crossing the belt of bottom land, we get a comprehensive idea of the promontory. In the sketch presented herewith, the numerous forest-trees and all undergrowth are omitted. It will be seen that from the point the exposure of rock extends back along the creek, descending slightly and soon disappearing, save where occasional masses project through the rounded slopes. The minute figure of a man is intended to indicate approximately the termination of the artificial embankment.

I wish now to call attention to a few points bearing upon the origin and significance of the work and its possible relations to the topography of the site. The use of the serpent by our aboriginal races has been well-nigh universal, so that we need not hesitate to class this specimen with other products of their religion, and we should naturally expect to find the counterpart of each feature in other representations, ancient and modern.

Most of the attempts to throw light upon the more extraordinary features of the work have been made through the medium of oriental philosophy; but it is manifestly wrong to go thus out of our way to seek a symbolism for the oval enclosure, as do Squier and Davis, who liken it to the symbolic egg of old-world philosophy; nor need we make a serious effort to combat the idea that the terminal portion is a frog, as suggested by McLean. It would not seem unreasonable that the former feature should be simply the eye of the effigy; but we have another explanation more in accord, perhaps, with the analogies of native ceremonial art. The heart, which represents the life, is made a prominent feature in all superstitious delineations of living creatures, as shown by a multitude of examples. When we restore the neck and head of the reptile, omitted by Squier and Davis and misinterpreted by others, the strange oval takes the position of the heart, and in all probability marks the site of the ceremonies that must have been connected with this work. This leads to a consideration of the proper identification of the head of the effigy, and the relations of the natural to the artificial features of the site. From the point of view of my second illustration, we have a comprehensive view of the serpent ridge. Having the idea of a great serpent in the mind, one is at once struck with the remarkable contour of the bluff, and especially of the exposure of rock, which readily assumes the appearance of a colossal reptile lifting its front from the bed of the stream. The head is the point of rock, the dark lip-like edge is the muzzle, the light-colored under side is the white neck, the caves are the eyes, and the projecting masses to the right are the protruding coils of the body. The varying effects of light must greatly increase the vividness of the impressions, and nothing would be more natural than that the Sylvan prophet, secluding himself in this retired part of the wilderness, should recognize this likeness, and should at once regard the promontory as a great manito. His people would be led to regard it as such, and the celebration of feasts upon the point would readily follow. With a mound-building people, this would result in the erection of suit-

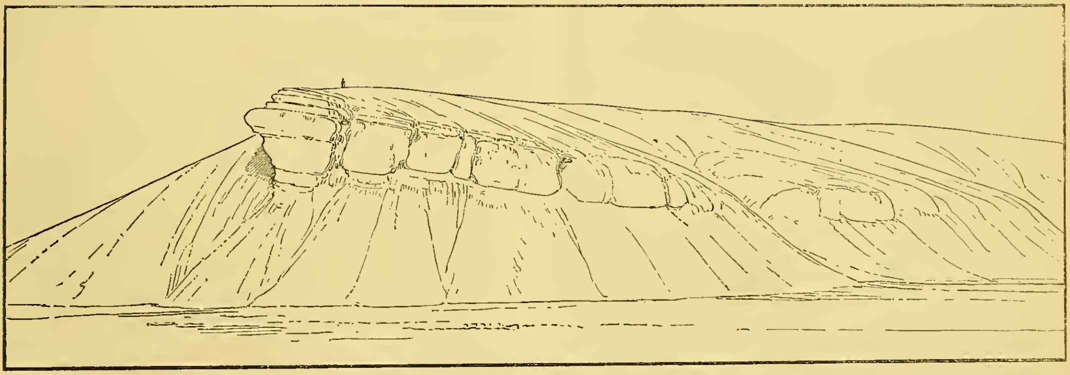


FIG. 2. — THE SERPENT HEADLAND FROM THE CREEK BANK, TREES OMITTED.

able enclosures and in the elaboration of the form of the reptile, that it might be the more real. The natural and the artificial features must all have related to one and the same conception. The point of naked rock was probably at first and always recognized as the head of both the natural and the modified body. It was to the Indian the real head of the great serpent manito.

W. H. Holmes.

NOTES AND NEWS.

On the 8th of December, at Victoria, British Columbia, died Dr. W. F. Tolmie, known to ethnologists for his contributions to the history and linguistics of the native races of the west coast. Dr. Tolmie was born in Scotland, but had been resident on the west coast since 1833, at first as medical officer to the Hudson's Bay company's port of Fort Vancouver on the Columbia River, but afterwards becoming a chief factor in the company's service, from which he retired in 1870. During the Indian war in the Oregon territory in 1855-56, his knowledge of the language and influence among the Indians enabled him to render efficient service in pacifying them. Dr. Tolmie dated his interest in ethnological matters from his contact with Mr. Horatio Hale, who visited the west coast as ethnologist to the Wilkes exploring expedition. He afterwards transmitted vocabularies of a number of the tribes to Dr. Scoulèz and to Mr. George Gibbs, some of which have been published in 'Contributions to American ethnology.' In 1884 he published, in conjunction with Dr. G. M. Dawson, a nearly complete series of short vocabularies of the principal languages met with in British Columbia, and his name is to be found frequently quoted as an authority on the history of the north-west coast and its ethnology in the works of Bancroft and other authors. He was at all times ready to place his extensive and accurate knowledge on these subjects freely at the disposal of inquirers.

— The financial position of the American geographical society has been greatly improved in the past two years by the lease and possible sale of a portion of its real estate upon very remunerative terms. Upon the completion of this sale, and upon the sale of the building in Twenty-ninth Street now occupied by the society, the council have in mind the erection of a large building which will be an ornament to the city, and more suited to the growing needs of the society, — a building which will be fire-proof, to furnish the society with a safe and proper place in which to preserve its constantly increasing collection of valuable books and maps. The erection and furnishing of this building will necessarily entail increased expenditures, to provide for which, without burdening the present members, the council suggests that the number of fellows be largely increased. If each member will interest himself in this respect, the membership will be largely increased, and the amount which it is estimated the society will annually need in its new building will be the more readily attained.

— The English do not propose to permit the statue of Liberty in New York harbor to rank as the biggest on record, without a contest. The *Illustrated London news* comes forward with a description of the colossal statues of Bamian, together with measurements and illustrations. Travellers, oriental and occidental, have spoken of these statues from time to time, but accurate measurements of them were first made by the surveyors who were attached to the Afghan boundary commission. Bamian, where these statues are, is on the road from Cabul to Balkh, where it crosses the Paropamismus range. The elevation is about 8,500 feet above sea-level. There are five statues, three of them, including the largest, being in niches, the figures being formed of the rock within the niche. Captain Talbot of the boundary commission, using a theodolite, found the tallest statue to be 173 feet high, whereas the statue of Liberty is only 151½ feet high. Since Liberty is on a pedestal, however, the statue of Bamian must rank below her, unless the English propose to count its 8,500 feet elevation above sea-level as a pedestal. The Bamian statues seem to be Buddhist idols of great antiquity, and the natives have a variety of legends concerning them.

— The annual report of the coast and geodetic survey was submitted to congress recently. The report states that the demands upon the survey have been not only for accurate charts of the sea-coast, but also for correct data upon which the several states can base maps of the entire territory. During the past year, due consideration has been paid to immediate and pressing demands for re-surveys of important harbors and highways of commerce, and special care was taken to give wide publicity to discoveries of dangers to navigation. Hydrographic surveys were prosecuted off the coasts or in the waters of fifteen states and two territories. Important investigations in terrestrial magnetism, physical hydrography, and geographical history, have been made. The aggregate of estimates for the next fiscal year ($560,765) is considerably larger than the appropriation for the current year, but is less than the average appropriation for many years past. The report also speaks of the advance toward completion of the resurvey of New York bay and harbor, to the studies of ice formation and movement in Delaware river and bay, to the observation of currents in the Gulf Stream, and to the near approach of the transcontinental triangulations, which will form a geodetic connection between the work on the Atlantic and that on the Pacific.

— The remarkable regularity in the recurrence of climatic conditions, as well as the small variation in the weather on a subtropical island, is illustrated in the following table of maximum and minimum temperatures in the summer months of 1885 and 1886, at Nassau, Bahamas, clipped from a paper published there.

Month.	Temperatures, Fahrenheit.			
	Maximum.		Minimum.	
	1885.	1886.	1885.	1886.
May........	85°	85°	67½°	67½°
June........	86½	87	71½	73
July........	88	88¼	75½	76½
August.....	88¾	87½	73½	73
September.	87¼	86	73½	72½

Thunder-storms seem unpleasantly frequent. In 1885 there was lightning with rain every two days from May to September, with a violent storm about once a week; in 1886, lightning and rain were as frequent, but severe storms were reduced to only once a fortnight. The general absence of lightning-rods makes these storms a rather dangerous element in the summer weather of Nassau.

— An interesting case is reported to have occurred at Rising Sun, Ind. According to the accounts, a man named Seward, a farm-laborer, aged twenty-eight years, became sick about six months ago. At first there was nothing especially noteworthy about his sickness except that he was easily tired. Although a man of unusual strength, two hours of labor completely prostrated him. This increased, until, after two months, he was totally unfit for work, and at the same time his skin became changed in color. In health a blonde, with gray eyes, his face became ash-color, and then darker and darker, until, at the time of his death, it was like that of a negro. The neck, shoulders, hands, fore-arms, and afterwards other portions of the body, became similarly affected. The disease above referred to was undoubtedly what is known as Addison's disease. In 1855 Dr. Thomas Addison first described it. He regarded it as connected with disease of the supra-renal capsules, and since his day there has been but little more learned about its causation than Addison himself knew. The deposit of pigment in the lowest layers of the epithelium is the outward manifestation of the affection, though why it should be so deposited is not known. The disease occurs in adult life, very seldom in childhood or in old age. Males and laborers are usually the patients. Although it may last for many years, it is almost invariably fatal. Dr. Greenhow has devoted especial attention to this disease, and treats of it in the 'Croonian lectures on Addison's disease,' published in the *Lancet* in 1875. In vol. iii. of 'System of medicine by American authors,' is an article on the subject, written by Professor Osler, to which we would refer those who desire more particulars of this remarkable disease.

— The next number of the Proceedings of the American society for psychical research is to be issued as soon as sufficient material is collected. The council is anxious to obtain, so far as may be possible, the co-operation of all members and associate members of the society, in the preparation of this number. All members are therefore earnestly requested to report any experiences or observations which they may have collected on any subjects falling within the range of the society's work. Edw. G. Gardiner, 12 Otis Place, Boston, Mass., is the secretary.

— A curious feature of the weather, described in the Ohio meteorological bureau report for September last, is the damage caused by the lightning in a violent storm on the 23d of the month. The rain was very heavy at certain stations, Sidney reporting 5.57 inches in twenty-four hours. At New Bremen the storm began at 8 P.M. on the 22d, with high wind and hail-stones. From 2 to 3 A.M. on the next morning there was a continuous blaze of lightning. As the storm moved eastward, it entered a region of oil-wells, where derricks and tanks were struck, and large quantities of oil set on fire. At Lima the lightning struck a derrick, and ran thence by a pipe-line to a tank thirty rods distant, where it fired a thousand barrels of oil. Old oil-men said they had never experienced such storms in the Pennsylvania oil-fields, and were anxious to know if they were common in Ohio. The Ohio monthly report now occupies fifty-eight pages, and presents the records of thirty-seven stations in much detail.

— The northern portion of the Sierra Nevada, as recently summarized by Diller in bulletin 33 of the U. S. geological survey, may be briefly described as an old lowland made up of granite and tilted and folded slates, worn down smooth, close to its base level of erosion, and then recently unevenly elevated in three great blocks. Every block is slightly tilted to the westward, and separated from its neighbor by a fault with bold face, falling steeply to the east. Longitudinal valleys lately occupied by lakes lie between the eastern face of one block and the long western slope of the next. During and since the uplift, streams flowing westward down the longer slopes have cut deep cañons. The date of the faulting is in great part later than the lavas of Lassen's Peak and thereabouts, and it is at least very likely that the dislocation is still in progress. The limestone beds of the region are considered of carboniferous age by previous observers, but a large portion of the auriferous slate series is thought to be of older origin.

— A recent supplement (No. 83) to Petermann's *Mittheilungen* contains an elaborate account by Dr. Berndt, of the effects of the foehn — the hot, dry wind of the Swiss valleys — on organic and inorganic nature. The memoir is prefaced by a good description of the wind itself : it is illustrated by a map showing the valleys, south as well as north of the divide, that are most frequented by it, and also by two weather-charts for the foehn of Feb. 20, 1879, demonstrating its relation to a cyclonic area of low pressure that crossed Europe from France over central Germany on that day. The body of the work is concerned with the action of the foehn on the mountain snow, and the floods thereby produced in the valleys, with its relation to rock-weathering and consequently to topography, and to its effects on plants, animals, and men. The danger of village fires is great during the prevalence of the hot wind, and extra watchmen are employed then. After the town of Glarus was thus burned in 1861, even smoking was prohibited outdoors and in the public streets during the blowing of the foehn.

— Dr. Forel, the distinguished Swiss entomologist, has recently published an account of experiments designed to ascertain whether the perception of the ultra-violet rays of the spectrum by ants took place by means of their eyes, or as a photo-chemical action on the skin. By varnishing the eyes of some ants, it became evident that the main impression was a visual one : such ants did not exhibit the preference for darkness above ultra-violet light which normal ants showed. This does not absolutely exclude any action on the skin, but makes it improbable. It is interesting to note that the blind are unable to judge of the amount of light in a room if care is taken to exclude the effects of heat and other indications.

— The college building in Charleston was so much injured by the recent earthquake that they have been obliged to pull down entirely the two wings, equivalent to nearly half the space occupied by the whole building. Half of the specimens in the museum of natural history, and all the physical and chemical apparatus, have been removed, and crowded into the remaining portion, which has also to serve for lecture and recitation rooms. The private library and collection of Mollusca and Crustacea belonging to Prof. L. R. Gibbes, and probably the most valuable in the south, were also in one of the wings, and of course had to be removed. Our naturalists will have great sympathy for those upon whom this unlooked-for labor has fallen, but will be glad that the collections are uninjured.

— A very interesting communication to the *Medical news* has been made by Dr. F. Peyre Porcher of Charleston, on the influence of the recent earthquake shocks in that city upon the health of the inhabitants. In addition to the natural alarm and fright which were quite universal, some persons were attacked with nausea and vomiting, which recurred or persisted in several cases for days. Two gentlemen on the islands eighty miles from Charleston had their eyes filled with tears not to be repressed, but not caused by alarm, or fears for their personal safety, for the danger there was not imminent. Many persons experienced decidedly electrical disturbances, which were repeated upon the successive recurrence of the shocks. These were generally tingling, pricking sensations, like 'needles and pins,' affecting the lower extremities. One gentleman was completely relieved of his rheumatism ; another, who for months was nervous, depressed, and entirely unable to attend to business, regained his former activity and energy. Several cases of mental disturbance, owing to anxiety and prolonged loss of rest, some of them persistent, occurred among Dr. Porcher's patients.

— We had occasion in a recent number of *Science* to refer to a remarkable case in which the breath of an individual, or rather the eructations from his stomach, took fire when brought in contact with a lighted match. This case, which was reported in the *Medical record*, has called forth communications from physicians by which it would appear that the phenomenon is not such a rare one as was at first supposed. In one case of disordered digestion the patient emitted inflammable gas from the mouth, which, upon analysis, was found to be largely composed of marsh gas. In another case the gas was sulphuretted hydrogen. A case is reported in the

British medical journal, in which, while blowing out a match, the patient's breath caught fire with a noise like the report of a pistol, which was loud enough to awaken his wife. One evening, while a confirmed dyspeptic was lighting his pipe, an eructation of gas from his stomach occurred, and the ignited gas burned his mustache and lips. In Ewald's book on indigestion, the analysis of the gas in one of these cases was, carbonic acid, 20.57; hydrogen, 20.57; carburetted hydrogen, 10.75; oxygen, 6.72; nitrogen, 41.38; sulphuretted hydrogen, a trace. The origin of these gases is undoubtedly the undigested food, which in these cases undergoes decomposition.

— Dr. Gilles de la Tourette finds that the average step of men is twenty-five inches; for women, twenty inches. The step with the right foot is somewhat longer than that with the left. The feet are separated laterally in walking about four and one-half inches in men, and five in women.

LETTERS TO THE EDITOR.

****Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Cremona's Projective geometry.

YOUR review of this work does scant justice, I think, to one of the most valuable text-books recently published. We have a multitude of elementary books in all branches of science; but why most of them are printed, there seems to be no reason, unless it be the reason why cheap razors are made. For my own part, I am thankful when we get a book such as Professor Cremona has given us, — a book so well designed to give the student more general views of geometry.

ASAPH HALL.

Washington, D.C., Dec. 28.

Pleuro-pneumonia.

Referring to Mr. Butler's communication and your editorial remarks on p. 587, it may be of interest to put on record the fact that horses have suffered quite extensively, particularly in Indiana and Missouri, from what Dr. Salmon has decided to be vermicular or verminous bronchitis. He has fully treated of this disease, and illustrated the Strongyli which induce it in calves and lambs, in the veterinary part of the 'Agricultural report for 1885.' That producing the disease in horses seems to be Strongylus micrurus meplis, which is carefully figured on plate V., and described on p. 557. It is an elongate, thread-like worm from an inch and a half to two inches in length; and the point that I wish to put on record is that these Strongyli have very generally been supposed to have some connection with the narrow elongate eggs of Orchelimum glaberrimum. The eggs of this species are inserted in the pith of a number of different plants, and are particularly abundant in stalks of corn-tassels. The punctures were figured in my 'Fifth report on the insects of Missouri,' and again referred to in bulletin 6, U. S. fish commission The bronchial disease which has been so prevalent and fatal to horses has been quite generally associated with these eggs, the supposition being that the horses became diseased by eating the corn tassels and stalks. The Orchelimum eggs have been received from about a dozen different correspondents, all of them independently making the same suggestion as to their connection with the bronchial worms, a rather remarkable instance of a prevalent and popular error arising from an imperfect knowledge of natural science.

C. V. RILEY.

Washington, D.C., Dec. 27.

Stereoscopic vision.

I would like to inquire of the readers of *Science* if it is generally known to be possible — and if, indeed, it is possible to all persons — to obtain a complete stereoscopic effect in viewing a *single* picture, and without a glass or other instrumental aid.

I have for several years been in the habit of practising a method in looking at photographs or good engravings, which, with me, makes the illusion perfect, and the objects pictured seem to stand out in full relief like the real objects.

In consists simply in entirely closing one eye, and shutting the other as nearly as possible, while admitting just sufficient light to afford a distinct, or at first rather dim, view of the picture. It is necessary first, however, to see that the picture is placed in a light corresponding as accurately as possible in direction with that in which the objects are represented in the picture: for example, if the scene is shown as lighted from the left, let the picture be so held that the actual illumination is from the left, and exactly at the same angle. An incongruity in this respect will spoil the result entirely. A little time is usually required to realize the full effect, and probably many persons unaccustomed to the experiment will need to exercise more patience at first than after some practice.

It is found, too, that a picture presenting strong lights and shades, as of photographs of objects in the direct sunlight, or engravings of the same character, produces the effect most readily. Take, for example, the engravings representing highly magnified views of the scenery on the surface of the moon, such as those illustrating Professor Langley's article 'The new astronomy,' in the *Century*. After looking at one of those in that manner for a few moments, the parts represented as elevations appear to rise from the paper; and, indeed, the flat surface disappears altogether, as well as the inky blackness of the shadows, and both elevations and depressions appear in startling reality.

The lights and shadows appear to be merely the illuminated and unilluminated portions of the same uniformly colored substance, showing it distinctly carved in all the reality of the forms intended to be indicated. It seems as if one could closely estimate the actual heights of the elevations, and the lengths of the shadows, and the precise position of the source of light.

The illusion once perfected, it may be retained while opening the eye a little, thus gaining a clearer view; but, carrying this a little too far, the scene at once 'flattens out' again, and becomes a mere lifeless black-and-white representation of the outlines, producing nothing of the impression of reality of contour: the landscape is gone.

As far as I am aware, this simple method is not generally known or thought of; nevertheless I am inclined to the belief that it would become easy to most persons after a little practice, and it is certainly very convenient, and greatly enhances the pleasure of viewing the many fine engravings almost everywhere to be seen. W. H. Pratt.

Davenport, Io., Dec. 14.

Laws against quacks.

I notice in your notes on the laws regulating the practice of medicine and surgery an omission to call attention to the fact that a bill (senate, 485) passed the senate last year, and would have passed the assembly but for the late date of its introduction, whereby it failed to be reached on the calendar. That bill embodied the points of agreement of those practitioners of medicine who have a legal status. It was based upon the bills introduced by the Medical society of the state of New York, so far as they were not concerned with the formation of a board of medical examiners. The State homoeopathic society has directed its legislative committee to favor this bill if again introduced, as it probably will be. I do not think that either of the judges you name would consider the construction of the registration law adopted by the Medical society of the county of New York as absurd; nor would they differ in opinion from the judges before whom that construction has been maintained.

You will admit, I think, — as frankly as you admitted that the society was justified in the prosecution that elicited your comments, — that it is reasonable to require registration of every physician in a county who regularly practises or resides therein. No registered physician has been prosecuted for a consultation or occasional act of practice in a county wherein he was not registered. But the bill in question specifically meets your criticism, and, if introduced again, will be made even clearer on this point There is an opportunity at the next session of the legislature to codify the various acts restricting medical practice into a simple statute, and fair criticism of the bill in question will materially aid the purging of the statute-book of the present clumsy enactments.

W. A. Purrington.

New York, Dec. 21.

The Panama canal.

The article with the above title, from the pen of M. de Lesseps, copied by you in Dec. 3 issue from *The Scottish geographical magazine* for November, contains some errors both of fact and of inference.

Commercially the needs for and uses of the canal are misstated and overestimated. Trade must follow certain routes, governed by the earth's form and dimensions, and by the winds that blow or do not blow. For fear of the calm belt in Gulf of Mexico, the captain of a big ship, loaded with guano or nitrate of soda, would rather face the gales off Cape Horn. Because of the 'trades,' sailing ships from India and Australia would still go home *via* Cape of Good Hope. I have yet to meet a captain who would not elect Cape of Good Hope rather than Panama if loaded at a port even as far east as Philippines. A sailing-ship bound from San Francisco to Liverpool would think twice before she paid any thing to be put into the calms in land-locked water off Colon. Many captains have told me they would go on around the Cape Horn. Many cargoes are put on to sailing-ships, *because* they will be longer at sea than if sent per steam. It is no uncommon thing that a sailing-ship gets the same, and even more, freight than a steamer, because of the exigencies of the shipper or the condition of the market for merchandise. Hence the assumption that any of his '2' (p. 519), or that all of '1' or '3,' would seek Panama, is unfounded. A fair estimate, granting the correctness of his figures, would throw out '2,' and halve '1' and '3,' and leave, say, rising 2,000,000 tons per annum. In the table of distances, same page, London to Sydney, Havre to Sydney, he conveniently forgets that that traffic would use Suez rather than Panama. I fancy it is not generally known that the entire traffic of Suez is steam. There has never been an American merchantman through Suez, nor a sailing-ship of any nationality. The few sailers that have passed through were towed not only through Suez, but the entire distance to and from port of departure (Bombay) and destination (Malta). Practically the entire traffic on Suez is steam

But M. de Lesseps does not refer to the most important factor in the problem. The evolution of the marine engine is still progressing. Steamers of moderate size and speed already approximate the expenses of sailers, not counting the further saving in interest on plant by reason of more frequent 'turns;' i.e., though a steamer may cost more than sailer, the former makes more voyages in a year, i.e., earns more freights. Before the Panama canal is finished, I doubt not such progress will have been made in compounding engines and in expansion of steam, that few new sailers will thereafter be built. The carrying-trade of the world will be done by steamers, just as the passenger trade has passed into their hands. Soon, as nations reckon life, sail will be limited to cruising for pleasure, fish or whale, or scientific research: even these will have steam power to go and come to place of resort. This change might and probably would throw the traffic of west coast America with east coast America and Europe into Panama canal; but Australia and India with Europe and America, never. Frank Goodwin.

Framingham, Mass., Dec. 13.

What was the rose of Sharon?

In *Science* for May 14 (vii. No. 171) is an article headed 'What was the rose of Sharon?' Though not familiar with either former or recent discussions of the question, I am interested in recalling an observation of my own while riding over the plain of Sharon on the road from Jaffa to Ramleh. It was about the middle of the afternoon, Feb. 18, 1859. The dark soil was for a considerable distance half covered with broad patches of bright red flowers. 'Roses of Sharon!' some one exclaimed. I forget whether it was the United States consul from Beirut or some one else of our party. As my impression now is, several persons who were likely to know concurred in saying that these flowers were commonly so called in that region. The flower which I gathered and pressed was afterwards identified by an American scholar as Anemone coronaria of Sibthorp's 'Flora Graeca.' The color of the dried petals is now a dark maroon. Fisk P. Brewer.

Grinnell, Io., Dec. 18.

SCIENCE.—SUPPLEMENT.

FRIDAY, DECEMBER 31, 1886.

SEACOAST DEFENCES.

THE two excellent and valuable articles on seacoast defences which have been placed before the public within a few days of each other — the one by Lieut. Eugene Griffin of the corps of engineers, in the *Journal of the military service institution*, and the other by Capt. F. V. Greene of the engineers, in *Scribner's magazine* — should suffice to convince the most devoted advocate of a 'peace policy,' and the most economical of legislators, that something should be done by the authorities, and that speedily, as a mere matter of insurance if nothing more, to protect our defenceless seaports. Lieutenant Griffin's paper is more technical than Captain Greene's, as might be supposed from the fact of its being published in a magazine devoted exclusively to military interests; but while Captain Greene's article is popular, it is not superficial, and by a comparison of the two the intelligent reader can gain an excellent insight into the subject. Lieutenant Griffin summarizes the arguments against coast defences under three heads: 1. The navy should constitute our defence; 2. Torpedoes alone suffice to close any channel; 3. Earthen batteries of sufficient strength can be hastily thrown up in case of war. He then answers these objections by showing that the office of the navy is not defensive, but offensive: it should protect our commerce on the high seas, and injure that of our enemies. Moreover, fixed guns on land have many advantages over guns on floating supports. The second argument proceeds from entire ignorance of the nature and object of torpedoes. They have been introduced to offset the advantages gained by the attacking party in the invention of the screw-propeller. Their function is to harass an enemy's ships, and prevent them from running by batteries. Instead of being a substitute for fortifications, torpedoes presuppose the latter. The plea that earthworks can be thrown up as rapidly as need be, is shown to be equally flimsy. In winter no suitable earthworks could be thrown up at all in our northern states. And supposing the largest available force to work day and night, it would take more than a week to construct the seventy-foot parapet. What this means is evident when we remember that Bermuda is only seventy-one hours' steaming from Savannah, sixty-six hours from Charleston, and fifty-eight hours from New York; that a British fleet could get from Halifax to Portland in thirty-one hours, and to Boston in five hours more, or from Vancouver to San Francisco in ninety-six hours. Similarly a Spanish fleet at Havana is within forty-five hours of New Orleans. Then, as Lieutenant Griffin points out, the modern theory is to make war sudden, sharp, and decisive, and to make the defeated party pay all the expenses. The billion of dollars which Germany exacted from France in 1871 would be but a fraction of what we should have to pay to any hostile power that had our great seaports at its mercy.

We have on the Atlantic and Pacific and lake coasts "a series of great cities containing an aggregate population of more than five million souls, and destructible property which is carried on the assessors' books with a valuation of $4,000,000,000 (and which probably has an actual value of nearly twice as much), yielding annually a product in manufactured goods alone valued at over one thousand million dollars." Captain Greene shows that every man, woman, and child of this great population, and every dollar of this vast accumulation of wealth, is in danger of destruction by a hostile fleet. As he puts it, the problem is one of national insurance on life and property. Now, the usual annual premium on policies of insurance on life or property, with good risks, is from one to one and one-half per cent. In Captain Greene's judgment, less than half that percentage, computed on the sum total of property exposed, — say, $20,000,000, — expended annually for six years, would give us a complete system of insurance; that is, it would suffice to erect harbor defences stronger than any ships which could be brought against them, or, with an expenditure of $10,000,000 annually for six years, — a sum which is only about three per cent of our annual appropriations for the support of the government, — fully three-fourths of the lives and property on our coasts could be placed out of danger.

To these considerations Lieutenant Griffin adds the teaching of history, which is that the surest way to avoid war, with all its attendant ravages and losses, is by so thorough a preparation that no weak point is exposed to an enemy's attack, and no temptation is offered to his cupidity.

Besides dealing with the general question in the way indicated, both Captain Greene and Lieutenant Griffin discuss the various problems presented by the great advances made in the apparatus both for attack and for defence in recent years. The absurd inadequacy of most if not all of our present fortifications is pointed out ; for those of them that were erected about 1812 had only to withstand a 42-pound projectile fired with a muzzle energy of 800 foot-tons by a 10-pound charge of powder, and those built at the outbreak of the rebellion had only to withstand a 450-pound projectile fired with a muzzle energy of 9,000 foot-tons by a 130-pound charge of powder. The 16-inch rifle of 1886, which is 45 feet 6 inches long, weighs 115 tons, and fires a projectile weighing 2,300 pounds with a muzzle energy of 55,000 foot-tons by the explosion of 800 pounds of powder, would make short work of the best of them. The bombardment of Alexandria in 1882 is cited as an instance of what might quite readily happen to us. The defences of Alexandria were quite similar to ours, and their armament far superior to any that we have ; yet eight English ironclads made their evacuation necessary after one day's bombardment.

Our forts, excellent during the masonry and earthen ages, have never been replaced in the iron age. On the other hand, twenty-eight of the Gruson cast-iron cupolas, which have been found efficient against the heaviest projectile, have been constructed in the harbors of Germany, Austria, Belgium, and Holland within a few years. Lieutenant Griffin's treatment of modern seacoast defences is very thorough, and, we should fancy, authoritative. He appends to his article a very valuable table, showing the name, age, displacement, draught, speed, class, thickness of armor and style of armament, of every foreign vessel available for offensive operations against the United States. The list is most imposing, and includes 71 English ships, 50 French, 14 German, 24 Russian, 19 Italian, 15 Turkish, 13 Austrian, 7 Danish, 7 Dutch, 5 Spanish, 6 Brazilian, 3 Japanese, and 3 Chilian. In the face of all this, "since 1875 not one penny has been appropriated for the construction of seacoast defences. The annual appropriation of $100,000 for preservation and repairs, increased to $175,000 since 1881, has not even sufficed to preserve our unfinished works, and our defences are actually in a worse condition to-day than they were ten years ago."

METEOROLOGY IN CALIFORNIA.

THE ninth biennial report of the California state board of health (Sacramento, 1886) contains, besides much immediately pertinent to its office, several valuable descriptions and tables concerning meteorological data, which the members of the board wisely deem of importance in their professional studies. First in value is a long table of monthly rainfall, both for the past year and for the mean of several years, compiled by Lieut. W. A. Glassford, in charge of the Pacific coast division of the signal service. This is similar to the newspaper list prepared by the same officer, to which reference was lately made in *Science*, but it is here presented in more extended and convenient form. The weak spot in this table is the absence of any indication that the numerous stations possess good gauges, uniformly placed and well observed. On account of the difficulty in identifying the position of many of the stations, it would be of much service to readers at a distance if such a table as this could be reduced to graphic form in a series of monthly maps. They would necessarily be only provisional for the present, as some records are much shorter than others, so that the means are not properly comparable ; but even these values would doubtless present a truer picture of west-coast precipitation than any yet prepared. It is to be hoped that similar tables and diagrams of temperature means may also be attempted.

Sergt. J. A. Barwick of the Sacramento signal office contributes a review of the meteorological conditions of his city for the past year, and a table of its temperature and rainfall since 1853 and 1849 from records early established by Drs. Logan and Hatch. The mean seasonal temperatures for 33 years are, spring, 59°.5 ; summer, 71°.7 ; autumn, 61°.5 ; winter, 48°.3 ; for the year, 60°.2. The extremes of the mean annual are 57°.5 (1880) and 62°.8 (1864). The absolute maxima rise to 103° or 105° in July and August, and the minima fall to 21° or 22° in January or February. The mean annual rainfall for 38 years is 19″.64, varying from 8.44 (1877) to 34.92 (1844) : the mean for July is 0″.03 ; August, 0.003 ; December, 4.65 ; January, 3.84; February, 2.80; March, 2.91; counting the years by seasons, from July to June inclusive, the annual amounts range from 4.71 (1850–51) and 7.79 (1863-64) to 36.00 or a little more (1849–50, 1852–53, 1861–62). These pronounced contrasts of seasonal fall and great variations in the annual total show how completely unlike the western coast climate is the eastern and central. Sergeant Barwick presents also brief monthly notes of significant features, all of interest and value, but easily increased in both respects if the phenomena described were viewed in a broader way, from a more physical and less statistical stand-point. Annual and monthly averages show general planetary or continental relations ; monthly extremes usually result from cyclonic disturbances, and should be stated in connection with their transitory causes; diurnal variations, when not controlled or destroyed by importation of external conditions in the winds of strong gradients, are always significant of local geographic surroundings, and cannot be too closely examined for every separate station. Such local characteristics are, without doubt, known to many of our signal-service observers, but they have not often found their way into print. The annual reports of the chief signal officer hardly have room for them; the regrettable cessation of the 'signal-service notes' withdraws a fitting medium for their publication; scientific journals and local health or engineering reports may well open their pages to such material, when adequately prepared.

Three general papers should also be mentioned, — 'The climatology and diseases of southern California,' by H. S. Orme, M.D., of Los Angeles, president state board of health; 'Report on the . . . climatology . . . of Surprise and Goose Lake valleys,' by Dr. G. M. Kober, U. S. A., stationed at Fort Bidwell; and 'The coast climate of California,' by J. W. Robinson, M.D., of Crescent City. Dr. Orme mentions the pronounced control of the sea-breeze over the coast temperatures. During hot days, when thermometers in the interior rise to 115° to 125°, a stiff sea-breeze blows inland all along the southern coast, and prevents the littoral temperature from rising over 90°. He briefly mentions also a hot and dry wind, usually confined to limited localities a few miles inland, and frequently issuing from the Santa Ana pass in the Coast range, whence it takes its name. This is of particular interest, as it suggests the physical identity of the wind with the Foehn of Switzerland; and further details of its occurrence will therefore be impatiently awaited by those who are already tired of having to quote so largely from foreign sources for illustration of phenomena that certainly only need intelligent and discriminating observation for their discovery in our own country. The same expectation is raised by Dr. Kober's brief report on Surprise valley, — a flat depression in the north-eastern corner of the state, sixty miles north and south by eight east and west, with elevation of 4,600 feet, enclosed by an ascending barren plateau on the east, and separated from Goose Lake valley on the west by the Warner range, 6,000 to 8,000 feet high. The valley is well described in its geological relations by Russell in the 'Fourth annual report of the geological survey,' and shown to be the dried bed of an old lake, whose highest shore-line forms a conspicuous feature on the valley slopes, 550 feet above the present shallow alkaline lakes on the valley floor. Dr. Kober's figures give a characteristic great diurnal range of temperature, not uncommonly amounting to 50°; a relative humidity of 83 per cent in November, 1885, January and February, 1886, when 9″.09 of the total 19″.15 of precipitation occurs, according to a twenty-year record, contrasting strongly with the nearly absolute dryness of the summer: in September, 1885, the mean relative humidity was only 24.1 per cent, with a mean temperature of 64°. The winds show two diurnal maxima, indicating local control of their flow, — a west wind from the Warner range, with highest velocity shortly after midnight; and a southerly wind from the centre of the valley basin towards the high northern divide, with greatest strength just after noon. These directions clearly indicate the rhythmical flow of the cool, mountain, down-cast wind at night, and the warm, valley, up-cast wind by day. Winds of the Foehn species — commonly known in the north-west as the Chinook — ought to be felt here with much distinctness; and a comparison of records at Fort Bidwell, in Surprise valley, with others at some of the settlements in Goose Lake valley, on the western side of the Warner range, would doubtless lead to their accurate definition.

Dr. Robinson's paper is of especial value in its desire to discriminate between the good and poor records of the various coast stations. We fear that his criticism on observations at military posts may be only too just. These observations are in many cases merely perfunctory, in obedience to orders from headquarters, and are here described as too often made, not by the post-surgeon, but by the hospital steward, "who, from the recesses of his inner consciousness, draws up a report that reads well, but which has not the slightest foundation in fact." But in other cases great differences appear in neighboring records, where both observers are conscientious and painstaking: so that the variation must be laid, as it commonly may well be, to the instruments and their exposures. For example: Crescent City, on the coast, in latitude 42°, has two gauges: one is a five-inch square gauge, placed near the shore, at low level, and in line with a depression that leads an indraught of rainy winds from the sea; the other is a two-inch circular gauge, half a mile away at the lighthouse on a promontory, sixty feet over the ocean. From September, 1885, to May, 1886, inclusive, the first gauge collected 105″.28, and the second only 57″.69. Along with critical comparisons such as these, we regret to see the author's belief in the forest-control of rainfall. Rain-records have not yet been quoted in sufficient confirmation of this unwarranted conclusion; and even here we read, in regard to Crescent City, that the rainfall has diminished, but "how much it is difficult to say, as observations conflict." Dr. Robinson also makes interesting reference to the winds of the coast, and describes the west winds of summer as greatly intensified by the (diurnal) heat of the interior valley, so that the sea-breeze is unusually strong over the passes that break down the elevation of the Coast range.

It is greatly to be wished that further detail should be presented of facts so interesting in themselves and so valuable in the physical description of our country. The suggestion made above concerning the cyclonic and local control of the weather elements is, it is believed, in a most profitable line for further work. Examples of similar weather-types, as indicated by recurrence of similar distribution of isobaric lines on the signal-office daily maps, should be brought together and discussed in search of their specific characteristics, instead of lost in the indiscriminate average of the monthly mean, itself of true value, but too often the end instead of the first step of the discussion. Local controls are found to prevail during anticyclonic weather, with high pressure and weak baric gradients: imported conditions appear with the approach and passage of cyclonic areas of low pressure and stronger gradients. Here is a wide field for observation and research. W. M. D.

CONSUMPTION IN PENNSYLVANIA.

THE *New York medical journal* of Dec. 4 contains in full the exceedingly valuable contribution to the climatological study of consumption in Pennsylvania, by William Pepper, M.D., which was read at the third annual meeting of the American climatological association. In the inquiry which formed the basis of this paper, Dr. Pepper followed the plan adopted by Dr. Bowditch in investigating the same disease in Massachusetts in the years 1854–62. Dr. Bowditch, it will be remembered, found a law in the development of consumption in that state, which has for its central idea that the dampness of the soil of any township or locality is intimately connected with, and probably a cause of, the prevalence of consumption in that township or locality. Similar investigations, especially those of Dr. Buchanan in England, which were carried on in 1865, 1866, and 1867, confirm the views of Bowditch. In that country, where the subsoil was drained by sewers, and where the water-supply was improved, deaths from consumption diminished, falling 49 per cent in Salisbury, 47 in Ely, 43 in Rugby, and 41 in Banbury. With answers from physicians to twenty-eight questions propounded in a circular by Dr. Pepper, and the statistics of the tenth census of the United States, together with the topographical map of Professor Lesley as a basis, maps have been prepared showing the prevalence of consumption in Pennsylvania counties, and the relation between such prevalence and elevation, and mean annual temperature and rainfall. One of these maps is given in the journal referred to: the others will be published in the Transactions of the association. It is noticeable that those portions of the state where phthisis is rarest are the most elevated, having a general altitude of 1,500 to 2,000 feet, from 2,000 to 3,000 feet, and that its mortality increases as the altitude becomes less. In Philadelphia the wards having the least elevation, greatest density of population, and most inferior water-supply, furnish the greatest mortality from phthisis. The answers to the inquiries received from the state at large do not seem to indicate excessive soil moisture as the main causal condition of consumption in the state. A number of individual cases are given, in most of which damp and otherwise unsanitary conditions existed in and around the houses in which repeated cases occurred. This inquiry is a most timely one, as the tendency of the times seems to be to ignore conditions such as are here described, and to account for the disease only by the introduction of the bacilli of Koch. That these are the direct cause but few doubt, though unsanitary surroundings and heredity are important predisposing causes.

THAYER'S GREEK-ENGLISH LEXICON.

THE only special dictionary in the English language hitherto available for students of the Greek New Testament has been a translation of Cremer's 'Biblisch-theologisches wörterbuch der Neutestamentlichen Gräcität.' This is not only very inconvenient in its arrangement, but is justly chargeable with a certain vagueness in its definitions. We think, therefore, that Professor Thayer has rendered an incalculable service to a numerous class of students by opening to them the treasures of German erudition to be found in Grimm's 'Clavis.' But he has done vastly more than this. Almost every page of the noble volume before us shows such signal traces of his critical scholarship, his profound learning, and his conscientious labor, as to make it only a matter of simple justice that the book should bear his name. In regard to the technical and theological aspects of the work, we have neither the desire nor the competence to pronounce an opinion; but, as a

A Greek-English lexicon of the New Testament, being Grimm's Wilke's Clavis Novi Testamenti. Tr. by JOSEPH HENRY THAYER, D.D. New York, *Harper*, 1887. 4°.

monument of Greek lexicography, we consider that it reflects the highest honor upon American scholarship. After a careful comparison of results obtained from the long-continued use of other Greek lexicons, we feel constrained to pronounce the present one a marvel of accuracy. In his modest preface the editor expresses a keen sense of the shortcomings of his work, and seeks to enlist the co-operation of fellow-laborers to help rid it of every remaining blemish. Surely all who profit by his labors must rejoice to be able to serve him in this way. We will accordingly make such few suggestions as have occurred to us in the course of our examination of the volume.

In the summary of the interminable discussion about the distinction between βούλομαι and θέλω, which is found upon p. 286, it may be advisable to quote also the opinion of such an eminent Hellenist as the late Professor Shilleto. He states in a note to Demosthenes (*De falsa legatione*, 348, 14) that in *Attic* writers βούλομαι implies *a positive wish*, and θέλω the merely *negative idea of willingness, having no objection*. This is the view also of Sauppe, on Demosthenes (24, 3), who cites to the same effect Gottfried Hermann (*Zimmermann*, 1835, p. 299).

The very unusual expression ἐκ τῶν ἰδίων, which is found in John viii. 44, may be illustrated by the example of the same idiom in Thucydides (ii. 42). where it is opposed in signification to κοινῶς. It occurs also upon a bronze tablet containing a decree of the senate and people of Assos, in honor of Germanicus, discovered in the course of the explorations made upon that site by the Archaeological institute of America (*Clark's Report upon the investigations at Assos*, p. 134). It is there translated, 'at their own expense;' but the rendering, 'in a private capacity,' would seem to be more in conformity with the other instances of its use.

In the text the statement is made that the word καταργέω is found frequently in Paul's writings, who uses it twenty-five times; while elsewhere in the New Testament it occurs only twice; viz., in Luke xiii. 7 and in Hebrews ii. 14. We recollect that this exceptional use by Paul of one word is referred to by Rev. Robert Aris Wilmott, in his charming little volume on the pleasures of literature, as characteristic of his style. This would seem to make the word a proper candidate for a place among the words *peculiar* to Paul, contained in Appendix iv. 6, unless that term is intended by the editor to be restricted to words used by him alone among the New-Testament writers.

Under the word πάσχω we are told that it nowhere occurs in a *good* sense, unless either the adverb εὖ, or an accusative of the thing, is added. Sophocles' *Electra* (v. 169) is an instance to the contrary.

This slight contribution we offer towards the perfecting of a work whose beautiful mechanical execution makes it a delight to use it, and which testifies to a liberality on the part of the publishers as creditable as is the quality of the editing.

H. W. H.

THE WINNIPEG COUNTRY.

It is with genuine pleasure that the critic takes hold of a volume like the present, so daintily gotten up with illustrations made for the book, and evidently the work of a practised hand. Then the story is told in such a simple and attractive manner, that one unconsciously drifts into the places of the astronomers, and feels each mosquito-bite as keenly as though he had actually experienced the bites in the flesh.

The journey was undertaken in 1860, before the days of railroads in that part of the continent, or, indeed, of steamboats — with the exception of the solitary stern-wheeler on the Red River, which broke down before our voyagers returned. The portion of the route lying beyond Fort Garry — the site of the now live city of Winnipeg — was made in the North canoe, a giant of its kind, which had been constructed years before for the accommodation of Sir George Stimson. Delay after delay occurred, for in even such a big canoe one could not brave the waves of Winnipeg with impunity. Then the current of the Saskatchewan proved to be unusually swift. The result of this combination was, that on the day of the eclipse the observers had not reached their destination: nor. in fact, had they advanced much beyond the outskirts of the eclipse belt. However, there was nothing for it but to get out on the first bit of solid ground that showed itself above the everlasting flooded marsh. An alcohol can on top of four stakes served as a pedestal for one telescope, while a birch-tree with lopped-off branches did similar duty for the other. Then, while the naturalist carefully beat time with a screw-driver, the clouds obscured the sun so that the astronomers who had dared hunger and mosquitoes could only note the minor phenomena of the last phase. It was provoking, but nothing could be done. By the time the instruments had been repacked, the river had risen higher and submerged the little island. A rest of one day, and then the homeward journey was begun. The delights of that portion of the trip can best be understood from the following: "Our long canoe-voyage of forty-

The Winnipeg country; or, Roughing it with an eclipse party. By a Rochester Fellow. Boston, *Cupples, Upham, & Co.*, 1886.

two days was over. We had been provisioned for thirty-five."

To add to their miseries, upon their arrival at Fort Garry they learned that the steamer had broken down: so the return journey was made overland in a Red River ox-cart. However, it must have had its pleasant side, or our author could not have looked back with so much evident pleasure to the experience. Not the least striking part of the volume is a set of views contrasting the state of things then at Fort Garry with the bustle and noise of a street of the present Winnipeg. The old Selkirk settlement has disappeared. But is not something better in its place?

COMPARATIVE MORPHOLOGY.

STUDENTS of vertebrate and invertebrate anatomy, both in this country and Great Britain, and other parts of the world where the English tongue is spoken, have much to be thankful for of late years; for during the last four or five of them have appeared in their language, either through original contribution or by translation, an exceptionally fine series of helpful handbooks of their science. Chief among these we notice upon our shelves the compact though useful little volume by Prof. F. Jeffrey Bell: the admirable manuals of Professors Martin and Mosle; the welcomed and invaluable translation of Claus's 'Text-book of zoölogy,' by Adam Sedgwick, in two volumes; the popular series contributed by Prof. A. S. Packard; a carefully revised third edition of Flower's excellent work on the osteology of the Mammalia; the favorite of all students of vertebrate anatomy. Mivart's 'Cat;' the best of little books, T. J. Parker's 'Zoötomy,' the work of the younger representative of a house the members of which now hold an unrivalled place in the science of modern times, which their extraordinarily fertile and brilliant contributions to vertebrate morphology have easily gained for them. And now comes a welcome volume from the pen of the senior son of this same family, an English translation of Wiedersheim's famous handbook of vertebrate anatomy.

It is to this last handsomely gotten up, and, almost without exception, exquisitely illustrated work, that we would here now devote a few words by way of comment and criticism. We find the book bound and printed with all that care for which the firm of Macmillan & Co. are so justly famous, and which they invariably bestow upon all their scientific publications. The work itself is divided into two parts, the first of which, entitled the 'Introduction,' comprises fifteen pages only, while the second or 'Special part' claims the remainder of the volume.

One of the principal points open for criticism in the introduction lies in its extreme brevity, and it must stand to reason that much must be sacrificed when one attempts to present the structural characters in general, and the mode of development in so important a group as the Vertebrata, in so limited a space. The great wonder is, that, notwithstanding this, the subjects treated in this part have been rendered so clearly and so thoroughly comprehensible. Nine excellent figures illustrate it, and it is completed by a helpful 'Table showing the gradual development of the Vertebrata in time.'

We find the 'Special part' divided up into sections, leading off with 'A. Integument;' followed by 'B. Skeleton;' then 'C. Muscular system;' 'D. Electric organs;' 'E. Nervous system;' 'F. Organs of nutrition;' 'G. Organs of respiration;' 'H. Organs of circulation;' and, finally, 'I. Urinogenital organs.' These several sections are found appropriately subdivided into other parts; and this plan has been found to answer the purposes both of the student and anatomist most admirably. Following as a natural sequence to such an arrangement as this, it affords, so far as the make-up of a volume is concerned, an excellent opportunity to offer a concise and convenient table of contents. presenting us with the several headings and divisions of the treatise, which has been done in the present instance. And to one at all familiar with the subject, this table of contents, supplemented, as it here is, by a wonderfully well-arranged and complete index (which latter contains but few omissions), leaves but little to be desired on this score. One word, however; for students are critical, and all are not thoroughly informed upon anatomical synonymes: so in future editions of this work it would be better to have index and text agree in every particular, and such errors, for instance, as indexing 'adrenal, 161,' and on p. 161 find 'suprarenal' only referred to, removed.

The section devoted to the treatment of the integument, though very brief, is excellent, and has been fully brought up to our present knowledge of the morphology of this structure and its appendages, in the several groups of the Vertebrata.

As we might expect, a considerable share of the work (pp. 30–111) is devoted to the 'Skeleton,' and it is ably dealt with under two headings; viz., (I.) Dermal skeleton (pp. 30–33), and (II.) The endoskeleton. Under the latter we are presented with a capital discussion of the 'Theory of the segmentation of the skull,' a fitting introduc-

Elements of the comparative anatomy of vertebrates. Tr. by W. NEWTON PARKER. New York, *Macmillan*, 1886. 8°.

tion to the consideration of that part of the osseous system. Notwithstanding the generosity of the authors in allotting such a goodly share of their space to the treatment of this part of their subject, it has materially suffered, in common with the other systems of the economy, by the too extensive condensation of matter which characterizes the entire volume. Space will not permit us here to show the numerous instances wherein this is evident, and an example or two must suffice. As an instance, we fail to discover even a mention of such structures as are presented us in the vestiges of a pelvis in the whales and other marine mammals; and a similar omission applies to the limbless Reptilia, as in Ophisaurus, for example. Nor (were these well-known facts alluded to) would the absence of external limbs imply that 'pectoral and pelvic arches are also wanting,' as our authors would have us believe (p. 87). And in regard to these vestiges of organs, and rudiments of the same, we are, in view of the fact of the highly important part they play in general morphology, compelled to deplore the exceedingly slight attention they have had bestowed upon them throughout the book.

Without the assistance of some such handbook as Parker's 'Zoötomy,' we are quite certain that the special student would find but little to serve him in the chapter devoted to the musculature of the trunk and its appendages, for the subject has been generalized to the last degree; nor is this section entirely free from error, as, to instance, we are told that 'no trace of a transversalis can be distinguished' in birds, — a statement that is by no means true, for a well-developed one is found in Apteryx, and this muscle is also found in some of the higher groups.

It will be out of the question to even enumerate the many slips that have been allowed to creep into the section devoted to the 'Nervous system,' certain portions of which must be read with great caution by the student, who perhaps may have to rely upon this manual as final authority.

So far as the defects among the figures are concerned, one of the principal ones to be noted is the inaccurate representation of the lancelet on p. 247, as compared with the far more correct drawing of the same animal on p. 114. Aside from these strictures, however, and many others that could be made, this work, with its long list of brilliant, and for the most part accurate, woodcuts, some of which are even colored, greatly enhancing their usefulness, its excellent bibliographical references at the end of each section, and its list of general works following the preface, and finally its admirable arrangement and clearness of diction, will be sure to commend itself to English students and readers of the subject of which it, as a whole, so ably treats. R. W. S.

THE LIFE OF HAMILTON.

EARLY in the third volume of *Science*, at p. 23, we left Hamilton at the age of twenty-seven, young in years, but with the foundation of that superstructure, which is and always will be the marvel of mankind, well and deeply laid. Nothing can be of profounder interest than, in this second volume of his life, to watch the completion and growth to maturity of that imposing intellectual edifice so ably delineated by the accomplished author, whom Hamilton had nominated as his literary executor.

Mr. Graves finds enough in a year of Hamilton's life for a single sizable chapter, if not for more. So important an event to Hamilton as his marriage is given the prominence it ought to have: in fact, subsequent events justify his biographer in terming it 'a crisis of his life.' As might be surmised, the period of his courtship of Miss Bayly was no less a period of his courtship of the Muse; but it was not with Hamilton as it would have been with a mere poet, a period devoid of intellectual activity in other directions. His head was full of the mathematics of conical refraction, while his heart craved the satisfaction of that complete consent, long delayed, which he prized above every thing else.

On the whole, this book, as well as its companion volume, is a most diffuse one — at least, it so seems; but its compiler might well have made it even more so without undergoing in the long-run any charge of error in judgment; for every scrap of even meagre information becomes of importance, no one can tell how great, when related to a man like Hamilton, of whom it may more truly be said than of any other man of the present century, that his highest fame is still of the future. While the slow progress of the quaternion method is not a little remarkable, Hamilton appears to have been himself conscious that this might be the case, and to some extent foreshadowed it, somewhere speaking of the mathematicians of a thousand years hence, and their gratitude to him for the discovery of the new calculus.

We have nothing but the highest praise for Mr. Graves's delicate and trustworthy descriptions of Hamilton's character, and the incidents of his life. We have also to thank him for the charming glimpses he gives us of other distinguished names, in the space allowed their letters: what we see of

Life of Sir William Rowan Hamilton. Vol. ii. By ROBERT PERCEVAL GRAVES. London, *Longmans, Green & Co.* 8°.

Sedgwick, De Morgan, Maria Edgeworth, and a number of others, leads us to the strong wish that their correspondence might have been presented in even greater fulness. We have, indeed, the promise of an extended correspondence between Hamilton and De Morgan in the appendix to the succeeding volume of Hamilton's life. Mr. Graves has considerately provided indexes to both these volumes with a minuteness to suit the most exacting librarian: their thoroughness, in fact, nearly doubles the value of his work. The possibility of a collection of the strictly scientific and technical correspondence of Hamilton has already been hinted at, and will, on the completion of the present work, supplement this literary biography in a most important direction. Still beyond that, are the abounding mathematical remains of Hamilton, to edit and publish which in proper form would require the work of a genius little inferior to that of Hamilton himself. Mr. Graves promises to complete his biography in the next succeeding volume: let us hope that his promise is not well grounded, and that he will give us a fourth.

THE Young-Helmholtz theory of color-sensation has recently been put to the test of direct experimental proof by Herr Frithiof Holmgren (*Verhandlungen der physiolog. gesellschaft zu Berlin*, 1886, No. 18). As is well known, the theory is that the retina contains three sets of nerve-elements, each set capable of responding to the stimulus of a single color alone; and that the three colors which correspond to three sets of nerve-elements are green, red, and violet. These are the primary colors, and our sensation of all others is due to the simultaneous excitation of nerve-elements of different sets. Now, it is possible to produce a point of light so minute that its image on the retina shall have no greater dimensions than those of a single nerve-element or cone. If such a point of light in any color of the spectrum be examined in such a way that its image falls in turn upon different parts of the retina, it will, if the Young-Helmholtz theory be true, be seen only as red, green, or violet. If one of these primary colors be chosen for examination, it will appear in its own shade or not at all; but, if any other shade is employed, it will be resolved into its primary elements, and seem red, green, or violet, according to its composition and the particular cone on which it falls. The results of Holmgren's investigation were in entire accordance with the theory; red, green, and violet (indigo-violet) were unchanged; yellow appeared red, green, or colorless, in no part of the field distinctly yellow; blue was resolved similarly into green and violet. Further experiments, with a view to determining how many cones must receive simultaneous stimulus to produce the sensation of a particular color, show that yellow is seen as red or green even when the retinal image is considerably smaller than the section of a cone; while, to be seen as yellow, the image must be large enough to cover two or three cones.

— In a paper read before the chemical section of the fifty-ninth versammlung deutsch. naturforscher zu Berlin on the 23d of September, Herr Liebreich calls attention to the curious fact that certain chemical reactions, which proceed readily enough under ordinary conditions, are delayed or fail altogether when the liquid reagents are in the meniscus of a narrow tube. Herr Liebreich is inclined to regard this phenomenon as due to cohesion, and to conclude that certain reactions may be delayed, or permanently prevented from taking place, by the action of this force. Whether this be the true explanation or not, the fact is a very interesting one, and likely to be of the highest importance in its bearing on physiologico-chemical processes, which go on in the capillaries of the body. Many reactions which are readily effected in the laboratory may be altogether impossible in the living organism; and, since the character of the capillary walls may be of considerable influence, reactions which give normal results in the healthy organ, may yield quite different products or be entirely suppressed when the organ is diseased.

— A thesis on the geology and vein-structure of south-western Colorado, by Prof. T. B. Comstock of Champaign, Ill., lately published in the Transactions of the American institute of mining engineers, is one of the few detailed geological studies of a western locality, not the work of a government surveyor. It contains a general account of the geology of the region, in greatest part from original observations, and examines with especial care the succession of the volcanic rocks and the phenomena of mineral veins. The division of the paper that will perhaps excite most comment is the one that contains the author's views on the relation between the direction and the minerals of the veins in the Redpeak district. Six zones of mineral veins radiate from the peak as a centre, as follows: N. 38° E., arsenical; N. 79½ E., bismuth; S. 34½ E., galena-gray copper; S. 35 W., antimonial; S. 76½ W., argentiferous galena; N. 36½ W., silver sulphuret. Between these mineral zones there are wedge-shaped barren areas, which begin to be particularly noticeable along the course of the Animas River, skirting around the peak. Reference is made to the criticisms of Professor Ihlseng, who does not accept Mr. Comstock's views.

INDEX TO VOLUME VIII.

⁂ *Names of contributors are printed in small capitals.*

ERRATA.

Page 68, col. 1, 14th line from top, for 'West' read 'East.'
" 68, " 1, 20th line from top, for 'West Indies' read 'East Indies.'
" 68, " 2, 15th line from bottom, for 'decreasing' read 'increasing.'
Page 190, col. 2, 2d line from bottom, for 'Grey' read 'Guy.'
" 631, " 1, 12th line from bottom, for 'meplis' read 'Mehlis.'
" 631, " 2, 1st line, for 'U. S. fish commission' read 'U. S. entomological commission.'